Population Health Management: Using Geospatial Analytics to Enable Data-Driven Decisions

Brian Jacobs, MD
VP, CMIO & CIO
Children’s National Health System
Washington, DC
Volume vs Value Based Care Delivery

• Affordable Care Act of 2010
• IHI Triple Aim of 2012
Hospital Admissions & ED Visits
5,686 hospitals in US

Hospital admissions/1000 population

One or More ED Visits

ACA
IHI Triple Aim

Promote Health
Primary Care Medical Home
Keep patients out of the hospital
Avoid ED Visits
Healthcare Cycle

- Healthcare encounters impact a small fraction of health factors, others include:
  - Diet
  - Exercise
  - Med compliance
  - Pollution
  - Climate
  - Genetics
  - Socioeconomics
  - Race
  - Gender
  - Stress
  - Relationships
  - Substance Abuse
  - Etc…
Why Geospatial Analytics?

• Healthcare conditions have geographic & environmental variation

• Many co-variables effect the expression of health and disease

• Understanding geographic & co-variable distribution can impact targeting of epidemiology, prevention, treatment & research efforts
Geospatial Analytics & EHR
(Crime Reports)
Geospatial Analytics & EHR
(Military Applications since 2009)
Since 1979, more than 20% of the Polar Ice Cap has melted away.
EHR represents rich source of essential health data to power similar work
EHR-Rich Granular Data

- Blood Pressure
- Weight
- Hemoglobin
- Chest x-ray
- Age
- Gender
- Cost
- Triage to Doc Time
- Blood Culture
- BMI
- Heart Rate
- Medications
- Allergies
- Immunizations
- Procedures
- Address
- Insurance
- Race
Health Data Processing

Data Source

Data Validation Process

Data Validation Tool

Web Server with Secure Storage:
Firewall, Antivirus, Encryption, Backups

Data De-identification Process

Data De-identification Tool

Geocoding API
(address removal)

Address Validation API

Web Server
ArcGIS Desktop
ArcGIS Online
ArcGIS Explorer
Environmental Data Gathering

Students

Google Search

DC Map Layers

Findings are saved to excel spreadsheets

Restaurants
- Dining
- Take out
- Fast Food

Groceries
- Delis
- Convenience Stores
- Supermarkets

Education
- Elementary Schools
- Middle Schools
- High Schools

Health Services
- Clinics
- Hospitals

Demographics
- Population Data
- Economic Data
Other Available Data

The premier source of business and residential information for reference and research.

Want to see how it works?

Available Databases
Select A Database To Get Started.

<table>
<thead>
<tr>
<th>Business Databases</th>
<th>Residential Databases</th>
<th>Specialty Databases</th>
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</thead>
<tbody>
<tr>
<td>U.S. Businesses</td>
<td>Canadian Businesses</td>
<td></td>
</tr>
<tr>
<td>14 Million Businesses</td>
<td>1.5 Million Businesses</td>
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<tr>
<td>One Source</td>
<td>U.S. New Businesses</td>
<td></td>
</tr>
<tr>
<td>International Companies and Executives by Title</td>
<td>4 Million New Businesses</td>
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Latest News

Did you know...
ReferenceUSA provides quality information to help you:

- Search for jobs, location, and industry
- Find new business opportunities
- Research executives & companies worldwide
- Track down addresses and phone numbers
- Find news articles for research
- Locate out-of-town companies
GIS Methodology Applied to EHR

1. Identify EHR Data Fields
2. Write Data Query
3. Run Data Query
4. Filter/Clean Data
5. De-identify & Geocode Data

Upload Data to GIS

Map Data Against Covariables in GIS
Representative Conditions

Burns in Infants
Childhood Obesity
Sickle Cell Disease
Epidemiology: Burn Injuries in Infants


- Studied factors determining ED disposition of infants sustaining burn injuries
- 344 patients treated in the ED – Analyzed EHR data, environmental & socioeconomic variables
- Scalds (53.2%) & contact burns (39.8%) were most common
- Race played significant role in mechanism & severity of burn
- Focal geographic distribution
Childhood Obesity

- Patients presenting to Children’s National Inpatient, Inner City Clinics & Suburban Clinics
- Weight, Height, Gender, Race, Age & Address extracted from 3-regional EHRs
- Primary extract cleaned, de-identified & analyzed
- CDC BMI percentile equations applied
Percent of Regional Population

3.2 million Children in VA, MD, DC

400,000 Immediate Population (12.5%)

49,713 unique patients (12.4%)

EHR Data Extraction
Results - Total Population

Children Ages 2-20
CP&A, Goldberg, and Inpatients
October 1, 2009 - October 1, 2010

- Healthy: 30773 (61%)
- Morbidly Obese: 7769 (16%)
- Obese: 2238 (5%)
- Overweight: 6145 (12%)
- Underweight: 2788 (6%)

49,713 Unique Patients
Obesity Rates

Obesity Cases

Map: Center for Urban & Environmental Research, GWU

Percent Obesity
Within the Study Population

- 0%
- 0.1% - 5%
- 5.1% - 10%
- 10.1% - 15%
- 15.1% - 20%
- 20.1% - 25%
- 25.1% - 30%
- 30.1% - 35%
- 35.1% - 40%
- 40.1% Plus

No. of Obese Participants
(Per Square Mile)

- 0 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- Zip Codes

Map: Center for Urban & Environmental Research, GWU
Sickle Cell Disease Readmission

• Retrospective analysis using EHR-derived data on children with SCD-related pain crises
• Readmissions described, geospatial analysis conducted
• Models constructed to obtain readmission risk factors
• 373 subjects, 125 with at least one 30-day readmission compared to no readmission group.
• Readmission risk factors: Older, decreased LOS, increased pain scores, >3 hospitalizations in 1-year

Readmitted Patients with Sickle Cell Disease
Conclusions

• Improved health & achieving the Triple Aim cannot rely solely on encounters with healthcare organizations.

• Care model redesign must harness other factors beyond the healthcare system in addition to EHR data.

• Geospatial analytics is an important tool to bring qualitative & quantitative information forward to augment traditional approaches to healthcare analytics.
? Questions ?

bjacobs@childrensnational.org