Big Data in Healthcare

Prashant Dhamdhere, Jeremiah Harmsen, Raaghav Hebbar, Srinath Mandalapu, Ashish Mehra & Suju Rajan
An Industry Rife with Inefficiencies…

Source: OECD Health Statistics 2013
...And Drowning in Healthcare Data...

80% of the data is “unstructured” and stored in very different formats & in different silos.
...With Many Ecosystem Stakeholders

- Vital signs
- Activity levels
- Nutritional data
- Behavioral data
- Social interactions

- EMRs
- Clinical notes
- Medical images
- Clinical trials
- Genomics
- Resource allocation

Patients

Providers

Pharma / Drug Companies
- Population Health
- Patient Similarity
- Drug Discovery

Payers
- Claims and Billing
- Approvals and Denials
- Population Health and Risk

...That Need Big Data Analytics
To Reduce Costs and Improve Outcomes

1. Holistic benefits
   - Patients
   - Providers
   - Payers
   - Pharma

2. Personalized care
   - Right intervention
   - Right patient
   - Right time

3. Top Use Cases for Big Data Analytics
   - Improve Clinical Trials
   - Predict Diseases
   - Find Cures (e.g., for Cancer)
   - Study Population Health
   - Prevent Diseases (proactively)

Fragmented, Siloed Data → Shared Data → Evidence and Insights → Reduce Costs → Improve Outcomes
Smart Money Is Fueling Digital Health

DIGITAL HEALTH FUNDING
2011-2015

2015 $4.5B
2014 $4.3B
2013 $2.0B
2012 $1.5B
2011 $1.1B
Case Study: Improve Care Efficiency and Cost

Goals
- Optimal utilization of resources
- Reduce prescription of antibiotics for children
- Charges based on claim pattern
- Reduce care cost by Genomic analytics
- Reduce claim denials

Example: LeanTaaS
- Imbalance between Infusion, appointment, supply and demand
- Frequent mid-day peaks
- Unpredictable long wait
- Sub-optimal utilization of resources
- Manual approach causes over-staffing

Takeaways
- Machine learning delivers key results
  Stanford Infusion:
  - 25% higher patients, at 15% lower costs
  - 30% wait time reduction at mid-day.
  Colorado Cancer Center:
  - 16% higher patients
  - 28% lower overtime
  - Significant staff satisfaction

LeanTaaS used advanced data science

Stanford Infusion treatment handling 65,000 cases annually

5 types of infusion appointments...

<table>
<thead>
<tr>
<th>Type</th>
<th>1 hour</th>
<th>2 hour</th>
<th>3-5 hour</th>
<th>6-8 hour</th>
<th>9+ hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>20</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

...each with a different daily volume of patients...

...resulting in a total of 25% possible appointment slots...

Max of 4 patients can start at a given time

Colorado Cancer Center facing mid-day peak & long wait

Credits: LeanTass.com
Case Study: Disease Prediction

About Metabolic Syndrome
- People with three or more of these risk factors have metabolic syndrome: insulin resistance, high BP, high triglycerides, low HDL
- More than one in three U.S. adults have metabolic syndrome
- Metabolic syndrome increases risks of heart disease, stroke and diabetes. It is costly to treat.

Goal
Accurately predict subsequent risk of metabolic syndrome and its various factors on both population and individual level

Results
- Reverse engineering and Forward simulation (REFS) can learn models directly from data which capture the underlying mechanisms and processes consistent with the data
- Generated individual insights with accuracy
- Developed targeted cost-effective care management programs for individuals with or at risk for metabolic syndrome

Data Sources and Big Data Analytics Platform
- Aetna’s database of 37K individuals
- Demographic (age, body mass index etc.)
- Medical claim, pharmacy claim
- Laboratory test and Biometrics engineering results
- GNS Healthcare Analytics platform for accurate prediction of intervention outcomes
Case Study: Disease Prevention

Objectives
- Prevent diseases and deliver more effective healthcare through proactive intervention and lifestyle changes
- Infer insights from patient data and correlate with population health
- Patient data: profile, vital signs, activity, diet, sleep, physiological and behavioral indicators

Players
- **Welltok (startup with >$145M raised):** Caféwell Concierge and Insights apps for personalized health solutions for everyday consumers
- **IBM Watson Health:** “cognitive computing” backend in the cloud

Engagement and Analytics Platform
- Cafewell Health Optimization Platform
- For population health managers and consumers
- Personalized plan that engages consumers in healthy behaviors via rewards, streamlined communication, actionable insights
- Intelligent Health Itinerary – action plan with recommendations that get better with use and over time
- Watson Health platform provides natural language processing to assess user’s activity goals and provide prompts

Results
- State of Colorado engagement
- Co-sponsored by United Healthcare and Kaiser
- 50% participation in program
- 650% increase in health assessment completion
- $100K awarded for healthy behaviors
- Other successful rollouts with Centura Health, Community Health Plan (Washington), Coventry HealthAmerica
Emerging Landscape...Digital Health Gold Rush

Data Analytics / Machine Learning / AI Platforms and Services
- Watson Health
- Amara Omada
- Hindsait/Google Cloud
- PhysIQ LeanTas
- Inovalon Holdings
- Optum GNS

Data Aggregation Platforms

Data Sharing Initiatives

Research Studies and Clinical Trials

Patient Engagement Platforms and Services
- EMR
- Clinical Notes
- Resource Usage

Providers

Payers

Patients

Wearables & Sensors

3

1

2

Data

Insights
In 2014, medical records accounted for 43% of all data stolen and the healthcare sector has seen the biggest increase in data theft since 2010 (far more so than business or government sectors).
Are We There Yet?…Long Road, Bumpy Ride!

The best way to predict the future is to create it.

- Abraham Lincoln and Peter Drucker

 Likely Winners and Losers

Patients will win but might pay more
Better, more efficient, and timely care with more choices
Might pay higher premiums based on fitness and lifestyle data (for poor choices)

Providers – hospitals will win but doctors could see tradeoffs
Higher efficiencies and lower costs
Some specialties will benefit, but not all
Private practices may struggle / lose
“Intelligent machines” may complement doctors, but also squeeze them more

Payers – insurance companies could win but it depends
Depends on mix of healthy vs unhealthy population
Back To The (Healthy) Future

"Henry, it's for you - apparently your heart is about to fail..."
Q & A