Integrative Informatics and Predictive Modeling Support for Population Health

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Suffolk Care Collaborative (SCC)
a DSRIP Performing Provider
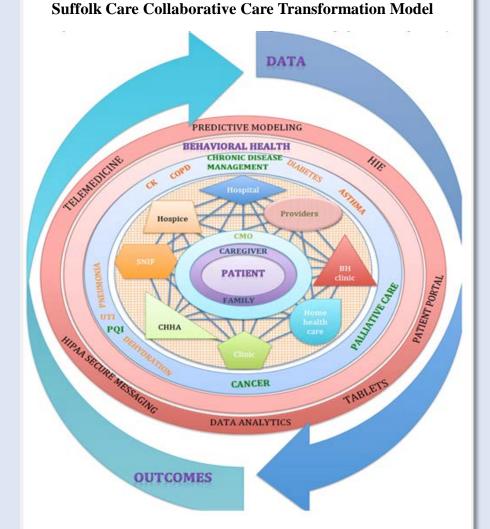System (PPS)

Introduction

This project targets development of proactive population health informatics methods in a geographically distributed medically and culturally heterogeneous population of app. 450,000 lives (Medicaid and Uninsured) served by 3000+ providers. The informatics infrastructure will be generally applicable to population health clinical informatics efforts. It is being developed in the context of the Suffolk Care Collaborative, a Performing Provider System (PPS) in Suffolk County, NY, funded for 5 years by the Center for Medicare and Medicaid (CMS) through the Delivery System Reform Incentive Payment (DSRIP) Program. Stony Brook University Hospital (SBUH) is the PPS Lead. Future payments to the PPS will be directly tied to performance on the key metrics of 25% reduction in potentially preventable hospitalizations (PPR) and emergency department visits (PPV) [3M Health Information Systems] and to improvements in patient quality indicators such as Agency for Healthcare Research and Quality (AHRQ) Prevention Quality Indicators (PQI) and Pediatric Quality Indicators (PDI). Eleven intervention projects (see center panel) deployed across the PPS comprise a data-generating ecosystem in which a change in one place affects outcomes of the whole. From a bioinformatics viewpoint, it is not enough to merely identify outcomes and trends; we aim to design and use an in silico test bed to evaluate and thus steer proposed interventions or changes to the system.
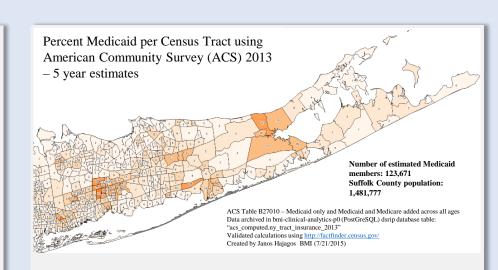
Methods and Objectives

In order to plan, coordinate and steer population health activities, we need to assemble a 360° view that: 1) encompasses patient health, co-morbidities and geographic location; 2) takes into account each provider's patient population; and 3) is able to attribute PPRs, PPVs, PQIs and PDIs to health care systems and providers. Toward that end we must integrate multiple electronic health records, data from the NY Statewide Planning and Research Cooperative System (SPARCS), US Census Bureau, Behavioral Risk Factor Surveillance System (BRFSS), and American Community Survey, along with data from deployed smart phones, mobile sensors such as Fitbits and Apple Watch, and instrumented home medical devices. Data integration pipelines, data quality control pipelines, data dictionary and data products are being created using a variety of tools, including a novel open-source streaming JavaScript-based OpenHealth platform (https://github.com/mathbiol/openHealth). The tools are designed and configured to take secure advantage of a combination of open and protected data sources.

Data products encompass clinical/computational phenotype generation, e.g., validated co-morbidities, treatment history and demographics. In the near future, data will also characterize patients by provider with respect to quality indicators such as PPRs and PPVs. Data will also include computed quality indicators, and detailed insight into demographics using geo-located American Community Survey/Census data along with project specific data marts. Success in the core DSRIP objectives of 25% reduction in PPRs and PPVs requires systematic targeting of interventions and coordinated population and risk stratification, as well as iterative adaptive analyses to allow nimble interventions. Effective efforts to improve care transitions require projects to identify patients at risk and to characterize patient-specific risks.
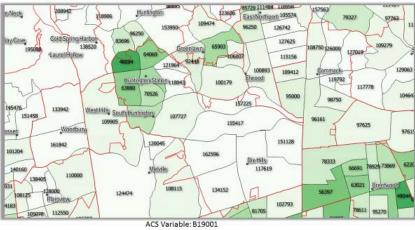
This project will leverage a variety of machine-learning methods including the techniques reported in [1] as data is collected and as the DSRIP program is implemented.
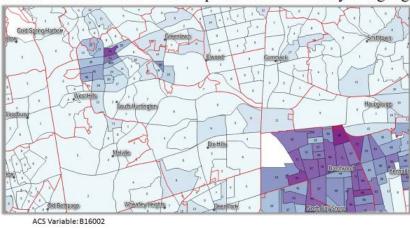
Suffolk Care Collaborative Care Transformation Model

A unified patient centered healthcare safety net to deliver the right care to the right patient at the right time.

Percent Medicaid per Census Tract using American Community Survey (ACS) 2013 – 5 year estimates

Number of estimated Medicaid members: 123,671
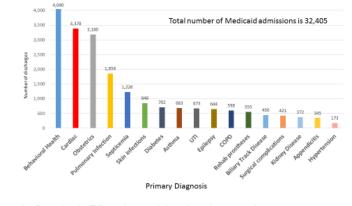Suffolk County population: 1,481,777

Median Household Income – Census Tracts

Percent of Households where Spanish is the Primary Language
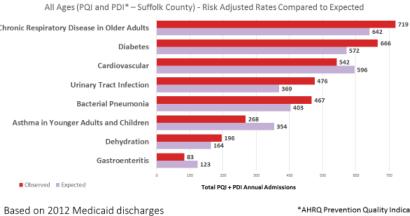
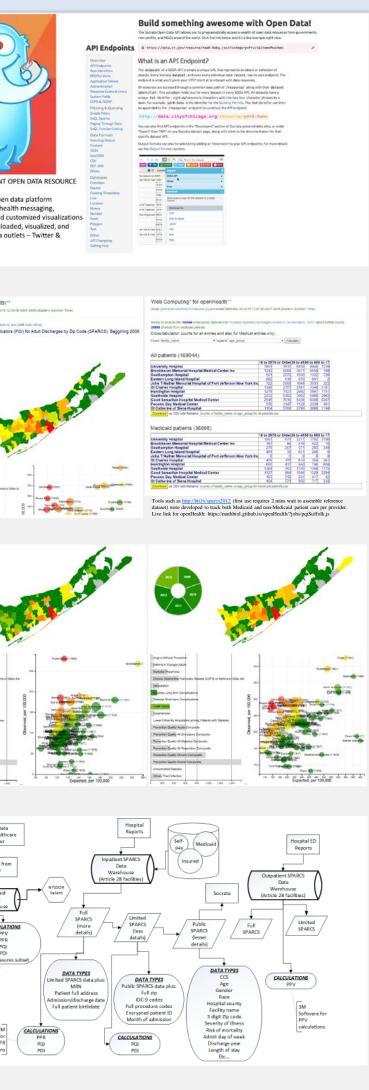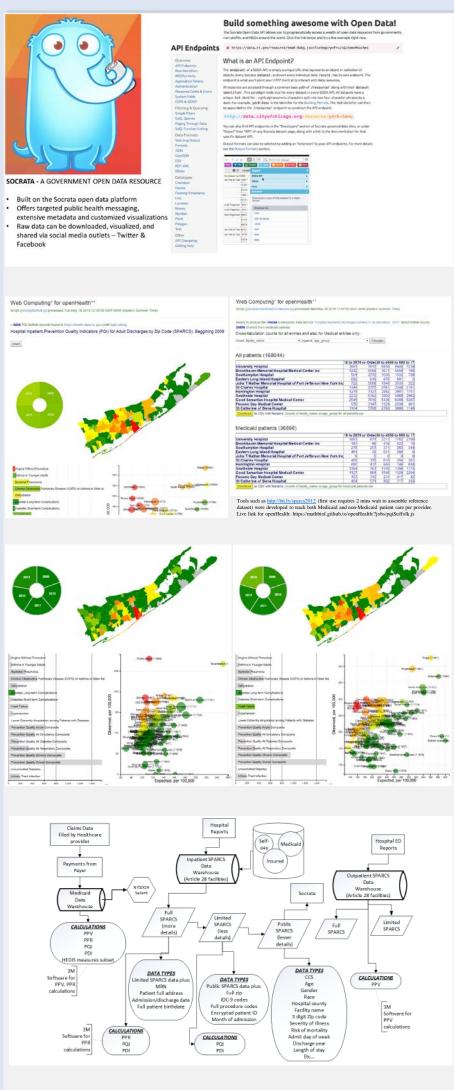Primary Diagnoses present in Medicaid members admitted to a Suffolk County Hospital in NYS

Avoidable Admissions Seen in the Medicaid members of Suffolk Co., NYS
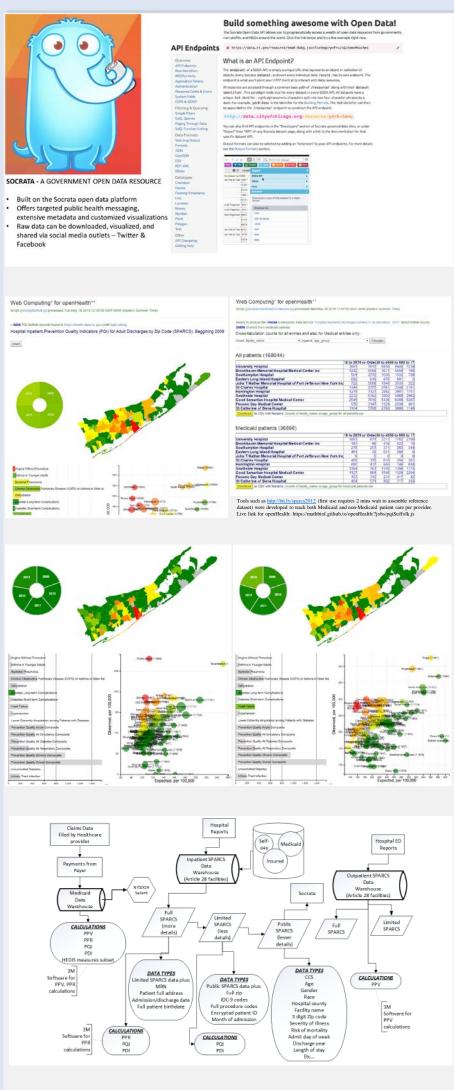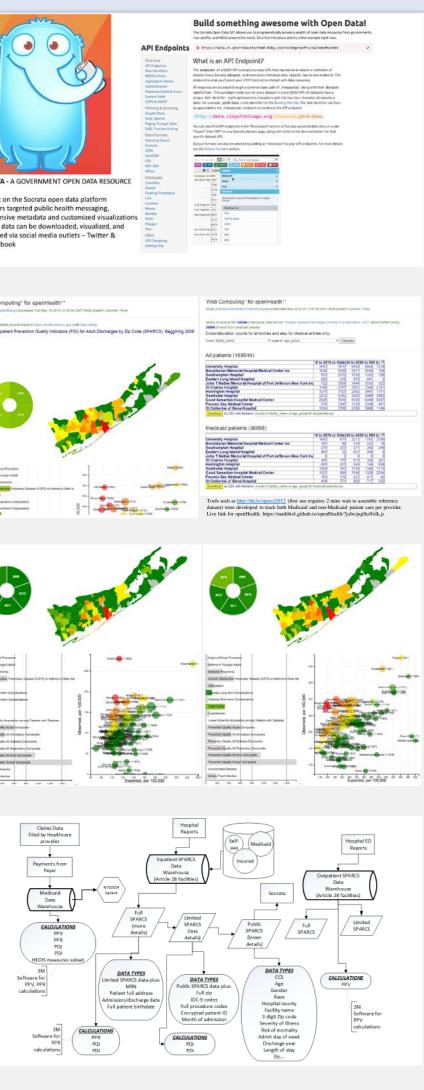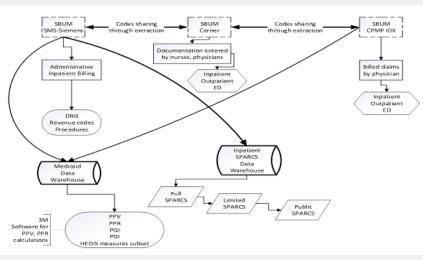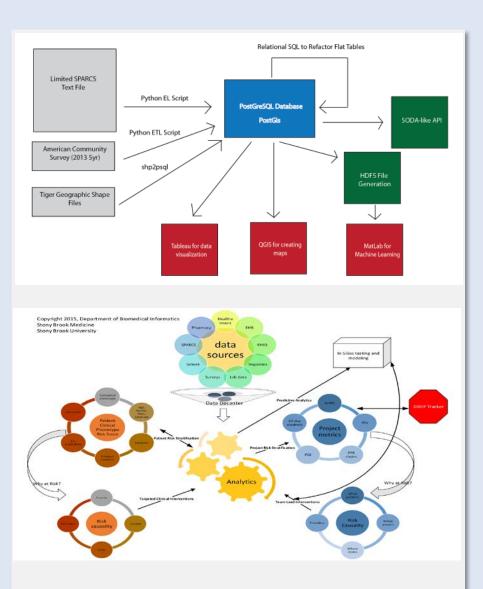
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11 Suffolk Care Collaborative Projects

Project 2.a.i - Create an Integrated Delivery System focused on Evidence-Based Medicine/Population Health Management
Project 2.b.iv - Care transitions intervention model to reduce 30-day readmissions of chronic health conditions
Project 2.b.vii - Implementation of the INTERACT (Interventions to Reduce Acute Care Transfers) project to reduce Skilled Nursing Facility (SNF) transfers to hospitals
Project 2.b.ix - Implementation of observational programs in hospitals
Project 2.d.i - Implementation of Patient and Community Activation Activities to Engage, Educate and Integrate the uninsured and low/non-utilizing Medicaid populations into Community Based Care
Project 3.a.i - Integration of primary care services and behavioral health
Project 3.b.i - Cardiovascular health - Evidence-based strategies for disease management in high risk/affected populations (adult only)
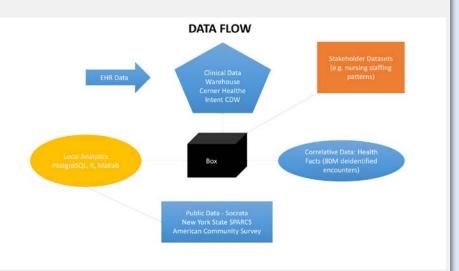**Project 3.c.i** - Diabetes Care - Evidence-based strategies for disease management in high risk/affected populations (adults only)
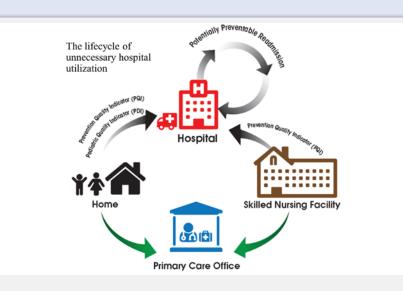**Project 3.d.ii** - Expansion of asthma home-based self-management program
Project 4.a.ii - Prevent Substance Abuse and other Mental Emotional Behavioral Disorders
Project 4.b.ii - Population-based health chronic disease prevention and management

Clinical Areas Not Selected by the SCC - HIV / AIDS (3.e.i), Perinatal Care (3.f.i), Palliative Care (3.g.i), Renal Care (3.h.i)
Project selection was based on a community needs assessment and that there was a limit on the number of projects that could be selected from a given domain area.

DATA FLOW

DSRIP Project support-High Performance metrics

Domain 2- Metric System Transformation
Potentially Avoidable Emergency Room Visits
3M PPV (Alternative NPV ED Algorithm)
Potentially Avoidable Readmissions
3M PPR – (Alternative Computing 30-day readmission above)

Domain 3 – Clinically focused projects

Project 3.a.i - Integration of primary care services and behavioral health
Antidepressant Medication Management – Effective Acute Phase Treatment
and Continuation-Phase Treatment (HEDIS AMM)
Follow-up after Hospitalization for Mental Illness – within 7 days and within 30 days (HEDIS FUH)
Diabetes Monitoring for People with Diabetes and Schizophrenia (HEDIS SMD)
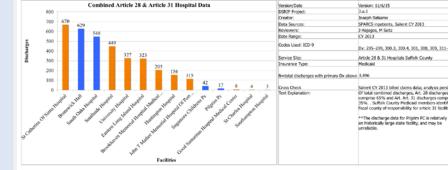Cardiovascular Monitoring for People with Cardiovascular Disease and Schizophrenia (HEDIS SMC)

Project 3.b.i - Cardiovascular health - Evidence-based strategies for disease management in high risk/affected populations (adult only)
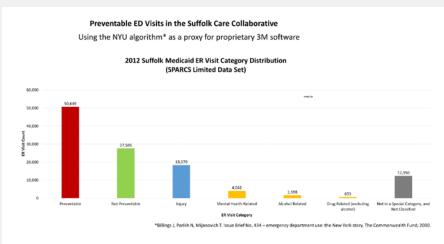Controlling High Blood Pressure (HEDIS CBP, Medical Record Review)
Medical Assistance with Smoking and Tobacco Use Cessation – Discussed Cessation Medication (HEDIS MSC, Survey)
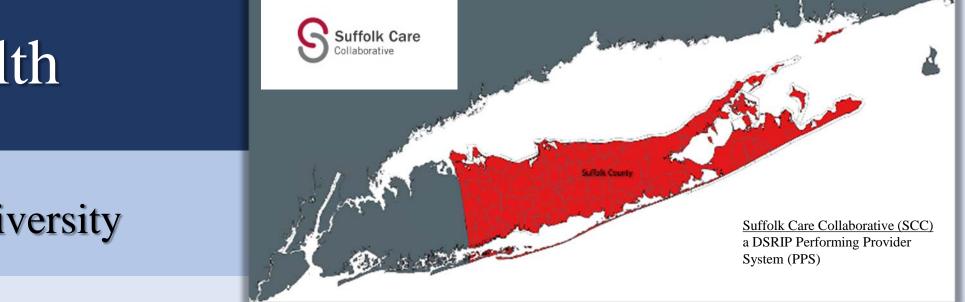
Estimated Total Discharges of HEDIS-Defined Mental Health Patients by Hospital & County for DSRIP Project 3.a.i: Art. 31 Data
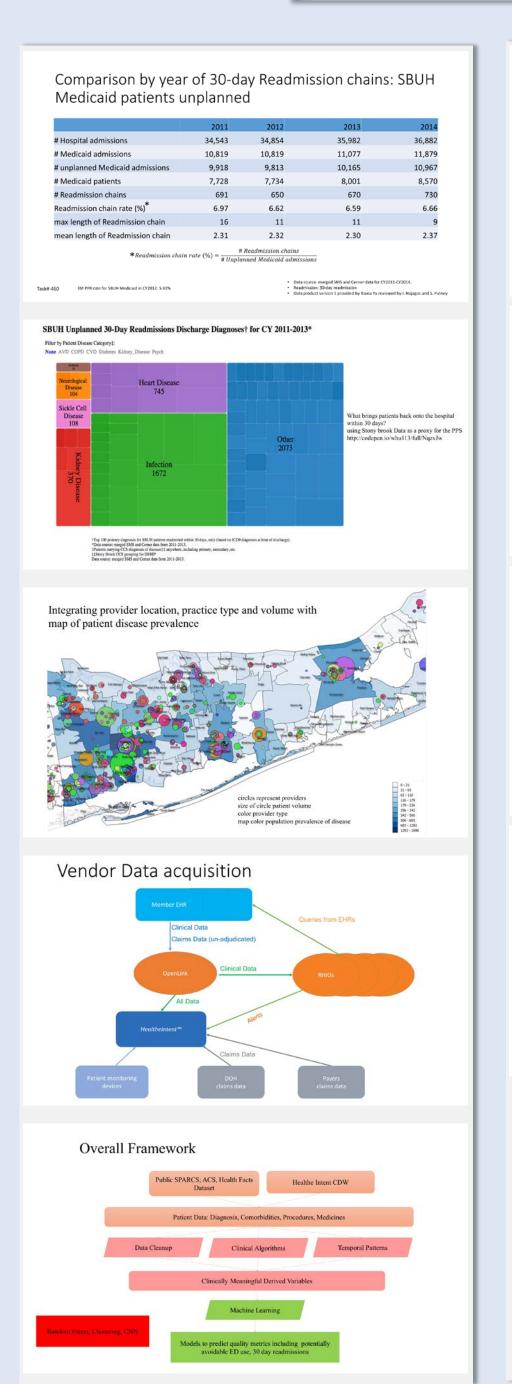
- This identifies the total number of Medicaid inpatient encounters at all Suffolk County hospitals during 2013 with the primary diagnosis of select mental health disorders. These disorders are defined in the HEDIS measure "Follow-up After Hospitalization for Mental Illness (FUH)."
- This task breaks down this number of inpatient discharges by hospital in Suffolk County. Suffolk County Medicaid members identified by fiscal county of responsibility.
- Understanding this distribution is critical to the initial allocation of DSRIP resources across Suffolk County. To achieve compliance with HEDIS measure FUH, adequate personnel must be allocated to schedule and track 7- and 30-day follow-up visits for all patients discharged with these select mental health disorders.
- The concept is to compute these measures in near real time on a continuous basis so that the PMO can respond quickly to evaluate performance and address deficiencies.

Preventable ED Visits in the Suffolk Care Collaborative
Using the NYU algorithm" as a proxy for proprietary 3M software

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Comparison by year of 30-day Readmission chains: SBUH Medicaid patients unplanned

	2011	2012	2013	2014
# Hospital admissions	34,543	34,854	35,982	36,882
# Medicaid admissions	10,849	10,819	11,077	11,879
# unplanned Medicaid admissions	9,918	9,813	10,105	10,967
# Medicaid patients	7,728	7,734	8,001	8,570
# Readmission chains	691	650	670	790
Readmission chain rate (%)	6.97	6.62	6.59	6.66
mean length of Readmission chain	16	11	11	11
mean length of Readmission chain	2.31	2.32	2.30	2.37

SBUH Unplanned 30-Day Readmissions Discharge Diagnoses? for CY 2011-2013*
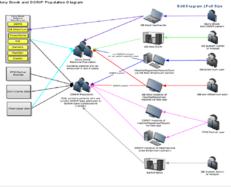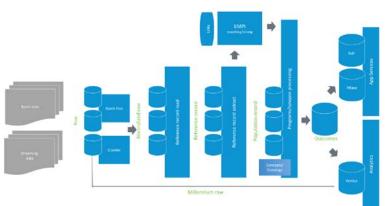
Vendor Data acquisition - Data architecture

DSRIP Suffolk Care Collaborative DRAFT Connectivity Diagram

Vendor Processing model

Clostridium difficile (C. diff.) Dashboards

Vendor Data acquisition

Overall Framework

Ongoing Efforts
- Integration of multiple disparate data sources
- Reproducibility of results
- Tracking and cataloging data products
- Predictive analytics leveraging random forest, clustering and other algorithms
- Integration with DSRIP clinical systems
- Feeding back information to stakeholders in meaningful format

Opportunities
- DSRIP is a model for many population health informatics challenges
- Data analytics should drive care delivered and allow target metrics to be reached
- Create highly functioning healthcare delivery system and maximize the fiscal support in a pay-for-performance environment
- Set stage for a Suffolk County Accountable Care Organization in 5 years, at the end of the DSRIP program

Conclusion
While this project is still in its early stages, our tools and methods have already played a pivotal role in generating the detailed population health characterization that led to our nearly perfect score on the Community Needs Assessment for the SCC DSRIP proposal. The tools and methods developed have laid a foundation for predictive population health analytics planned over the 5 years of the project.