Proximity to Treatment and Likelihood of Mastectomy Among Early Stage Breast Cancer Patients

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Concurrent Session #4 -- Section D: ANALYTIC EPIDEMIOLOGY

Presented by: Christopher Johnson, MPH
Cancer Data Registry of Idaho
NAACCR Susan G. Komen for the Cure®
Road Network Distance Project

• 3-year, $300,000 Susan G. Komen for the Cure® grant in 2007
  – “Quantifying Transportation Barriers in Accessing Health Facilities for Breast Cancer Diagnosis and Treatment”
  – First competitive grant award not from a Sponsoring Organization
Objectives

1. Develop a driving time and distance calculator software program.

2. Pilot the software in two breast cancer research projects on disparities in access to care.

3. At the end of the project, make the road network distance calculator available to researchers through the NAACCR Website.
NAACCR Susan G. Komen for the Cure® Road Network Distance Project

- PI for NAACCR: Myles Cockburn (USC)
- Project manager for NAACCR: Charlie Blackburn (NAACCR)

- GIS Committee Advisors
  - Frank Boscoe (New York)
  - Kevin Henry (New Jersey)
  - Chris Johnson (Idaho)

- NAACCR Researcher Advisors
  - Dave Stinchcomb (NIH/NCI)
  - Rich Pinder (Los Angeles Cancer Surveillance Program/USC School of Medicine)

- Others
  - Holly Hodges (CCR)
  - Josh Whitley (NAACCR)
  - More...
NAACCR Susan G. Komen for the Cure® Road Network Distance Project

- GIS Research Lab, Department of Geography at the University of Southern California, developed a software program to process batches of patient records supplied by NAACCR registries and output multiple measures of driving time and distance traveled by car from the patient’s residence to the health care facilities visited for cancer diagnosis and treatment.
  - Covers United States and Canada.

- John Wilson
- Dan Goldberg
- Kaveh Shahabi
- Ji Ma
NAACCR Susan G. Komen for the Cure®
Road Network Distance Project

• Road network data file generously donated by NAVTEQ.
Komen GIS Project Protocol

• Participating registries were asked to prepare two data files:

1. Latitude and longitude coordinates of cases and facilities that reported them were submitted to a secure file server at the USC GIS Lab for road network calculation purposes.

2. Cancer registry data fields plus the distance measures; submitted to NAACCR and used to conduct the research projects resulting in the two papers.
Case Selection Criteria – Source Records

- Female in situ and invasive primary breast cancer cases diagnosed during 2004-2006.
- Reportable cases (i.e. residents of geographic areas covered by respective registries at time of diagnosis).

- Because we used distances between patient location and facility location(s), we needed to use source records for this project, not consolidated records.
  - Data files contained one record per case per reporting facility, with one unique identifying number per individual.
We are here.

Participating States

Arkansas
California
Idaho
Iowa
Kentucky
New Hampshire
New Jersey
New York
North Carolina
Oregon
Two Papers

• Geographic proximity to treatment for early stage breast cancer and likelihood of mastectomy.
  – “Treatment Paper”
  – Article in press in The Breast.

• Breast Cancer Stage at Diagnosis: Is Travel Time Important?
  – “Stage Paper”
Women diagnosed with early stage invasive breast cancer in the United States are typically presented with a choice of mastectomy or breast conserving surgery (BCS) with radiation therapy (RT).
  
  - Two options have long been established as equally effective in terms of survival.
  - Following the National Institutes of Health’s 1990 consensus statement that BCS with RT was the preferred treatment for most women, national mastectomy rates fell steadily through 2006.
Treatment Paper – Methods

• Early stage breast cancer cases
  – Collaborative Stage-derived SEER Summary Stage 2000 localized cases

• Cases were limited to women who had either:
  – Breast conserving surgery (FORDS codes 20-24)
  – Mastectomy (FORDS codes 30-80)

• Radiation treatment data were also available, but because of differential reporting by state were determined not to be of sufficient quality to use in the analysis.
Treatment Paper – Methods

• Two distance measures were calculated for each patient:
  • Travel distance via roads from the patient’s residence to the location of surgical treatment.
    – Realized access to cancer care.
    – For patients whose diagnosis and treatment spanned multiple facilities, the minimum distance from among the candidate facilities was used.

• Travel distance via roads from the road nearest the centroid of the patient’s census tract to the nearest RT.
  – Potential access to RT.
The likelihood of receiving breast conserving surgery versus mastectomy was modeled using multilevel logistic regression using PROC GLIMMIX in SAS Version 9.2.

Two models were developed, one using each distance measure.

State random effect.

Fixed effects in the model included:

- age
- year of diagnosis
- Race
- Ethnicity
- census tract-level household poverty rate
- rural/urban status
- whether the tumor was a person’s first primary tumor.
• **Bypass Patients**

• We were further interested in assessing the probability of mastectomy for patients who traveled more than 60 km for surgery but who lived within 30 km of a radiation treatment center.
  – Seek care at locations outside of their own community, typically at large, urban, nationally recognized hospitals.
Treatment Paper - Results

Actual Travel Distance to Surgery

- % Receiving Mastectomy
- Adjusted Odds

Unadjusted - % Mastectomy

Road Network Travel Distance (km) / # Cases

<table>
<thead>
<tr>
<th>Distance Range</th>
<th># Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 15</td>
<td>62872</td>
</tr>
<tr>
<td>15 - 30</td>
<td>21303</td>
</tr>
<tr>
<td>30 - 45</td>
<td>7687</td>
</tr>
<tr>
<td>45 - 60</td>
<td>3614</td>
</tr>
<tr>
<td>60 - 75</td>
<td>1821</td>
</tr>
<tr>
<td>75 - 100</td>
<td>1534</td>
</tr>
<tr>
<td>100+</td>
<td>1934</td>
</tr>
</tbody>
</table>
Treatment Paper - Results

Potential Travel Distance to Radiation Therapy

- % Receiving Mastectomy
- Adjusted Odds

Odds of Mastectomy

Road Network Travel Distance (km) / # Cases

Unadjusted - % Mastectomy

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th># Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 15</td>
<td>76559</td>
</tr>
<tr>
<td>15 - 30</td>
<td>15106</td>
</tr>
<tr>
<td>30 - 45</td>
<td>5640</td>
</tr>
<tr>
<td>45 - 60</td>
<td>2876</td>
</tr>
<tr>
<td>60 - 75</td>
<td>1472</td>
</tr>
<tr>
<td>75 - 100</td>
<td>997</td>
</tr>
<tr>
<td>100+</td>
<td>657</td>
</tr>
</tbody>
</table>

(Percentage values and adjusted odds for each distance category are shown in the chart.)
Treatment Paper - Results

Age, Race, and Ethnicity

Unadjusted - % Mastectomy

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>% Receiving Mastectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>21573</td>
<td>35%</td>
</tr>
<tr>
<td>50-64</td>
<td>36970</td>
<td>30%</td>
</tr>
<tr>
<td>65+</td>
<td>46187</td>
<td>25%</td>
</tr>
<tr>
<td>White</td>
<td>89884</td>
<td>20%</td>
</tr>
<tr>
<td>Black</td>
<td>8027</td>
<td>15%</td>
</tr>
<tr>
<td>API</td>
<td>5631</td>
<td>10%</td>
</tr>
<tr>
<td>AI/AN</td>
<td>271</td>
<td>5%</td>
</tr>
<tr>
<td>Unknown</td>
<td>917</td>
<td>3%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>7964</td>
<td>2%</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>96766</td>
<td>1%</td>
</tr>
</tbody>
</table>

Odds of Mastectomy

% Receiving Mastectomy

Adjusted Odds
Treatment Paper - Results

Poverty Rate in Census Tract of Residence at Diagnosis (2000) (%) and Commuting Proximity (RUCA)

% Receiving Mastectomy
Adjusted Odds

Unadjusted - % Mastectomy

0 - 5 N=31494
5 - 10 N=31738
10 - 20 N=28345
20+ N=13153
Metropolitan N=86558
Micropolitan N=8867
Neither N=7920
Tumor Sequence / Year of Diagnosis

- % Receiving Mastectomy
- Adjusted Odds

Unadjusted - % Mastectomy:
- Seq 00-01 N=86710
- Seq 02+ N=18020
- 2004 N=34280
- 2005 N=34681
- 2006 N=35769

Odds of Mastectomy:
- 0.00
- 0.20
- 0.40
- 0.60
- 0.80
- 1.00
- 1.20
- 1.40
- 1.60
- 1.80
- 2.00

50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Of the 2678 patients defined as bypass patients (>60 km from surgery and <30 km from nearest RT), 42.2% received mastectomy (OR=1.27).

– Bypass patients far outnumber those with poor geographic access; there were 1345 patients more than 60 km from both their surgery location and nearest RT.

– This remains true even for more inclusive definitions of bypass patients and patients with poor geographic access.
Treatment Paper - Limitations

• Lack of data on prior medical history, comorbid conditions, hormone receptor status.
• Incomplete reporting of radiation treatment data.
• Lacked data on patient insurance coverage, contracting arrangements between hospitals and insurers.
• Lack of data on hospital characteristics such as volume, specialization, reputation, and waiting time.
• For patients with multiple reporting sources, we potentially underestimated the distance to surgery and potentially misclassified distance.
  – Would tend to underestimate the magnitude of the distance effect.
• In real estate, it is: LOCATION, LOCATION, LOCATION.

• In early stage breast cancer surgery, it is:
  – LOCATION (Distance to Treatment)
  – LOCATION (Regional/State Differences)
  – And some other things.

• Geographic distance is a fundamental element of patterns of cancer care.
Thanks

• Myles Cockburn, Charlie Blackburn and John Wilson for project oversight.

• David Stinchcomb, Rich Pinder, and staff of the University of Southern California GIS Research Laboratory for technical input.

• NAVTEQ for the generous donation of the reference street network used for these analyses.

• Mostly, the authors would like to thank staff at the participating cancer registries for providing their data.