Today’s Patient Centered Outcomes Seminar

"The Boston PCORI Clinical Data Research Network: Scalable Collaborative Infrastructure for a Learning Healthcare System"
Ken Mandl, MD, MPH, Professor of Medicine, Harvard Medical School

“Architecture for a distributed Clinical Data Research Network”
Shawn Murphy, MD, PhD, Associate Professor of Neurology, Harvard Medical School

PCERC Contact Information. Please email Josh to register for the Seminar Series.
• Daniel Solomon, PCERC Co-Director (dsolomon@partners.org)
• Joel Weissman, PCERC Co-Director (jweissman@partners.org)
• Joshua Di Frances, Biomedical Research Institute Project Manager (jdfrances@partners.org)
Next Patient-Centered Outcomes Seminar
Monday, March 24, 4 pm – 5 pm

John Hsu, MD, MBA, MSCE
Associate Professor of Medicine, Harvard Medical School
Director, Clinical Economics and Policy Analysis Program, Mongan Institute for Health Policy

Additional Seminar Speakers:
• Joseph Kvedar, MD (April)
• Sonya Shin, MD, MPH (May)
• Milt Weinstein, PhD (September)
• David Blumenthal, MD, MPP (October)
Introducing SCILHS
The Scalable Collaborative Infrastructure for a Learning Healthcare System

Kenneth D. Mandl, MD, MPH
- Harvard Medical School
- Boston Children’s Hospital

Shawn Murphy, MD, PhD
- Partners Healthcare
- Massachusetts General Hospital
US Spending per capita vs. Life Expectancy
Learning Health System: Evidence Generated from a Well-Instrumented Health System

- Experimental studies
- Models and nonexperimental studies
- Recorded clinical outcomes

Contribution to Body of Evidence

Safety & Efficacy

Market Entry

Safety & Effectiveness

Periodic Systematic Reviews of the Evidence
How do we learn from

“All the Patients . . .
All the Time?”

(Instead of Some of the Patients All of the Time . . . )

. . . or really, just a couple of the patients, not that often.
Dr. Collins discussing the Rapid Learning Network
Patient Centered Outcomes Research Institute

- An **independent, non-profit health research organization** authorized by the Patient Protection and Affordable Care Act of 2010.

- PCORI funds **patient-centered research** to assist patients, caregivers, and other stakeholders in making informed health decisions.

**Mission**

PCORI helps people make informed healthcare decisions and improves healthcare delivery and outcomes by producing and promoting high integrity, evidence-based information that comes from research **guided by patients, caregivers, and the broader healthcare community**.

**Vision**

Patients and the public have the information they need to **make decisions** that reflect their **desired health outcomes**.
The National Network of Networks

$500M/yr
18 Month Work Period:
Standing High Jump will Not Clear
The Plan

Common data platform *(i2b2)*

+ Federated queries across sites *(SHRINE)*

+ Point of care apps *(SMART)*

+ Patient-facing technologies *(RedCap, SMART, +)*
- $48B investment in HIT
- $1.4B at Partners
- North of $0.5T total
- “1987 called and they want their EHR back”
Designing the App Store for Health

The NEW ENGLAND JOURNAL of MEDICINE

No Small Change for the Health Information Economy
Kenneth D. Mandl, M.D., M.P.H., and Isaac S. Kohane, M.D., Ph.D.

The economic stimulus package signed by President Barack Obama on February 17 included a $19 billion investment in health information technology. How can we best take advantage of this unprecedented opportunity to transform health care and stimulate the health information economy while also streamlining the U.S. economy? A health care system adapting to the effects of an aging population, growing expenditures, and a diminishing primary care workforce needs the support of a flexible information infrastructure that facilitates innovation in wellness, health care, and public health.

Flexibility is critical, since the system will have to function under new policies and in the service of new health care delivery mechanisms, and it will need to incorporate emerging information technologies as they emerge. As we seek to design a system that will constantly evolve and encourage innovation, we can glean lessons from large-scale information-technology successes in other fields. An essential first lesson is that closed systems components should be not only interoperable but also substitutable. The Apple iPhone, for example, uses a software platform with a published interface that allows software developers outside Apple to create applications; there are now nearly 10,000 applications that consumers can download and use with the common phone interface. The platform separates the system from the functional-
Inspired by a

18.12 Issue

Design Challenge
State-of-the-Art ???

Cardio CRP

For Ages > 17 Years:

<table>
<thead>
<tr>
<th>CRP mg/L</th>
<th>Risk According to AHA/CDC Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.0</td>
<td>Lower Relative Cardiovascular Risk.</td>
</tr>
<tr>
<td>1.0-3.0</td>
<td>Average Relative Cardiovascular Risk.\n</td>
</tr>
</tbody>
</table>
Bloodwork Cardiology Result

**Patient Info**

**NAME:** John Doe  
**GENDER:** M  
**AGE:** 49  
**DOB:** 01/10/1961

**ORDERED BY:** Dr. Francis Pulaski  
Bellevue Medical Centre  
lamarol@bactamed.edu  
(603) 555-54321 x1523  
**COLLECTED:** 11/02/2010, 10:40 a.m.  
**RECEIVED:** 11/02/2010, 1:03 p.m.

1. **About this test**
   This report evaluates your potential risk of heart disease, heart attack, and stroke.

2. **Your results**
   **CRP level test**
   - Low risk (0-0.3)
   - Average (0.3-3)
   - High risk of cardiovascular disease (3+)
   - **your level:** 3.3

3. **Your risk**
   You show an elevated risk of cardiovascular disease.
   If you’re a smoker with normal blood pressure, (130 mm/Hg) but family history of heart attack before age 60 (one or both parents) your risk over 10 years is: 15%.

   **Your risk would be lowered to**
   - 12% if your blood pressure were 120mm/Hg  
   - 10% if you quit smoking  
   - 6% if you reduced cholesterol to 160mg/DL
   Use your CRP results and cholesterol level to calculate your 10 risk of a cardiovascular event at ReynoldsRisk.org

4. **What now?**
   - Diet & exercise can improve your cholesterol levels
   - Quitting smoking can decrease your heart disease risk by 50% or more
   - Ask your doctor about statins or other medications that can lower cholesterol
   - Consider retesting in 1 to 2 weeks to exclude a temporary spike in blood levels

David McCandless & Stefanie Posavec for Wired Magazine // informationisbeautiful.net

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An Inspired Design from Dave McCandless (cc license)
1 Design + 1 Developer + 1 Week

SMART Cardiac Risk App
1 SMART App in 3 SMART Systems
Trial Eligibility

Gender: Female, Male
Age: 43 y
Location: Boston, MA

Search Term: rheumatoid arthritis + methotrexate

Intervention / Observation
- Biological (14)
- Device (1)
- Dietary Supplement (1)
- Drug (69)
- Observational (14)
- Other (4)
- Procedure (1)

Trial phase
- N/A (8)
- Phase 1 (8)
- Phase 2 (23)
- Phase 3 (17)
- Phase 4 (26)
<table>
<thead>
<tr>
<th>Clinician engagement; patient representation</th>
<th>Patient ID; real-time EHR aggregate data exchange</th>
<th>Patient ID; real-time EHR line list data exchange</th>
<th>SMART PCOR Apps tested at the point of care</th>
<th>Patient enrollment, survey, PRO assessment</th>
<th>Comprehensive claims data available, Phase I</th>
</tr>
</thead>
<tbody>
<tr>
<td>i2b2 with fresh EHR Data SHRINE 1.0, SHRINE 2.0 I2b2 SMART Plugin at point of care SCILHS-CONNECT patient link I2b2-CLAIMS data population</td>
<td><strong>“BLUE SITES”</strong> Boston Children’s Hospital Boston HealthNet Partners HealthCare Wake Forest Baptist Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I2b2 with fresh EHR data SHRINE 1.0, SHRINE 2.0 I2b2 SMART Plugin at point of care SCILHS-CONNECT patient link</td>
<td><strong>“RED SITES”</strong> Beth Israel Deaconess Hospital Cincinnati University of Texas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New installation of I2b2 New installation of SHRINE 1.0</td>
<td><strong>“GREEN SITES”</strong> Columbia U. Mississippi Med Center Morehouse</td>
<td></td>
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</tr>
</tbody>
</table>
Clinical Data Research Networks

The Clinical Data Research Networks (CDRNs) will develop the capacity to conduct randomized comparative effectiveness studies using data from clinical practice in a large, defined population. These established or newly developed networks involve two or more healthcare systems, with plans to function as integrated research networks.

- **C1_Scalable Collaborative Infrastructure for a Learning Healthcare System (SCILHS)**
  - Harvard University
- **C2_Mid-South CDRN**
  - Vanderbilt University
- **C3_Patient-oriented SCAlable National Network for Effectiveness Research (pSCANNER)**
  - University of California, San Diego (UCSD)
- **C4_Great Plains Collaborative (GPC)**
  - University of Kansas Medical Center
- **C5_Kaiser Permanente & Strategic Partners Patient Outcomes Research To Advance Learning (PORTAL) Network**
  - Kaiser Foundation Research Institute
- **C6_Louisiana CDRN (LACDRN)**
  - Louisiana Public Health Institute (LPHI)
- **C7_National Pediatric Learning Health System (PEDSNet)**
  - The Children's Hospital of Philadelphia
- **C8_New York City Clinical Data Research Network (NYC-CDRN)**
  - Weill Medical College of Cornell University
- **C9_Chicago Area Patient Centered Outcomes Research Network (CAPriCORN)**
  - The Chicago Community Trust
- **C10_Accelerating Data Value Across a National Community Health Center Network (ADVANCE)**
  - Oregon Community Health Information Network (OCHIN)
- **C11_P2aTH: Towards a Learning Health System in the Mid-Atlantic Region**
  - University of Pittsburgh
Collaborating PPRNs

- CARRANet
- CCFA IBD
- ImproveCare Now
- Sleep Apnea
- Mood
- Phelan McDermid
- Adrenoleukodystrophy
- Vasculitis
## 11 CDRNs

<table>
<thead>
<tr>
<th>CDRN Name</th>
<th>Lead Organization</th>
<th>Principal Investigator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVANCE</td>
<td>Oregon Community Health Information Network</td>
<td>Jennifer DeVoe</td>
</tr>
<tr>
<td>CAPriCORN</td>
<td>The Chicago Community Trust</td>
<td>Terry Mazany</td>
</tr>
<tr>
<td>Great Plains Collaborative</td>
<td>University of Kansas Medical Center</td>
<td>Lemuel Waitman</td>
</tr>
<tr>
<td>Louisiana Clinical Data Research Network</td>
<td>Louisiana Public Health Institute</td>
<td>Anjum Khurshid</td>
</tr>
<tr>
<td>Mid-South CDRN</td>
<td>Vanderbilt University</td>
<td>Russell Rothman</td>
</tr>
<tr>
<td>NYC-CDRN</td>
<td>Weill Medical College of Cornell University</td>
<td>Rainu Kaushal</td>
</tr>
<tr>
<td>PEDSNet</td>
<td>The Children’s Hospital of Philadelphia</td>
<td>Christopher Forrest</td>
</tr>
<tr>
<td>PORTAL</td>
<td>Kaiser Foundation Research Institute</td>
<td>Elizabeth McGlynn</td>
</tr>
<tr>
<td>pSCANNER</td>
<td>University of California, San Diego</td>
<td>Lucila Ohno-Machado</td>
</tr>
<tr>
<td>P2ATH</td>
<td>University of Pittsburgh</td>
<td>Rachel Hess</td>
</tr>
<tr>
<td>SCIHLS</td>
<td>Harvard University</td>
<td>Kenneth Mandl</td>
</tr>
</tbody>
</table>
## CDRNs: Disease Cohorts

<table>
<thead>
<tr>
<th>Organization</th>
<th>Common Cohort</th>
<th>Rare Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVANCE</td>
<td>Diabetes</td>
<td>HIV &amp; Hepatitis C virus Co-infection</td>
</tr>
<tr>
<td>CAPriCORN</td>
<td>Anemia; Asthma</td>
<td>Sickle cell disease; Recurrent C. Difficile colitis</td>
</tr>
<tr>
<td>Great Plains Collaborative</td>
<td>Breast Cancer</td>
<td>Amyotrophic Lateral Sclerosis (ALS)</td>
</tr>
<tr>
<td>Louisiana Clinical Data Research Network</td>
<td>Diabetes</td>
<td>Sickle Cell Disease, Rare Cancers</td>
</tr>
<tr>
<td>NYC-CDRN</td>
<td>Diabetes</td>
<td>Cystic Fibrosis</td>
</tr>
<tr>
<td>Mid-South CDRN</td>
<td>Coronary Heart Disease</td>
<td>Sickle Cell Disease (SCD)</td>
</tr>
<tr>
<td>PEDSNet</td>
<td>Inflammatory bowel disease</td>
<td>Hypoplastic left heart syndrome</td>
</tr>
<tr>
<td>PORTAL</td>
<td>Colorectal Cancer</td>
<td>Severe Congenital Heart Disease</td>
</tr>
<tr>
<td>pSCANNER</td>
<td>Congestive Heart Failure</td>
<td>Kawasaki Disease</td>
</tr>
<tr>
<td>P2ATH</td>
<td>Atrial Fibrillation</td>
<td>Idiopathic Pulmonary Fibrosis</td>
</tr>
<tr>
<td>SCIHLS</td>
<td>Osteoarthritis</td>
<td>Pulmonary arterial hypertension</td>
</tr>
</tbody>
</table>
PPRNs represent a number of conditions...

<table>
<thead>
<tr>
<th>Organization</th>
<th>PI</th>
<th>Condition</th>
<th>Population Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerated Cure Project for Multiple Sclerosis</td>
<td>Robert McBurney</td>
<td>Multiple Sclerosis</td>
<td>20,000</td>
</tr>
<tr>
<td>American Sleep Apnea Association</td>
<td>Susan Redline</td>
<td>Sleep Apnea</td>
<td>50,000</td>
</tr>
<tr>
<td>Cincinnati Children's Hospital Medical Center</td>
<td>Peter Margolis</td>
<td>Pediatric Crohn's Disease and Ulcerative Colitis</td>
<td>15,000</td>
</tr>
<tr>
<td>COPD Foundation</td>
<td>Richard Mularski</td>
<td>Chronic Obstructive Pulmonary Disease</td>
<td>50,000</td>
</tr>
<tr>
<td>Crohn’s and Colitis Foundation of America</td>
<td>R. Balfour Sartor</td>
<td>Inflammatory Bowel Disease (Crohn’s disease and ulcerative colitis)</td>
<td>30,000</td>
</tr>
<tr>
<td>Global Healthy Living Foundation</td>
<td>Seth Ginsberg</td>
<td>Arthritis (rheumatoid arthritis, spondyloarthritis), musculoskeletal disorders (osteoporosis), and inflammatory conditions (psoriasis)</td>
<td>50,000</td>
</tr>
<tr>
<td>Massachusetts General Hospital</td>
<td>Andrew Nierenberg</td>
<td>Major Depressive Disorder and Bipolar Disorder</td>
<td>50,000</td>
</tr>
<tr>
<td>Univ of California, San Francisco</td>
<td>Mark Pletcher</td>
<td>Cardiovascular health</td>
<td>100,000</td>
</tr>
<tr>
<td>University of South Florida</td>
<td>Rebecca Sutphen</td>
<td>Hereditary Breast &amp; Ovarian Cancer</td>
<td>17,000</td>
</tr>
<tr>
<td>Organization</td>
<td>PI</td>
<td>Condition</td>
<td>Population Size</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>ALD Connect, Inc</td>
<td>Florian Eichler</td>
<td>Adrenoleukodystrophy</td>
<td>3,000</td>
</tr>
<tr>
<td>Arbor Research Collaborative for Health</td>
<td>Bruce Robinson</td>
<td>Primary Nephrotic Syndrome, Focal Segmental Glomerulosclerosis, Minimal Change Disease, and Membranous Nephropathy Multiple Sclerosis</td>
<td>1,250</td>
</tr>
<tr>
<td>Duke University</td>
<td>Laura Schanberg</td>
<td>Juvenile Rheumatic Disease</td>
<td>9,000</td>
</tr>
<tr>
<td>Epilepsy Foundation</td>
<td>Janice Beulow</td>
<td>Aicardi Syndrome, Lennox-Gastaut Syndrome, Phelan-McDermid Syndrome, Hypothalamic Hamartoma, Dravet Syndrome, Tuberous Sclerosis</td>
<td>1,500</td>
</tr>
<tr>
<td>Genetic Alliance, Inc</td>
<td>Sharon Terry</td>
<td>Alström syndrome, Dyskeratosis congenital, Gaucher disease, Hepatitis, Inflammatory breast cancer, Joubert syndrome, Klinefelter syndrome &amp; associated conditions, Psoriasis, Metachromatic leukodystrophy, Pseudoxanthoma elasticum</td>
<td>50-50,000</td>
</tr>
<tr>
<td>Immune Deficiency Foundation</td>
<td>Kathleen Sullivan</td>
<td>Primary Immunodeficiency Diseases</td>
<td>1,250</td>
</tr>
<tr>
<td>Parent Project Muscular Dystrophy</td>
<td>Holly Peay</td>
<td>Duchenne and Becker muscular dystrophy</td>
<td>4,000</td>
</tr>
<tr>
<td>Phelan-McDermid Syndrome Foundation</td>
<td>Megan O’Boyle</td>
<td>Phelan-McDermid Syndrome</td>
<td>737</td>
</tr>
<tr>
<td>University of Pennsylvania</td>
<td>Peter Merkel</td>
<td>Vasculitis</td>
<td>500</td>
</tr>
</tbody>
</table>
PCORnet: A Complex Equation

11 CDRN lead sites (x ≈ 100 partner organizations)
+ 18 PPRN lead sites (x ≈ 50 partner organizations)
  + 11 Task Forces (≈ minimum 25 people/TF)
    + Coordinating Center (n ≈ 15 staff)
      + PCORI Program Office (n = 7)

Sizable Communication & Coordination Effort!
Scalable Collaborative Infrastructure for a Learning Healthcare System

LEARN
- Generate
  - Patient & Family Advisory Panel
  - Clinician Advisory Panel
  - Researchers

APPROVE
- PCOR Participant and Expert Advisory Group
- PIs at all participating sites
- IRBs with reliance agreements

IDENTIFY
- Common Data Model
- Multisite Query
- PPRN–CDRN Data Exchange

INFORM
- Multimedia module
- Websites, pamphlets

ENROLL
- At home: Telephony, email, smartphone apps
- At clinic: Sidecar apps

ENGLISH
- Ongoing bidirectional communication with participants

PATIENT COHORT LIST
- Linkable to identifiers at individual sites by authorized investigators

RETURN results
- Clinicians and Patients benefit from knowledge gained in their studies

STUDY
- PCOR Methods

Clinicians
Patients
Researchers
Other Stakeholders
Key Challenges

- Regulatory
- Governance
- Co-opting the point of care
- Patient Engagement
PCORI Emphasizes Engagement for Getting to Relevant, Useful Research
Contact
Kenneth_Mandl@Harvard.edu
Introducing PCORnet:
The National Patient-Centered Clinical Research Network

Shawn Murphy MD, Ph.D.
Director, Research Computing, Partners HealthCare
Presentation to PCERC  February 24, 2014
A Clinical Data Research Network: Partners-Shrine Network through HMS

- Partners HealthCare System
- Boston Children’s Hospital
- BIDMC
- Boston Health Net (BMC and Community Health Centers)

- Columbia U. Medical Center and New York Presbyterian Hospital
- Wake Forest Baptist Medical Center
- Morehouse/Grady/RCMI

- Cincinnati Children’s Hospital
- U Mississippi Medical Center/RCMI
- U Texas Health Science Center/Houston
Research Patient Data Registry at Partners Healthcare: finding patient cohorts for clinical research

1) Queries for aggregate patient numbers
   - Warehouse of in & outpatient clinical data
   - 6.0 million Partners Healthcare patients
   - 2.0 billion diagnoses, medications, procedures, laboratories, & physical findings coupled to demographic & visit data

2) Returns detailed patient data
I2b2 Software developed by MGH and Partners Healthcare and distributed as open source.
Patients are selected through an Enterprise Repository and data are gathered into a detailed data set (to over 100 Hospitals in the US and Internationally).
Scalable Collaborative Infrastructure for a Learning Healthcare System (SCILHS):
SHRINE Architecture

- Start with i2b2
- Add the SHRINE Adapter
- Deploy the SHRINE Web client and broadcaster
- Deploy current ontology and mapping files
- Connect to the network
Query across sites
Use i2b2 detailed interface to screen patients
Select patients for surveys
ENROLL
ENGAGE
RETURN results

My.SCILHS
Contact list generated

At Home
- email
- web browser
- smartphone
- IVR telephony

At Clinic
- sidecar apps for clinicians
- tablet or kiosk

Central PCOR Analysis
Data pooled from all records. Identified data only pooled with patient consent.

Patient Cohort List
Sent to appropriate site (see RC1)

Site i2b2 + SHRINE
Query completed
(see IDENTIFY in RC1 overview diagram)

SCILHS sidecar
mySCILHS Phase 1

1. SCILHS-originated Patient Selection Query

2. SCILHS site Patient Set (IDs only)

3. Site PHI Database

4. Third Party Telephone Survey Service for PROs

CSV File

Patient PRO responses

mySCILHS Site
mySCILHS Phase 2

1. SCILHS-originated Patient Selection Query

2. SCILHS site Patient Set (IDs only)

Site PHI Database

Patient Contact Info

mySCILHS Site

SCILHS Adapter

National Adapter

Ontology Cell

Survey Data

Project Mgmt

EHR Cohort Data

Site I2b2 + SHRINE

Patient PRO responses

REDCap Patient-Reported Outcomes Survey Server

mySCILHS Research Subject Management Platform

mySCILHS VM
Early Objectives

PCORnet will need to:

- Establish priorities that patients, clinicians, clinical leaders, and investigators share
- Facilitate collaboration between networks
- Embed research into practice settings without disrupting clinical operations
- Create a distributed data network that protects patients’ confidential information
- Develop oversight procedures that protect patients while minimizing redundancy

All in 18 months
Partners PCORI Committee

- Anne Klibanski, MGH and Partners (Chair)
- Shawn Murphy, MGH and Partners (CDRN Co–PI and Co-Chair) *
- Ken Mandl, Center for Biomedical Informatics (CDRN PI) *
- Sebastian Schneeweiss, BWH (CDRN Co-PI) *
- Harry Orf, MGH
- Barbara Bierer, BWH
- Josh Metlay, MGH
- Lee Nadler, Harvard Catalyst
- Andrew Nierenberg, MGH
- Pearl O’Rourke, Partners
- Lee Schwamm, MGH
- Dan Solomon, BWH
- Ravi Thadhani, MGH and Partners
- Zak Kohane, Harvard
- Susan Edgemen Levitan
- Jennifer Haas
- Aaron Waxman
- Alison Goldfine