First open, collaborative research and innovation center to accelerate healthcare change, leading to improved patient care and patient value.

Founding partners: Optum and Mayo Clinic

- State-of-the-art facility in Cambridge, Mass
- Pre-competitive research collaborative
- Pre-commercial innovation center
Our Partnership Platform: Quality Growth Continues

MAYO CLINIC

AMIGA

School of Public Health

Lehigh Valley Health Network

Pfizer

Rensselaer

Tufts Medical Center

University of Minnesota

School of Nursing

Yale University

Brown School of Public Health

Harvard Medical School

Health Care Policy

MEDICA Research Institute

MIT Sloan Management

JOHNS HOPKINS Bloomberg School of Public Health

MERCK

ResMed

University of Maryland The Founding Campus

GLOBAL CEO INITIATIVE ON ALZHEIMER’S DISEASE
Our Data Today: Claims, EHRs & Consumer Behavior

315 million U.S. population

>33 million unlinkable claims

>35 million Consumers

Clinical Data (EHRs) for >31 million Patients

Linkable Claims for >128 million Patients

1,500+ data fields:
- Medical claims
- Pharmacy claims
- Lab claims and results
- Health risk assessments
- Standardized costs of care
- Race
- Income
- Education level
- Household
- Geography
- Mortality

Tests, Treatments

Expanded insights with deeper clinical context
250+ additional data fields:
- Encounters
- Vitals (BMI, BP, Heart Rate …)
- Labs
- Medication orders
- Procedures
- Admissions, discharges and transfers
- Patient-provided information

Expanded insights with Consumer data
300+ additional data fields:
- Consumer Behavior: general trends
- Demographic view including Income, Assets, Home Value, Education Level, Marital Status, Occupation, Home Ownership, Household Make-Up (multi-generational, presence of: children, grandchildren, grandparents), Ethnicity Data
- Psychographic Data including interest and participation in: travel, various leisure activities, charitable giving, advocacy, volunteering, community involvement

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Optum Labs: Five key assets to help solve many problems

1. Linked medical claims/EHR data
2. Forums to convene collaboration
3. Translation partners
4. Experts on staff, within partners and alongside Optum
5. Data visualization “power tools”
Our Database Goal: “DNA to Diet to Disease to Death”

315 million U.S. Population

35 million Consumer Behavior

31 million Clinical

Genomic

33 million Claims (unlinkable)

Employer Data

31 million Claims (unlinkable)

Buying Behavior

Health system 1

Health system 2

Health plan 2

Health plan 3

Patient Registries

Gov’t Data

33 million Claims (unlinkable)
What happens here: A diversity of research methods

<table>
<thead>
<tr>
<th>Comparative Effectiveness</th>
<th>Delivery of care</th>
<th>Disparities</th>
<th>Epidemiology</th>
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<thead>
<tr>
<th>Guidelines/Quality of care</th>
<th>Health Economics</th>
<th>Methods</th>
<th>Policy and Incentives</th>
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<tr>
<th>Predictive Modeling</th>
<th>Safety &amp; Efficacy</th>
<th>Utilization</th>
<th>Variation in care</th>
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Number of projects by disease category

PRA Received in Quarter
What happens here: A diversity of diseases

Number of projects by disease category

- Non-specific
- Cardiovascular
- Oncology
- Gastrointestinal
- Diabetes
- Multiple
- Orthopedic
- Diagnostics
- Neurology
- Prevention
- Dermatology
- Immunology
- Pulmonary
- Psychiatry
- Women's Health
- Hematology
- Metabolic
- Pain
- Renal
**Constellations: Solving big problems … together**

**Sponsored:**
- The National Heart Failure Collaborative
- The U.S. Big Data Research Initiative to Fight Alzheimer’s Disease

**In development:**
- Type 1 Diabetes
- New Quality & Performance Measures
- New Big Data Methods
- Oncology
- Reducing Cost of Complex Co-Morbidity

**Why do partners need one?**
- I need answers to big questions
- I need a big data strategy
- I need arms, legs and brains to go faster
- I want collaboration with domain experts
- I need to cut my costs
- I want to predict a disease because…
Treating Congestive Heart Failure

Cardiac Rhythm Management
Boston Scientific is a company on the forefront of Cardiac Rhythm Management therapy. The Cardiac Rhythm Management group works with the Electrophysiology group to develop therapies for abnormal heart rhythms (arrhythmias) and heart failure. Boston Scientific remains committed to developing ever-improving technology to help improve the lives of those with cardiac conditions.

Devices → Disease Management

Care Personalization
Innovation
Value
HF Constellation Roadmap and Partners

Heart Failure Constellation

Partners
- Boston Scientific Constellation Leader
- Optum Labs
- Mayo Constellation Academic / Clinical Partner
- Novartis Constellation Sponsor
- Additional Constellation Partners

Year 1
- Environmental Scan
- Baseline Predictive Model
- Mayo HF Constellation Projects

Year 2
- Predictive Models for Patient Clusters
- HF Patient Pathways for Patient Clusters
- Optum Labs HF Const. Projects
- Mayo HF Constellation Projects
- Novartis HF Constellation Projects
- Additional HF Constellation Projects

Year 3
- Impact to Remote Monitoring & Device Diagnostics
- Optum Labs HF Const. Projects
- Mayo HF Constellation Projects
- Novartis HF Constellation Projects
- Additional HF Constellation Projects

Current Status
Precision Medicine for Heart Failure Patients

Personalized HF Therapy

Phenotypic Profiling & Mapping

Prognostic Markers
- Markers predictive of drug sensitivity/resistance
- Markers predictive of adverse events

Rx & Monitoring

Care Mgmt Services: Health Coach

Patient-centric non-HF Interventions (comorbidities, family, nutrition, loneliness...)

Rx

Devices
Precision Medicine for Heart Failure Patients

Phenotypic Data - Biomarkers
- LVEF
- Heart Rate
- BP Systolic/Diastolic
- BNP
- Creatinine
- Troponin
- BMI
- Age
- Gender
- Etc.

Phenotypic Data - Demographics
- SES
- QOL
- Marital status
- Church attendance
- Etc.

Phenotypic Data – Comorbidities
- Hypertension
- Diabetes
- COPD
- CKD
- Sleep Apnea
- Hyperlipidemia
- Afib
- Obesity
- Dementia
- Etc.

Genomic Data

Precision Medicine: Heart Failure
# Phenomapping and Patient Clustering, key studies

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<tbody>
<tr>
<td><strong>Study population</strong></td>
<td>• Patients from randomized clinical trial, HF-ACTION (Heart Failure: A Controlled Trial Investigating Outcomes of Exercise Training)</td>
<td>• March 2008 – May 2011</td>
<td>• Cohort of patients with prevalent HF extracted from OLDW – claims data only</td>
<td>• Patients hospitalized for HF from January 2005 to March 2006 (97 Hospitals)</td>
</tr>
<tr>
<td><strong>Patient Characteristics:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cohort, n</td>
<td>1619</td>
<td>397</td>
<td>231,764</td>
<td>18,516</td>
</tr>
<tr>
<td>Age, years</td>
<td>59</td>
<td>65</td>
<td>72</td>
<td>73</td>
</tr>
<tr>
<td>Female, %</td>
<td>27</td>
<td>63</td>
<td>50</td>
<td>50</td>
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<tr>
<td>Race, %</td>
<td></td>
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<td></td>
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<tr>
<td>White</td>
<td>62</td>
<td>52</td>
<td>69</td>
<td>72</td>
</tr>
<tr>
<td>Black</td>
<td>33</td>
<td>38</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>10</td>
<td>14</td>
<td>12</td>
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</tbody>
</table>
Alzheimer’s: Building a Global Big Data Center of Excellence

NOW IS THE TIME TO TAKE ACTION TO END ALZHEIMER’S

The memories you save could be your own...

WHY ALZHEIMER’S?

44 million people worldwide are currently living with Alzheimer's and dementia.

135 million people will be living with Alzheimer’s and dementia by 2050 if aggressive action isn’t taken now.

Number of Americans with Alzheimer’s

Source: Alzheimer’s Study Group, A National Alzheimer’s Strategic Plan: The Report of the Alzheimer’s Study Group (March 2009); Alzheimer’s Association, Changing the Trajectory of Alzheimer’s Disease: A National Imperative (May 2016); National Institute of Health Office of the Budget website.
Alzheimer’s Constellation

A RESEARCH AGENDA TO DRIVE INNOVATION FORWARD

In addition to ongoing and worthwhile research programs in genetics, medical imaging and clinical research, the opportunity at hand and the proposed research agenda is to leverage existing data, skills and technologies to discover new insights in the care and treatment of people with Alzheimer’s disease.

Now is the time for us to make a bold move and to fully leverage existing assets to drive innovation. That is why we are creating a national big data initiative to fight Alzheimer’s disease with the power of big data combined with a collaboration with leading research institutions in the world... the partners of Optum Labs.

“MEDICINE IS WELL ON ITS WAY TO BECOMING AN INFORMATION SCIENCE: DOCTORS AND RESEARCHERS ARE NOW ABLE TO HARVEST AND MINE MASSIVE QUANTITIES OF DATA FROM PATIENTS.”

“THE AUDACITY OF GOOGLE”, TIME MAGAZINE, SEPTEMBER 30, 2013
# A Research Agenda to Drive Innovation Forward

<table>
<thead>
<tr>
<th></th>
<th>YEAR 1 Launch</th>
<th>YEAR 2 Learn</th>
<th>YEAR 3 Leverage</th>
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</thead>
<tbody>
<tr>
<td><strong>PREDICTION AND DIAGNOSIS</strong></td>
<td>Epidemiological Profile of Alzheimer’s Population – Early Risk Signals</td>
<td>Clinical Data Model for Alzheimer’s from EMR Structured Data</td>
<td>Predictive Model for Identifying Early Alzheimer’s Risk</td>
</tr>
<tr>
<td></td>
<td>• Variation in the Path to Alzheimer’s Diagnosis</td>
<td>Exploratory Study: NLP on Clinical Notes for Alzheimer’s Patients</td>
<td>Exploratory Study: Predictive Power of Consumer Data</td>
</tr>
<tr>
<td></td>
<td>• Population characteristics—picking up the early signals</td>
<td></td>
<td>Predictive Model for Alzheimer’s Risk Staging</td>
</tr>
<tr>
<td><strong>DISEASE PROGRESSION</strong></td>
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<tr>
<td><strong>CARE PLANNING</strong></td>
<td>Community-based Indicators and Alzheimer’s Care</td>
<td>Caregiving and Impact on Patient and Caregiver Health</td>
<td>Comorbiditiy in Alzheimer’s and Implications for Care</td>
</tr>
<tr>
<td><strong>PATIENT REGISTRY</strong></td>
<td>Develop Prospective Care Registry framework and specifications for Alzheimer’s patient and key measures functionality</td>
<td>Populate registry</td>
<td></td>
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</table>

[www.ceoalzheimersinitiative.org](http://www.ceoalzheimersinitiative.org)
New Data Methods Constellation

Health care big data methods constellation

Optum Labs Linked Data: Data, Expertise, Technologies (EMR, claims, consumer data)

Data Linkage Methods & Imputation
Machine Learning & Epi/Econ Combination Methods
Semantic Modeling
Operations Research

Novel Applications: Risk adjustment, de-identification, care personalization, synthetic data

Improved patient care and outcomes
## New Data Methods Constellation

**Goal:** Accelerate the impact of big data-driven research in health care through a broad-reaching set of methodological studies aimed at enabling scientific excellence and novel applications in health care

<table>
<thead>
<tr>
<th>Primary methods research domains</th>
<th>Potential collaborative research topics with Optum Labs partners via a grant program approach (example ideas)</th>
</tr>
</thead>
</table>
| Data linkage methods and imputation | • Clinical data imputation  
• Semantic data linkage  
• Salting and hashing encryption |
| Blended approaches: machine learning & epidemiological/econometric methods | • Predictive modeling  
• Heterogeneity of treatment effects/ endogeneity  
• Time series methods — machine learning vs. health economics and outcomes research (HEOR) |
| Semantic modeling | • Graph analytics  
• Cohort building tools |
| Operations research | • Optimization methods  
• Simulation methods |
| Potential application areas | • Risk adjustment methods using machine learning  
• De-identification software — “safe harbor” views  
• Application development for care personalization (‘N of 1’ query capability)  
• Synthetic data — public anonymous data sets |

Massive, complex health care data require new analytic methods to provide rapid, reliable insights aimed at improving patient care.

Techniques from multiple disciplines (*data science, econometrics, epidemiology, operations research*) each have strengths and weaknesses.

Broad-reach collaboration efforts can leverage the skills of methodological data scientists from many different disciplines.

Moving the field forward requires secure data environment with high speed computing to advance methods while protecting patient privacy.
New Quality & Performance Measures Incubator

Mission and Vision

NQF Mission
The National Quality Forum leads national collaboration to improve health and healthcare quality through measurement.

NQF Vision

- To be the convener of key public and private sector leaders to establish national priorities and goals to achieve healthcare that is safe, effective, patient-centered, timely, efficient, and equitable;
- That NQF-endorsed standards will be the primary standards used to measure and report on the quality and efficiency of healthcare in the United States; and
- To be a major driving force for and facilitator of continuous quality improvement of American healthcare quality.
NQF Quality Measurement Incubator at Optum Labs

Designing and delivering quality measures that matter

NQF Members/Other Partners

Optum Labs Partners

Optum Labs Linked Data: Data, Methods, Technologies (EMR, claims, consumer data)

E-measures
Outcome measures
Patient-reported Outcome measures
Cost/Efficiency/Value measures

Transparent NQF Evaluation Process
- Effectiveness
- Efficiency
- Incubator-enabled evaluation of existing and novel quality measures

INNOVATIVE MEASURE DEVELOPMENT

QMI Advantages
- Volume
- Cycle time
- Patient Relevancy
- Scope
- Overall value
- Innovation

Improved patient care & outcomes
Value Proposition: Seat at the table of health care innovation

Lead a high impact national Initiative, called a “constellation”

Collaborate on healthcare’s biggest issues

Develop Your Big Data Strategy

Create innovation
New predictive models, algorithms, and tools

Accelerate best practice clinical translation

Advance your policy agenda

Health Care’s Biggest Challenges

- Patient/Consumer organizations
- Life sciences companies
- Academic institutions
- Health care providers
- Commercial payers/Employers
- Government researchers
- Technology leaders
Optum Labs Ways to Engage

- Constellation Leader
- Constellation Sponsor
- Constellation Member
- Research Partner (Data & Virtual Sandbox Access)
- Strategic Thought Leader (Special Forums & Advisory/Council Seats)
- Collaboration Partner (Collaborator w/o Data Access)
Join us to learn how the health care industry's first open, collaborative research and innovative center is bringing together great minds to accelerate discovery through collaboration. And see firsthand how life sciences companies can benefit from and contribute to this great endeavor.

Tuesday, June 23
10:00 am – 3:00pm
One Main Street, 10th Floor
Cambridge, MA 02142
Thank You.
Backup Slides
Optum Labs employs certified de-identified data sets, together with a hashing methodology to enable matching individuals from multiple sources, yet preserving statistical de-identification.
Virtual Sandboxes: How to Access The Data

Virtual computing environment

Research sandboxes:
Specific choice of data view and statistical/visualization tools

Research views
(certified as de-identified)

Linked logical database

Optum Labs Data Warehouse

Source databases

OLDW

Ingestion of de-identified data

dNHI  Mayo  Humedica  Etc.

Policy-based security

E.g., NHD, SAS, R, Spotfire

Controlled granularity
  e.g., State, Zip3, Date of Death

Linking by secure double-hash algorithm

Housed in Optum Labs Data Center

De-ID with first-stage hash/salt at source
Back Surgery Predictive Model:
Optum Labs model shows 37% improvement in accuracy over existing models.

<table>
<thead>
<tr>
<th>Model</th>
<th>Dataset</th>
<th>Application</th>
<th># Variables</th>
<th>Detection Prevalence</th>
<th>Sensitivity</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Model (Feb. 2013)</td>
<td>OptumHealth</td>
<td>Outbound (DP = 3.8%)</td>
<td>18</td>
<td>3.80%</td>
<td>29.24%</td>
<td>5.69%</td>
</tr>
<tr>
<td>Optum Labs Model</td>
<td></td>
<td></td>
<td>54</td>
<td>3.80%</td>
<td>40.00%</td>
<td>7.79%</td>
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</tbody>
</table>

Identifies 24.9% more patients headed for back surgery.

![Graph showing patient identification by different models and tools]