Using Geospatial Statistics to Analyze Medicaid Data

Medicaid Innovation Accelerator Program - Data Analytics National Webinar

August 31, 2017
3:00 PM – 4:00 PM EDT
Logistics for the Webinar

• All lines will be muted
• To participate in a polling question, exit “full screen” mode
• Use the chat box on your screen to ask a question or leave a comment
  – Note: chat box will not be seen in “full screen” mode
Welcome!

- Jessie Parker, GTL and Analyst on Medicaid IAP Data Analytics Team, Data and Systems Group, CMCS
Today’s Speakers

• Marty Jolly, Team Lead Programmer Analyst, Government Health and Human Services, Truven Health Analytics

• Aaron Truchil, Director of Analytics & Informatics, Camden Coalition
Agenda for Today’s Webinar

• Overview of Medicaid Innovation Accelerator Program
• Introduction to Approaches for Geospatial Analysis
• Example Geospatial Project
• Overview of Hotspotting Techniques
• Questions and Answers
Medicaid Innovation Accelerator Program (IAP)
Goals for Today’s Webinar

In this interactive webinar, states will learn about:

• Map types and usage
• Key questions to ask when evaluating a map
• Geostatistics
• Hotspot maps
• Key components of effective geospatial projects
Geographic Information Systems (GIS) Foundation

Marty Jolly, Team Lead Programmer Analyst, Government Health and Human Services, Truven Health Analytics
Geospatial Analysis - Introduction
Medicaid Questions

Things on map
- Regions
- Providers
- Population
- Beneficiaries
- Expenditures
- Services

Questions
- Capacity and Access
  - Network adequacy
  - Accessibility of providers
- Utilization and Expenditure
  - Number of beds
  - Number of provider visits
- Enrollment
- Provider Profiling
- Fraud and Abuse
Geospatial Team

Roles
• Direction
• Project Management
• Subject Knowledge
• Data Governance
• Computer (GIS) Skills
• Statistical Knowledge

People
• Stakeholder
• Manager
• PhD statistician
• GIS analyst programmer

Emphasis on Data Governance
Return on Investment

Key questions to answer

• Why invest in GIS
• What is level of investment
• When will benefits be delivered
• Who will deliver benefits
• What resources are required
• What is proven financial case

The Business Benefits of GIS: An ROI Approach
by David Maguire, Victoria Kouyoumijan, Ross Smith
ESRI Press - 2008
Example Geospatial Project

The Analysis of Spatial Association by Use of Distance Statistics

by Arthur Getis and J. K. Ord
Geographical Analysis, Vol. 24, Issue 3, pages 199-201

Professor Getis
San Diego State University

Professor Ord
Georgetown University

Professor Anselin
Arizona State University
North Carolina SIDS

• Sudden Infant Death Syndrome, SIDS
• Where: North Carolina
• When: 1979-1984
• Geographic Level: County
• Question: Spatial association of county, SIDS
**NC SIDS - Data**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
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<td>1</td>
<td>NAME</td>
<td>BIR79</td>
<td>SID79</td>
<td>SIDR79</td>
<td></td>
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<td></td>
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<tr>
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<td>SIDS deaths 1979</td>
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<tr>
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<td>1,568</td>
<td>1</td>
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<td>(SID79/BIR79) * 1000</td>
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<tr>
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<td>869</td>
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</tbody>
</table>

Statistical Data Requirements
- Minimum 30 counties
- Variance among county SIDS counts
- No known spatial association in data
  - e.g. no regional viral outbreaks

NC SIDS 1979
The University of Chicago Center for Spatial Data Science – Sample Data
https://s3.amazonaws.com/geoda/data/sids2.zip
Data Sources

• Census Bureau data and TIGER products
• State data and GIS portals
• County data and GIS portals
Map Projections

Form post card to ball - distortion significant for card not for stamp

- Shape
- Area
- Direction
- Distance

http://www.coxclasses.com/earthscience/ch2/figure5.jpg
Projection Comparison
National and State Levels

Three Map Projections Centered at 39 N and 96 W

Mercator
Lambert Conformal Conic

Un-Projected Latitude and Longitude

Peter H. Dana 6/23/97

How to choose a projection, by Jochen Albrecht, Hunter College
http://www.geo.hunter.cuny.edu/~jochen/gtech201/lectures/lec6concepts/map%20coordinate%20systems/how%20to%20choose%20a%20projection.htm
NC SIDS – Joining Data to Map

NC 1979 SIDS Ratio by County
SIDS/Births*1000

Legend

NC County with SID Ratio
NC SIDS - Thematic Map
Equal Count
NC SIDS - Thematic Map
Equal Interval

NC 1979 SIDS Ratio by County
SIDS/Births*1000

Legend

<table>
<thead>
<tr>
<th>SIDS Ratio Thematic Equal Interval [100]</th>
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<tbody>
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<tr>
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<td>3.6683 - 4.8911</td>
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</table>
NC SIDS - Hotspot Map

NC 1979 SIDS Ratio by County
SIDS/Births*1000

Legend

<table>
<thead>
<tr>
<th>SIDS Ratio Hotspot</th>
<th>Notation</th>
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<td>[100]</td>
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<td>[2]</td>
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<tr>
<td>confidence [2]</td>
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<tr>
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<tr>
<td>hotspot 90%</td>
<td>[1]</td>
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<td></td>
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<tr>
<td>hotspot 95%</td>
<td>[4]</td>
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<td>confidence [4]</td>
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<tr>
<td>hotspot 99%</td>
<td>[2]</td>
</tr>
<tr>
<td>confidence [2]</td>
<td></td>
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</tbody>
</table>

Getis – Ord Thematic
Hotspot Analysis: Under the Hood

To be a statistically significant hot/cold spot
• neighborhood has high/low mean value compared to study area
• high confidence it is not random

Geospatial Axiom

“Everything is related to everything else, but near things are more related than distant things.”
Toolkit

- QGIS
- Excel
- Internet Resources
Geospatial Takeaways

- Geospatial analysis is iterative
- Options used to create a thematic map can affect conclusions drawn
- Thematic maps are useful but subjective
- Hotspot maps provide statistical rigor, objective analysis
- Data governance is especially important in geospatial projects
Questions?
Improving Health Care & Reducing Costs with Innovative, Local Data Systems & Geospatial Analysis

Aaron Truchil
Director of Analytics & Informatics | August 2017
§1 About the Camden Coalition
Overview of the Camden Coalition

We are a citywide coalition of hospitals, primary care providers, social service providers, and community representatives that collaborate to deliver better healthcare to our most fragile citizens. We innovate and test health care delivery models to improve patient outcomes and reduce the cost of their care using data driven, human-centered approaches.
Building a Citywide, All-Payer, Hospital Claims Database to Improve Health Care Delivery in a Low-Income, Urban Community

Kennen Gross, PhD, MPH; Jeffrey C. Brenner, MD; Aaron Truchill, MS; Ernest M. Post, MD; and Amy Henderson Riley, MA, CHES
Camden Hospital Utilization
2014 Snapshot

Total Hospital Revenue: $132,000,000

Total Patients with a Hospital Visit: 42,708

Patients Visiting 2+ Hospitals (Same Year): 23%
Patients Visiting 2+ Hospitals (Over 5 years): 41%
The Camden “Cost” Curve

10% of patients = 74% of charges

1% of patients = 30% of charges
Anonymized 1% Case Study
What do Camden’s Most Expensive Residents Look Like?

≈1% of population
>5 chronic conditions

Averages:
57 years old
4.5 ED visits
5.3 inpatient
Hospitalized 54 days
$673,000 charges
$73,143 receipts
Healthcare hotspotting is the strategic use of data to target evidence-based services to complex patients with high utilization.

These patients are experiencing a mismatch between their needs and the services available.
Incorporating Geospatial Analysis into Hotspotting
<table>
<thead>
<tr>
<th>ID</th>
<th>Evl</th>
<th>Name</th>
<th>DOB</th>
<th>AdmitDate</th>
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<td>E</td>
<td>NEWMAN BERNICE</td>
<td>06-Sep-07</td>
<td>09-Feb-13</td>
<td>643.03</td>
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<tr>
<td>3555</td>
<td>I</td>
<td>VEGA JULIO</td>
<td>08-Jul-51</td>
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<td>CHAMP MAN LINDSEY</td>
<td>29-Aug-66</td>
<td>06-Jan-13</td>
<td>845.09</td>
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<td>4808</td>
<td>E</td>
<td>WALTON MELANIE</td>
<td>18-Jul-02</td>
<td>21-Jan-13</td>
<td>400.0</td>
</tr>
</tbody>
</table>
Where do Camden’s Most Expensive Residents Reside?

Several buildings (e.g.) annually generate $1-$3 million in hospital costs.

6% of city blocks account for 18% of patients and 37% of receipts.
Example High Cost Building

**Northgate II**
Over 5 years...
615 patients accounted for 3,901 hospital visits
$12 million in hospital receipts

<table>
<thead>
<tr>
<th>Top Diagnoses when Visiting the Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emergency Room</strong></td>
</tr>
<tr>
<td>1. Diabetes</td>
</tr>
<tr>
<td>2. Lung and chest symptoms (colds, flu)</td>
</tr>
<tr>
<td>3. General symptoms</td>
</tr>
<tr>
<td>4. Hypertension</td>
</tr>
<tr>
<td>5. Stomach and pelvis symptoms</td>
</tr>
</tbody>
</table>
Northgate II Utilization Profile

- **Low / No Utilization**
  - Rarely visit hospital

- **Medium ED Utilizer**
  - Average 2-3 ED visits per year

- **High ED Utilizer**
  - Average 1 Inpatient & 8 ED Visits per year

- **High Inpatient Utilizer**
  - Average 3 Inpatient & 1 ED Visit per year

Northgate II Utilization Profile
Other Uses of Geospatial Analyses
Other Uses of Geospatial Analyses (cont.)

The Cost of Preterm Pregnancies

Table 4: Total Cost of Pregnancy for Normal Delivery and Preterm Delivery*

<table>
<thead>
<tr>
<th>Normal Delivery</th>
<th>Preterm Delivery</th>
<th>Difference (Preterm - Normal)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>LOS</td>
<td>Charges**</td>
</tr>
<tr>
<td>avg</td>
<td>2.3</td>
<td>$24,521</td>
</tr>
<tr>
<td>median</td>
<td>2</td>
<td>$20,359</td>
</tr>
</tbody>
</table>

*Normal delivery and preterm delivery were determined by baby's initial length of stay. Babies with an initial length of stay greater than 4 days were categorized as preterm deliveries. Using this formula, we came to 12.7% of all deliveries, very close to the 12.1% estimated by NJ Vital Statistics.
**Charges reflect the amount charged by the Hospital to the Payer for a particular visit. Receipts reflect the amount that was actually collected.
§3 Hotspotting Outside of Camden
MaineCare Hotspotting Analysis

An analysis of 2 years of Medicaid claims data for 3 Maine counties (Cumberland, Kennebec, and Penobscot)

MaineCare Hot Spot Analysis: Cumberland County
7/1/2008 - 6/30/2010

What is a hot spot?
A hot spot is any geography where a large number of high utilizers reside. High Utilizers are defined as any individual with 3 or more hospital admissions or 6 or more ER visits within 2 years. Hot spots range from blue (no hot spot) to red (intense hot spot).

Geocoding notes
Individuals last addresses in the MaineCare database were used for all geospatial analyses. CCHP found 47,594 unique addresses in the three counties studied. Of these, 3,007 were PO Boxes, leaving 44,587 potential addresses. Through ArcGIS and other geospatial tools, CCHP was able to match 39,691 (89% success rate) of these addresses. Additional analysis was conducted to ensure that there were no geographic biases in unmatched addresses.
In Portland’s downtown area, on the peninsula south and west of Interstate 295, 6 buildings account for 515 members (6% of total Portland members), 79 high utilizers (8% of Portland’s High Utilizers) representing $1,769,053 in total hospital spending. In one single building, 43 patients accounted for over $500k in ED and Inpatient costs over the two year period.
<table>
<thead>
<tr>
<th>Town</th>
<th>Total members that reside in town</th>
<th># of inp visits from residents of town</th>
<th># of ED visits from residents of town</th>
<th>Percent of town's members that are High Utilizers</th>
<th>This town has what percentage of all members</th>
<th>This town has what percentage of all High Utilizers</th>
<th>This town has what percentage of all inpatient visits</th>
<th>This town has what percentage of all ER visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enfield</td>
<td>129</td>
<td>28</td>
<td>371</td>
<td>15.50%</td>
<td>0.26%</td>
<td>0.41%</td>
<td>0.17%</td>
<td>0.31%</td>
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<tr>
<td>Waterville</td>
<td>2,849</td>
<td>834</td>
<td>8,957</td>
<td>14.95%</td>
<td>5.71%</td>
<td>8.73%</td>
<td>4.94%</td>
<td>7.43%</td>
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<tr>
<td>Veazie</td>
<td>97</td>
<td>37</td>
<td>241</td>
<td>14.43%</td>
<td>0.19%</td>
<td>0.29%</td>
<td>0.22%</td>
<td>0.20%</td>
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<tr>
<td>Lagrange</td>
<td>97</td>
<td>20</td>
<td>243</td>
<td>13.40%</td>
<td>0.19%</td>
<td>0.27%</td>
<td>0.12%</td>
<td>0.20%</td>
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<td>Lincoln</td>
<td>947</td>
<td>256</td>
<td>2,648</td>
<td>12.78%</td>
<td>1.90%</td>
<td>2.48%</td>
<td>1.52%</td>
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<td>Winslow</td>
<td>939</td>
<td>286</td>
<td>2,473</td>
<td>12.25%</td>
<td>1.88%</td>
<td>2.36%</td>
<td>1.70%</td>
<td>2.05%</td>
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<tr>
<td>Newport</td>
<td>471</td>
<td>133</td>
<td>1,310</td>
<td>12.10%</td>
<td>0.94%</td>
<td>1.17%</td>
<td>0.79%</td>
<td>1.09%</td>
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<tr>
<td>Clifton</td>
<td>109</td>
<td>34</td>
<td>235</td>
<td>11.93%</td>
<td>0.22%</td>
<td>0.27%</td>
<td>0.20%</td>
<td>1.09%</td>
</tr>
<tr>
<td>Portland</td>
<td>8,360</td>
<td>3,007</td>
<td>23,728</td>
<td>11.88%</td>
<td>16.76%</td>
<td>20.35%</td>
<td>17.82%</td>
<td>19.69%</td>
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<tr>
<td>Pownal</td>
<td>59</td>
<td>18</td>
<td>124</td>
<td>11.86%</td>
<td>0.12%</td>
<td>0.14%</td>
<td>0.11%</td>
<td>0.10%</td>
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<tr>
<td>Brunswick</td>
<td>1,481</td>
<td>674</td>
<td>3,654</td>
<td>11.82%</td>
<td>2.97%</td>
<td>3.59%</td>
<td>3.99%</td>
<td>3.03%</td>
</tr>
<tr>
<td>Plymouth</td>
<td>195</td>
<td>39</td>
<td>540</td>
<td>11.79%</td>
<td>0.39%</td>
<td>0.47%</td>
<td>0.23%</td>
<td>0.45%</td>
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<tr>
<td>Alton</td>
<td>85</td>
<td>39</td>
<td>232</td>
<td>11.76%</td>
<td>0.17%</td>
<td>0.20%</td>
<td>0.23%</td>
<td>0.19%</td>
</tr>
<tr>
<td>Benton</td>
<td>391</td>
<td>114</td>
<td>973</td>
<td>11.76%</td>
<td>0.78%</td>
<td>0.94%</td>
<td>0.68%</td>
<td>0.81%</td>
</tr>
<tr>
<td>Oakland</td>
<td>786</td>
<td>195</td>
<td>2,089</td>
<td>11.70%</td>
<td>1.58%</td>
<td>1.89%</td>
<td>1.16%</td>
<td>1.73%</td>
</tr>
<tr>
<td>Millinocket</td>
<td>712</td>
<td>178</td>
<td>1,898</td>
<td>11.66%</td>
<td>1.43%</td>
<td>1.70%</td>
<td>1.05%</td>
<td>1.57%</td>
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<tr>
<td>Bradley</td>
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<tr>
<td>Chester</td>
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</tbody>
</table>
Final Takeaways

• GIS: one of many tools in your analytic toolbox
• Geospatial analysis is not limited to high utilizers
• Start with what’s relevant to your existing work
• Building out GIS capacity doesn’t have to be complicated and/or expensive
  • Low cost & open source software
  • Ability to train existing analytics staff
Thank You!

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Final Questions?
Key Takeaways

• Benefits of geospatial analysis include:
  – Relevancy to Medicaid questions on capacity, access, utilization, and expenditures
  – Useful for identifying areas of interest for further analysis
  – Relatively low cost when executed by data analysts with open source software
Thank you for joining today’s webinar!

Please take a moment to complete the post-webinar survey - We appreciate your feedback!