Population Health Management: Expanding from Clinical to Whole Patient Insight

Adrian Zai, MD PhD MPH

Clinical Director of Population Informatics
Laboratory of Computer Science, Massachusetts General Hospital

Faculty at Harvard Medical School

Chief Medical Informatics Officer
SRG-Technology
Population Health IT: 10 Lessons Learned

Adrian Zai, MD PhD MPH

Clinical Director of Population Informatics
Laboratory of Computer Science, Massachusetts General Hospital

Faculty at Harvard Medical School

Chief Medical Informatics Officer
SRG-Technology

Instead I will focus on...
10 Lessons Learned

1. Optimizing processes is important
2. Focus on precise population identification
3. It’s ok to (sometimes) take the physician out of the equation
4. Question your measures
5. Driving outcomes doesn’t have to be expensive
6. Interoperability between all IT components is critical
7. Don’t target high-risk patients only, look at how quickly low-risk patients are becoming high-risk
8. Use multi-interventions to optimize outcomes
9. Match the right high-risk patients to the appropriate interventions
10. Have an effective PHM IT system to compare effectiveness of your interventions
Cleveland - 2001

(County Hospital affiliated to Case Western Reserve University)
“PHM is about driving population outcomes upward”
For more than half a century, the Laboratory of Computer Science (LCS) at Massachusetts General Hospital has been transforming health care delivery through biomedical informatics research and the rapid development of innovative health information systems. LCS advancements have enabled Mass General and other hospitals to provide better, more efficient service and have improved patient outcomes and quality of care.

Founded in 1964 by Dr. G. Octo Barnett, LCS played an active role in shaping the modern health informatics field. LCS is the birthplace of MUMPS (Massachusetts General Hospital Utility Multi-Programming System) programming language, which remains the basis of clinical systems at many large hospitals today, and was involved in the development of some of the earliest electronic medical records and clinical systems.

Current projects in the lab explore novel applications of computer technology to enhance patient engagement, information management, decision support, provider workflows, medical education and clinical research.
Which diabetic patients need a letter reminder?

<table>
<thead>
<tr>
<th>Call Center</th>
<th>Hospital Administrator</th>
<th>Practice Manager</th>
<th>Physician</th>
</tr>
</thead>
<tbody>
<tr>
<td>End</td>
<td>Query database for patients with missing tests</td>
<td>Email/Txt list of patients to Practice for confirmation</td>
<td>Unconfirm</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Check EHR</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Call Patient</td>
<td>Email/Txt list</td>
<td>Confirm</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Document call list</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Why process Initiated by admin?

Can we automate via letters?

Redundant workflow!

Is this step necessary?
Diabetes Workflow Redesign

Before:

After:

Speed-to-Value:
Efficiency gain in identifying which patients to send letter reminders

4 months to implement
>70x efficiency gain/nurse*

Is this “my” patient?

In 2005…

A payer-agnostic attribution model? Who needs that?

In 2006-2008...

Identifying Heart Failure Inpatients

Linking electronic health record-extracted psychosocial data in real-time to risk of readmission for heart failure

Alice J. Watson, MD MPH1, Julia O'Rourke, PhD MS2, Kamal Jethwani, MD MPH1, Aurel Cami, PhD3, Theodore A. Stern, MD4, Joseph C. Kvedar, MD1, Henry C. Chueh, MD MS2, and Adrian H. Zai, MD PhD MPH2
1Center for Connected Health, Partners Healthcare, Boston, MA
2Laboratory of Computer Science, Massachusetts General Hospital; Boston, MA
3Children’s Hospital, Boston, MA
4Department of Psychiatry, Massachusetts General Hospital; Boston, MA

Abstract

Background—Knowledge of psychosocial characteristics that helps to identify patients at increased risk for readmission for heart failure (HF) may facilitate timely and targeted care.

Objective—We hypothesized that certain psychosocial characteristics extracted from the electronic health record (EHR) would be associated with an increased risk for hospital readmission within the next 30 days.

Methods—We identified 15 psychosocial predictors of readmission. Eleven of these were extracted from the EHR (six from structured data sources and five from unstructured clinical notes). We then analyzed their association with the likelihood of hospital readmission within the next 30 days among 729 patients admitted for HF. Finally, we developed a multivariable predictive model to recognize individuals at high risk for readmission.


task was successfully deleted

On call inpatients assigned to me (0)

Your responsibility: My Inpatients does not contain any patients

My subscriptions (14)

 OE-TEST, CATHY 44 M Text Patient List add

PFR MRN 3861820
47 yo M with burn
# Burn
- OR tomorrow
# FEver
Dayton Public School Project
In 2011...

Determine whether or not physicians need to be part of the workflow

TopCare

is the name of an AHRQ-funded clinical trial:

Technology optimized for population
Care in a resource-limited environment
Workflow of intervention and control groups

= TopCare

= TopCare + PCP

“TopCare + PCP” vs. “TopCare”

NO DIFFERENCE!
Percent of BWH Diabetics with No Pending Visit

Charles Morris MD, Mary Merriam RN, Tanya Zucconi MBA

Practices with TopCare (A-E) = ~2500 DM patients
Practices without TopCare (Non-CPM) = ~7500 DM patients
Percent of Overdue DM Labs

Charles Morris MD, Tanya Zucconi

% Overdue A1c March
% Overdue A1c June

TopCare Sites
% of patients with HbA1c > 9

Charles Morris MD, Mary Merriam, Tanya Zucconi

Charles Morris, MD., MPH1; Mary Merriam, RN1; Jessica Dudley, MD2; Joseph Frolkis, MD., PHD1; Tanya Zucconi2, Adrian Zai, M.D., MPH3; Faithful Baah1, *A Centralized Approach to Population Health Management Across A Network of 14 Primary Care Practices*. Presented at the 7th Annual Conference on the Science of Dissemination and Implementation: Transforming Health Systems to Optimize Individual and Population Health, December 2014.
In 2012…

searches for a Pop Health Tool
Decide on a population health management model
3 Interventions

1. Development of measures that are more clinically meaningful
2. Creation of a central Population Health Coordinator (PHC) program
3. Implementation of TopCare, an enterprise population health management IT system
We developed measures that are more clinically meaningful so that we no longer have to deal with the discrepancies of payor contracts.

Docs are much happier too!
As part of our effort to create more clinically meaningful quality measures, we listened to our physicians, and asked them why they called the “old” measures “STUPID”

**The Taxonomy of “Stupid”**

A. **Not a clinically important/correct idea**
   - e.g. Mammography for women 40-50

B. **Clinically important idea, but measure is not an appropriate proxy**
   - e.g. Antibiotics for bronchitis

C. **Attribution Error**
   - e.g. “These aren’t my patients.”

D. **Payer-Specific**
   - e.g. “I treat all my patients the same regardless of payer.”

E. **Denominator improperly measured**
   - e.g. not diabetic: gestational diabetes, PCOS on metformin, diabetes coded by podiatrist

F. **Numerator improperly measured**
   - e.g. Colorectal Cancer Screening

G. **Measurement process cumbersome/complicated/doesn’t allow for remediation**
   - e.g. Antidepressant Medication Management
No Excuses = High Targets

- Misattribution: Not my patient
- Improperly counted in denominator: errant claim
- Missed in numerator: changed insurance company, missing claim
- Clinical judgment: special circumstances for a particular patient
- On maximal therapy or intolerant to therapy

So, if we make all these changes … what reasons are left not to reach 100%?
We created a central Population Health Coordinator (PHC) team that supports population health initiatives across the entire MGH primary care network.

They huddle with physicians, take care of appointments, test reminders, patient outreach, and clean up EHR documentation, thereby allowing clinical providers to work at the top of their licenses!
MGH compared performance at “Pilot” sites where coordinators worked lists and engaged with clinicians to “Non-Pilot” sites that did not have coordinators.
Coordination between central and distributed model is critical

Cardiovascular Disease Outcome:
Pilot vs. Non-Pilot Practices (run chart)

PHC Team Fully Staffed

PHC Huddle Initiative
Intervention 3

We implemented TopCare, which enabled us to identify all the gaps in care, track our outcomes, coordinate care appropriately, and intervene to close those gaps.
The Objective

To improve outcomes, you need tools that enable continuous improvement.

The Challenge

The tools that need to work together are found in different vendor solutions.

English please!

Case Management

Data es el rey!

BI tools
Typical PHM IT strategy scenario:

The 4 Essential PHM Pillars are:
1. Data Aggregation
2. HC Analytics
3. Care Coordination
4. Patient Outreach

Ok, let’s purchase a software package for each pillar!
Data es el rey!

Dude! English please!

Je sais ce qu'il faut faire

Huh?

Data Aggregation

Analytics

Care Coordination

Patient Outreach

我跟患者只
What we did on day 1 (June 30\textsuperscript{th} 2014):

We managed \textbf{ALL} patients belonging to the Massachusetts General Hospital Primary Care Network.

\begin{itemize}
\item From managing \textbf{~70k} contract patients to:
\end{itemize}

\begin{table}[h]
\begin{tabular}{|l|c|}
\hline
\textbf{Populations} & \textbf{\#} \\
\hline
Diabetics & \textbf{~24k} \\
CVE (CAD, PVD, CVD) & \textbf{~18k} \\
Colorectal CS & \textbf{~108k} \\
Cervical CS & \textbf{~124k} \\
Breast CS & \textbf{~71k} \\
Hypertension & \textbf{~72k} \\
Other & n/a \\
\hline
\textbf{Total Patients Actively Tracked} & \textbf{~300k} \\
\hline
\end{tabular}
\end{table}
## Clinical Assets

<table>
<thead>
<tr>
<th>Clinical Setting</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Health Centers</td>
<td>2</td>
</tr>
<tr>
<td>Primary Care Practices</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clinical Providers</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physicians</td>
<td>1045</td>
</tr>
<tr>
<td>Delegates</td>
<td>261</td>
</tr>
<tr>
<td>Practice managers</td>
<td>58</td>
</tr>
<tr>
<td>DM Champions</td>
<td>64</td>
</tr>
<tr>
<td>DSME</td>
<td>29</td>
</tr>
<tr>
<td>Navigators</td>
<td>9</td>
</tr>
<tr>
<td>PHMs</td>
<td>33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1499</strong></td>
</tr>
</tbody>
</table>
Our Results
All of our quality measures went up!

Actively managing >300,000 patients over 6 months

<table>
<thead>
<tr>
<th>Measures</th>
<th>% Change over 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast Cancer Screening Process Measure</td>
<td>+ 3.1%</td>
</tr>
<tr>
<td>Cervical Cancer Screening Process Measure</td>
<td>+ 7.7%</td>
</tr>
<tr>
<td>Colorectal Cancer Screening Process Measure</td>
<td>+ 2.6%</td>
</tr>
<tr>
<td>CVE LDL Process and Outcome Measure</td>
<td>+ 8.5%</td>
</tr>
<tr>
<td>Diabetes Eye Exam Process Measure</td>
<td>+ 7.3%</td>
</tr>
<tr>
<td>Diabetes HbA1c Process and Outcome Measure</td>
<td>+ 5.0%</td>
</tr>
<tr>
<td>Diabetes HbA1c Process Measure</td>
<td>+ 4.6%</td>
</tr>
<tr>
<td>Diabetes HTN Process and Outcome Measure</td>
<td>+ 6.9%</td>
</tr>
<tr>
<td>Diabetes LDL Process and Outcome Measure</td>
<td>+ 6.5%</td>
</tr>
<tr>
<td>Diabetes Nephropathy Process Measure</td>
<td>+ 3.4%</td>
</tr>
<tr>
<td>HTN BP Process and Outcome Measure</td>
<td>+ 4.4%</td>
</tr>
</tbody>
</table>
Breakdown of Cervical Cancer Gains

8/31/14

Passing 5.0%

Pop. Shift 0.1%

Clin. Exp. 0.2%

Removed 0.2%

81.8%

12/31/14

87.0%

n = 124,457
Sources of Divergence

Cervical Cancer Screening Sources of Divergence:
Sample Payor vs. Partners Performance

Source of Divergence

- Sample Payor: 84.6%
- Attribution: DLC Algorithm: 1.76%
- Attribution: Exception: 0.01%
- Denominator: Partners Population Definition: 2.03%
- Denominator: Misdiagnosis Exception: 0.00%
- Numerator: Partners Passing Definition: 6.07%
- Numerator: Pass Exception: 0.00%
- Partners Performance (on BCBS Population): 94.5%
<table>
<thead>
<tr>
<th>Measure</th>
<th>NNT or NNS (number needed to treat to prevent 1 death/stroke/MI)</th>
<th>Net Patients Newly in Control from 8/31-12/31 (Clinical Only, most conservative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension BP Control</td>
<td>1:125 (death) 1:67 (stroke) 1:100 (MI)</td>
<td>667</td>
</tr>
<tr>
<td>Colorectal CA Screening</td>
<td>1:107 (death from colon cancer)</td>
<td>911</td>
</tr>
<tr>
<td>Cervical Cancer Screening</td>
<td>1:1000 (death from cervical cancer)</td>
<td>6,133</td>
</tr>
<tr>
<td>CVE Lipid Control</td>
<td>1:27 (composite death, MI, stroke) 1:83 (death) 1:39 (MI) 1:125 (stroke)</td>
<td>376</td>
</tr>
<tr>
<td>Diabetes Lipid Control</td>
<td>1:28 (composite death, MI, stroke) 1:104 (MI) 1:154 (stroke)</td>
<td>384</td>
</tr>
<tr>
<td>Diabetes Blood Pressure Control</td>
<td>1:125 (death) 1:67 (stroke) 1:100 (MI)</td>
<td>289</td>
</tr>
<tr>
<td>Breast Cancer Screening</td>
<td>1:368 (death from breast cancer)</td>
<td>1,140</td>
</tr>
</tbody>
</table>

Estimated 76 Lives saved with 4 Months Effort
Can we relax? Nope...
A few additional lessons
Targeting high-risk patients is important...

Step 1: Measure
Step 2: Intervene
Step 3: Measure

Average HbA1c = 7.5

Intensive Insulin Therapy Intervention

Tip #1

Average HbA1c = 7.5
But get the big picture first!

- Predictive Analytics
- Low-Risk
- Intervention
- High-Risk
- Descriptive Analytics
- Inertia
- Pre-Diabetic Patient
- Prescriptive Analytics
Think multi-interventions

**Tip #2**

- **Intervention 1**: High-risk for No-Show Prediction Model
- **Intervention 2**: Call outreach
- **Intervention 3**: Double booking
- **Intervention 3**: Identify loss to follow-up

<table>
<thead>
<tr>
<th>Intervention</th>
<th>No-show Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>65%</td>
</tr>
<tr>
<td></td>
<td>66%</td>
</tr>
<tr>
<td></td>
<td>70%</td>
</tr>
</tbody>
</table>
We identify High-Risk patients

- Why are they high-risk?
  - Poly-pharmacy
  - Multiple Comorbidities
  - Low-health literacy
  - Poor cognition

- High-risk for what?
  - Readmission
  - High-cost
  - Non-Adherence, etc...

- Is the risk modifiable?
- Do we have an intervention available?
- Is the intervention effective?

How to improve their outcomes?
How about identifying optimal patients to match interventions?

- Low health literacy → Education support
- Financial challenges → Social work consult

Supportive Clinical Care Consultation

Meets palliative care criteria
Which intervention is better?

Tip #4

Invest in a good balance!
Components needed for an effective population health IT system

Enterprise Data Warehouse

Multi data source reconciliation engine

EMPI

Population Rosters

Security Model

Business Logic

Intervention Campaign Engine

Databases

EHRs

Claims

Other

Population Health Managers work list

Physician work list

Community worker work list

Social worker work list

Navigator work list

Other role work list

Automated outreach: Secured messaging, robocalls, letters, etc...

3rd party data visualization tools

3rd party analytics tools

3rd party patient engagement tools

Iterate PDSA Cycle to optimize effectiveness of intervention campaign

Optimize campaigns using prescriptive analytics to further improve outcomes

Measure outcomes

- Defines numerators/denominators for populations
- Uses combination of descriptive and predictive analytics
- Algorithm for precise patient-to-physician attribution
- Security model enables network/hospital/practice/provider level access

- Enables work lists to be actionable
- Enables exception rules for precise registries
- Automates sequence of intervention components
- Presents the right patient needing an action to the right provider
- Shreds roster into role-based work lists

Components needed for an effective population health IT system
10 Lessons Learned

1. Optimizing processes is important
2. Focus on precise population identification
3. It’s ok to (sometimes) take the physician out of the equation
4. Question your measures
5. Driving outcomes doesn’t have to be expensive
6. Interoperability between all IT components is critical
7. Don’t target high-risk patients only, look at how quickly low-risk patients are becoming high-risk
8. Use multi-interventions to optimize outcomes
9. Match the right high-risk patients to the appropriate interventions
10. Have an effective PHM IT system to compare effectiveness of your interventions
Thank you.

www.linkedin.com/in/adrianzai

azai@mgh.harvard.edu