Observational Medical Outcomes Partnership: Overview and Lessons Learned

Patrick Ryan
OMOP Research Investigator
on behalf of OMOP Research Team

Sentinel Initiative Public Workshop
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A public-private partnership to serve the public health by testing whether multi-source observational data can improve our ability to assess drug safety and benefits.

- Assess the appropriate technology and data infrastructure required for systematic monitoring of observational data
- Develop and test the feasibility and performance of the analysis methods
- Evaluate required governance structures
Outstanding questions for active surveillance

**Governance**

What are the keys to a successful public-private partnership?

**Data**

Which types of data? administrative claims, electronic health records

Which sources? healthcare providers, insurers, data aggregators

**Performance**

What are appropriate analyses for:
- hypothesis generating?
- hypothesis strengthening?

**Architecture**

What is the appropriate infrastructure:
- hardware?
- software?
- processes?
- policies?

**Feasibility**

What are viable data access models:
- centralized?
- distributed?

**Methods**

How to maintain collaborations and engage research community?

**Technology**

What are best practices for protecting data?
OMOP’s research community requires active participation from all key stakeholders, including government, academia, industry, health care organizations, and patient groups.

Governance
- 10 Executive Board members, chaired by FDA and managed by Foundation for NIH
- 21 Advisory Board members
- Led by 5 research investigators and PMO

Methods
- 17 methods collaborators

Data
- 6 distributed partners, 5 central databases

Technology
- 2 data access models, 7 different systems architectures, including Research Lab

Over 100 partners collaborating to advance the science of drug safety!
**OMOP Research Phases**

- **Phase 1:** FEASIBILITY OF DATA INFRASTRUCTURE (Feb – July 2009)
  - Establish a consistent framework to use across disparate observational data sources
  - Establish OMOP Research Community

- **Phase 2:** FEASIBILITY OF ANALYSES (Aug – Dec 2009)
  - Develop and test analysis methods within the OMOP Research Lab and other data environments
  - Establish standard data characterization procedures
  - Implement health outcomes of interest definitions
  - OMOP to facilitate comparisons across databases

- **Phase 3:** PERFORMANCE MEASUREMENTS (Jan – July 2010)
  - Evaluate performance of methods and data in identifying drug safety issues
  - OMOP to facilitate comparisons across databases

- **Phase 4:** UTILITY OF ANALYSES & PROCESS (July – Dec 2010)
  - Assess the effectiveness and usefulness of how the results and comparisons contribute to decision-making
### OMOP data assessment:
Provider willingness for data access models

<table>
<thead>
<tr>
<th>Access Model</th>
<th>Organizations (n=21)</th>
<th>Total population (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Centralized model:</strong> Provide your data externally to load into the Central Research Core IT environment</td>
<td>7</td>
<td>297</td>
</tr>
<tr>
<td><strong>Federated model:</strong> Facilitate OMOP researchers access to execute queries directly (through firewall)</td>
<td>4</td>
<td>252</td>
</tr>
<tr>
<td><strong>Distributed CDM Model:</strong> OMOP queries run locally by your research staff</td>
<td>17</td>
<td>470</td>
</tr>
<tr>
<td><strong>Distributed protocol model:</strong> Develop and run your own queries locally</td>
<td>19</td>
<td>413</td>
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Each access model would have access to over 250m lives in aggregate, indicating the FDAAA mandate of 100m persons is achievable under all alternative infrastructures without full participation of potential data sources.
Evaluating alternative data access models

- Central systems architecture (network, hardware, software)
- Data owner provide access to de-identified patient-level data
- One or more databases stored independently (no data pooling)
- Analyses coordinated and conducted by central team across
- Central responsibility for validity of data and analyses

- Data owner conducts patient-level analyses within own systems architecture
- Central coordinating center manages protocol development and aggregates summary analysis results submitted by distributed partners
- Distributed partners assume responsibility for validity of data and analyses
Diversity across OMOP data community

OMOP Extended Consortium

OMOP Research Core
- Humana
- Regenstrief
- SDI Health
- VA
- GE
- Thomson Reuters
- I3 Drug Safety
- Partners HealthCare
- Research Lab

Centralized data

Distributed Network
Role of common data model in OMOP Analysis process

Source 1

Transformation to OMOP common data model

Source 2

Source 3
Establishing a common data model

- Developed with broad stakeholder input
- Designed to accommodate disparate types of data (claims and EHRs)
- Applied successfully across OMOP data community

http://omop.fnih.org/CDMandTerminologies
Standardizing terminologies to accommodate disparate observational data sources

**Standardizing conditions:**

System Organ Class (Level 5)
High Level Group Terms (Level 4)
High Level Terms (Level 3)
Preferred Terms (Level 2)
Low-level Terms (Level 1)

Source codes

**Standardizing drugs:**

Top-level concepts (Level 4)
Classifications (Level 3)
Ingredients (Level 2)
Low-level drugs (Level 1)

Source codes

Mapping
- Existing
- De Novo
- Derived
Role of common data model in OMOP Analysis process

Transformation to OMOP common data model

Analysis method

OMOP Analysis results
Heart of OMOP’s methodological research: Assessing the diversity in analysis methods

Disproportionality analysis
- Proportional reporting ratio
- Multi-item Gamma Poisson Shrinker
- Bayesian confidence propagation neural network
- Temporal pattern discovery

Exposure-based approaches
- Cohort Screening
- Incident user designs
- High dimensional propensity scoring
- Local control

Case-based approaches
- Case-control surveillance
- Case-crossover
- Self-controlled case series

Sequential methods
- Maximized sequential probability ratio test
- Conditional sequential sampling procedure
- Bayesian logistic regression
- Statistical relational learning

Other novel approaches? OMOP Cup

OMOP Methods Library at: http://omop.fnih.org/MethodsLibrary
Standardized procedures are being developed to analyze any drug and any condition.

All programs are being made publicly available to promote transparency and consistency in research.

Methods will be evaluated in OMOP research against specific test case drugs and Health Outcomes of Interest.
OMOP research experiment workflow

OMOP Extended Consortium
OMOP Research Core
Distributed partners
Research Lab

OMOP Methods Library

Method 1
Method 2
Method 3
Method 4

Common Data Model

Testing in each source:
- accumulating over time
- against the entire dataset

Drugs
1. ACE Inhibitors
2. Amphotericin B
3. Antibiotics
4. Antiepileptics
5. Benzodiazepines
6. Beta blockers
7. Bisphosphonates
8. Tricyclic antidepressants
9. Typical antipsychotics
10. Warfarin

Health Outcomes of Interest
1. Angioedema
2. Aplastic Anemia
3. Acute Liver Injury
4. Bleeding
5. GI Ulcer Hospitalization
6. Hip Fracture
7. Hospitalization
8. Myocardial Infarction
9. Mortality after MI
10. Renal Failure

Non-specified conditions
- All outcomes in condition terminology
- 'Labeled events' as reference
- Warning
- Precautions
- Adverse Reactions
- Postmarketing Experience

Testing in each source:
- accumulating over time
- against the entire dataset
Contact information

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OMOP website: http://omop.fnih.org
OMOP Cup website: http://omopcup.orwik.com
Backups
Partnership Structure

Governance Provided by an Executive Board
Scientific and Informatics advisory boards inform decisions

Key Design Elements:
1. Governance and Oversight
2. Research Leadership
3. Program Management
4. Partners & Collaborators

Scientific Advisory Board

Executive Board

Executive Director

Program Management Office

Principal Investigators

Research Team

- Industry, academic and other external resources

Infrastructure team

- System integrator team, ED and PMO oversight

FNIH Board

Key

Oversight

Dedicated
Executive Board
A multi-stakeholder group, the OMOP Executive Board oversees the operation of the Partnership.

Janet Woodcock, MD
Director, Center for Drug Evaluation and Research, Food and Drug Administration
Chair, Observational Medical Outcomes Partnership Executive Board

Rebecca Burkholder
Vice President of Health Policy, The National Consumers League

Sherine Gabriel, MD, MSc
Professor of Medicine and Epidemiology, The Mayo Clinic

Cynthia Gilman, JD
Special Assistant to the President for Advancement of Cancer Research and Collaborative Partnerships, Henry Jackson Foundation

Jesse L. Goodman, MD, MPH
Chief Scientist and Deputy Commissioner for Science and Public Health (acting), Food and Drug Administration

Ronald L. Krall, MD
Former Senior Vice President and Chief Medical Officer, GlaxoSmithKline

Richard Platt, MD, MSc
Professor and Chair of the Department of Ambulatory Care and Prevention, Harvard Medical School and Harvard Pilgrim Health Care

Stephen Spielberg, MD, PhD
Marion Merrell Dow Chair in Pediatric Pharmacogenomics, Children’s Mercy Hospital and Dean Emeritus, Dartmouth Medical School

Brian Strom, MD, MPH
George S. Pepper Professor of Public Health and Preventive Medicine; Professor of Biostatistics and Epidemiology, Medicine, and Pharmacology; Chair, Department of Biostatistics and Epidemiology; Director, Center for Clinical Epidemiology and Biostatistics; Vice Dean for Institutional Affairs, University of Pennsylvania School of Medicine
Senior Advisor to the Provost for Global Health Initiatives, University of Pennsylvania

David Wheadon, MD
Senior Vice President, Pharmaceutical Research and Manufacturers of America (PhRMA)
Research Investigators

The Principal Investigators (PIs) are the lead scientists for the OMOP project and guide and participate in the research across all four project phases

Marc Overhage, MD, PhD:  Director, Medical Informatics and Research Scientist, Regenstrief Institute, Inc.;  Regenstrief Professor of Medical Informatics, Indiana University School of Medicine, CEO; President of the Indiana Health Information Exchange

Paul Stang, PhD, FISPE:  Senior Director, Epidemiology, Johnson & Johnson Pharmaceutical Research and Development

Abraham G. Hartzema PharmD, MSPH, PhD, FISPE:  Professor and Eminent Scholar, Pharmaceutical Outcomes & Policy, Perry A. Foote Chair in Health Outcomes Research, University of Florida College of Pharmacy

Judy Racoosin, MD, MPH:  Sentinel Initiative Scientific Lead, US Food and Drug Administration

Patrick Ryan:  Manager Drug Development Sciences, GlaxoSmithKline R&D OMOP Co-Investigator
Foundation for the NIH Program Staff

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OMOP Statistics and Programming Team

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Mark Khayter
Ephir, Inc.

Carlos Alzola
Data Insights

Emmanuel Angel
Angelic Productions

Reed George
etera solutions

Eric Lantz
University of Wisconsin-Madison

Ron Mantha
Ephir, Inc.
Advisory Boards

A Scientific Advisory Board (SAB) will provide independent review of and expert input into the scientific aspects of OMOP’s activities.

- Elizabeth Andrews, RTI Health Solutions
- Andrew Bate, Pfizer
- Jesse Berlin, Johnson & Johnson
- Robert Davis, Kaiser Permanente
- Steve Findlay, Consumer Union
- Sean Hennessy, University of Pennsylvania
- Mike Katz, FDA patient representative
- Allen Mitchell, Boston University
- David Page, University of Wisconsin
- Ken Rothman, RTI Health Solutions
- Judy Staffa, FDA
- Alec Walker, WHISCON

A Health Informatics Advisory Board (HIAB) will provide independent review and expert input into the OMOP’s technology governance and project requirements related to privacy and security, terminology and coding, data and data models.

- Col. Kevin Abbott
- Jeff Brown, Harvard Medical School
- Stan Huff, Intermountain Healthcare
- Diane MacKinnon, IBM (retired)
- Ken Mandl, Harvard University
- Clem McDonald, National Library of Medicine
- David Memel, Klaipeda Consulting
- Mitra Rocca, FDA
- Joy Pritts, Georgetown University
- Rob Thwaites, United BioSource Corporation
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<tr>
<th>Organization</th>
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<td>Computer Sciences Corporation</td>
<td>Dan Foltz</td>
<td>Research Lab</td>
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<td>Department of Veterans Affairs Center for Medication Safety</td>
<td>Fran Cunningham, PharmD</td>
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<td>J. Marc Overhage, MD, PhD</td>
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<td>Partners HealthCare System</td>
<td>Shawn Murphy, MD, PhD</td>
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<td>ProSanos Corporation</td>
<td>Stephanie Reisinger</td>
<td>Simulated Data</td>
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<td>University of Miami-Humana Health Services Research Center</td>
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<td>M Alan Brookhart, PhD and SAS Institute</td>
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<tr>
<td>Uppsala Monitoring Center</td>
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