Using Spatial Analysis to Improve Health Care Services and Delivery at Baystate Health

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Who are we?

- Integrated health care delivery system
- Serves 1 million people
- Four counties in Western MA
- 10,000 employees
- Annual budget of 1.4 billion dollars
Who are we?

• 3 hospitals
• Outpatient clinics
• Comprehensive cancer care center
• Neuro-diagnostics/sleep center
• VNA and hospice
• Diagnostic labs and radiology facilities
• Respiratory/infusion facilities/services
• Major private practice organization
• For-profit HMO
Data Sources

Geography

Hospital

Census
GIS mapping allows us to visualize how we are providing healthcare services and identify areas of need for services.
Spatial Statistics: The guts behind the maps

• Can I believe what I’m seeing?
• Test hypotheses
• Make decisions
Spatial Statistics can be used for

- Identifying Clusters in time or space
- Modeling
  - risk factors in disease
  - location of events
  - flow of people/events
- Decision Analysis
Identifying Clusters

• Also known as spatial autocorrelation

• Things near each other in space are more alike than things far apart...

Waldo Tobler
Cluster Analysis

Is geography a factor in MRSA infection?
Cluster Analysis

Is there coordinated gene expression?

Genes act in a coordinated fashion based on their spatial organization.
Modeling

• Identify factors in disease development or treatment outcome
• Predict location of events
• Analyze movement of people and events
Risk modeling: Spatial Regression

What are risk factors for late stage breast cancer?

Advanced Stage-to-Case Ratio (ASCR)
- <=15%
- 15-30%
- 30-45%
- 45-60%
- >60%

Linguistic Isolation
African American Race
Poverty
Spatial Regression

What are factors in operative time in resection of colorectal polyps?
Modeling Flow

The movement of people, events, goods or services from one location to another.
Modeling Flow
One-to-Many
Modeling Flow

We can model the pattern of flow between a series of origins and destinations in terms of demands at the origins, attractiveness of the destinations, and distance between the two (geographical accessibility).

The Gravity Model:

- Size of Origin (Demand)
- Size of Destination (Attractiveness)
- Distance (Accessibility)
Modeling Flow

What are the factors in ED utilization
Factors in ED Utilization

- **Size of Origin (Demand)**
  - Total population
- **Size of Destination (Attractiveness)**
- **Distance (Accessibility)**
  - Distance from BMC
- **Barriers**
  - West of River
  - In Connecticut
  - Within 1 mile of Competing ED
  - Within Springfield
Decision Analysis

- Quantify decision-making process
- Make it more objective
- Where to build new facilities, locate intervention programs or allocate resources.
What is the best place for a new mammography facility?

- High LSBCA
- > 2 miles from existing facility
- Low income
- > Distance from I-91

Decision Analysis

Suitability Ranking

Far: 7 mi.
Near: 0 mi.
Thank you

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Department of Epidemiology/ Biostatistics
Academic Affairs
Baystate Health
Issues in Spatial Analysis

- Scale
- Zoning
- Ecologic Fallacy
Geographic Scale

- Geographic level at which data is analyzed
- Affects results of statistical analysis
- Presence of spatial autocorrelation is dependent on scale
Geographic Zoning

Springfield Tracts and Neighborhoods
Ecologic Fallacy

- Problem with aggregate data
- Statements made about groups do not necessarily apply to individuals
Questions??????
Hospital Uses of Spatial Statists

• Direct Patient Care
• Benchmarking outcomes
• Research
• Prevention/Intervention
• Resource Allocation
• Strategic Planning
• Disaster Planning, Preparedness, Response
Outline

• Data sources
• Spatial analysis Applications
• Examples
• Issues
• Tools
**Spatial Regression**

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<thead>
<tr>
<th>Factor</th>
<th>T-test</th>
<th>Significance</th>
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<tr>
<td>Median Household Income</td>
<td>-4.6563</td>
<td>0.0006</td>
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<tr>
<td>Linguistic Isolation</td>
<td>3.7255</td>
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<td>Hispanic</td>
<td>2.2748</td>
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Temporal Analysis

Is there a pattern of Shigella progression?

# Cases
- 0-5
- 6-10
- >10

July 1, 1999 to September 30, 1999
Modeling Flow

How can we increase the efficiency of Delivery of Respiratory and Infusion Services/Supplies
Where does the data come from?

- Hospital
- Census
- Public Health

- Location
- Numbers
- Demographics
- Socioeconomic
- Clinical outcomes
Modeling of Events

Where will the plume fall?
Spatial Regression

What are factors in operative time in Resection of colorectal polyps?