Shortest Path Tool

NAACCR Town Hall Webinar

Presented by the NAACCR GIS Committee

10/27/11

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Questions

- Submit all questions concerning content through the Q&A panel
- If you experience technical difficulties, let us know via the chat panel or call us at 217-698 0800 x 111

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Agenda

- Overview
  - Recinda Sherman, MPH, CTR Florida Cancer Data Systems
- Proximity to Treatment and Likelihood of Mastectomy
  - Christopher Johnson, MPH Cancer Data Registry of Idaho

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Agenda

- Breast Cancer Stage at Diagnosis: Is Travel Time Important?
  - Kevin A Henry, Ph.D. University of Utah, Department of Geography
- Shortest Path Finder Tool Demonstration
  - Dan Goldberg, Ph.D. University of Southern California

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NAACCR Shortest Path Tool Town Hall Meeting: Overview

Recinda Sherman, MPH CTR
Senior Research Associate
Florida Cancer Data Systems
Sylvester Comprehensive Cancer Center
Miller Medical School, University of Miami

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The Issue

- Distance between residence and treatment facility impacts
  - Treatment type, adherence
  - Screening type, adherence
  - Prognosis
    - stage at diagnosis, recurrence, survival
- Measurement of distance and time
  - Complex
  - Approximates
    - Straight “crow flies” line

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The Early Days

- Great Circle Distance Tool
- NAACCR GIS Committee
  - Chris Johnson
- 2005, SAS, available on website
- Estimates distance between residence and up to 5 case-level facilities
- "Crow Flies", curvature of earth

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A Better Measure

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Shortest Path Project

- Goal
  - Develop software to process batches of patient records
  - Calculate driving distance and time using current road network
- Funding
  - Susan G. Komen For the Cure
  - 3 year, $300,000 Grant, Oct 2007
- Collaboration
  - NAACCR GIS Committee
    - Frank Boscoe, Kevin Henry, Chris Johnson, David Stinchcomb
  - University of Southern California
    - Dan Goldberg, Myles Cockburn, Kaveh Shahabi, John Wilson
  - NAACCR Office
    - Josh Whitley, Charlie Blackburn

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Shortest Path Tool

- Calculates Shortest Travel Distance & Time
  - Between patient residence and treatment facility
  - Using actual street network
    - Utilizes comprehensive, current street level data
- Requires geocoded cases & facilities
  - Geocoded facilities available on GIS Website
- Free to NAACCR Members
  - Designed for cancer registry data
- MyNAACCR
  - Upload files to secure, encrypted server

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Use of the NAACCR Shortest Path Tool in Health Services Research

NAACCR Shortest Path Town Hall Meeting
October 27, 2011

Christopher Johnson, MPH, Cancer Data Registry of Idaho
Kevin Henry, PhD, University of Utah
Francis Boscoe, PhD, New York State Cancer Registry

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Use of the NAACCR Shortest Path Tool in Health Services Research

1. Geographic proximity to treatment for early stage breast cancer and likelihood of mastectomy.
   - "Treatment Paper"
2. Breast Cancer Stage at Diagnosis: Is Travel Time Important?
   - "Stage Paper"
3. Ideas for future research

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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 University of Southern California 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.

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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.

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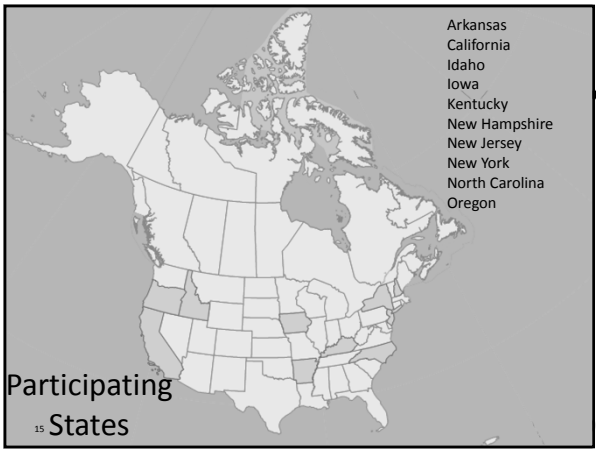

Participating States

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Geographic proximity to treatment for early stage breast cancer and likelihood of mastectomy.

Boscoe FP, Johnson CJ, Henry KA, Goldberg DW, Shahabi K, Elkin EB, Ballas LK, Cockburn M. Breast. 2011 Aug;20(4):324-8.

NAACCR Shortest Path Town Hall Meeting
October 27, 2011
Presented by: Christopher Johnson, MPH
Cancer Data Registry of Idaho

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Treatment Paper – Introduction

- 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.

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Treatment Paper – Methods

- Early stage breast cancer cases
  - Collaborative Stage-derived SEER Summary Stage 2000 localized cases
  - Women diagnosed between 2004 and 2006.
- 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.

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Treatment Paper – Methods

- Two distance measures were calculated for each patient:

1. 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.
2. Travel distance via roads from the road nearest the centroid of the patient's census tract to the nearest radiation treatment location.
   - Potential access to RT.

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Treatment Paper – Methods

- 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.

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Treatment Paper – Methods

- **<u>Bypass Patients</u>**
- 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.

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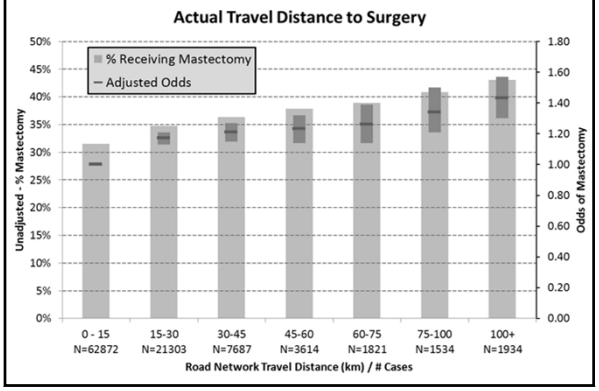
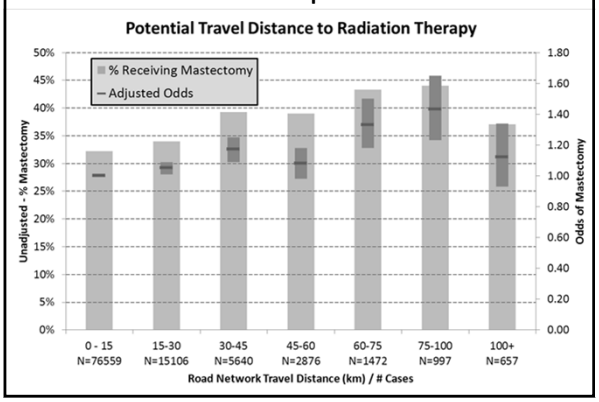
Treatment Paper - Results



Treatment Paper - Results



Treatment Paper - Results

- 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).

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Treatment Paper - Conclusions

- 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.

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Breast Cancer Stage at Diagnosis: Is Travel Time Important?

Henry KA, Boscoe FP, Johnson CJ, Goldberg DW, Sherman R, Cockburn M. Journal of Community Health. 2011, in press

Presented by: Kevin A Henry, Ph.D.

University of Utah, Department of Geography

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Introduction

- Screening mammography has increased early detection and reduced breast cancer mortality (Taplin et al 2004)
- Breast cancer stage at diagnosis is related to the utilization of early detection procedures and following recommended guidelines.
- Many factors associated with stage at diagnosis:

Age	Health Insurance
Facility Capacity	Race/ethnicity
Obesity	History of mammography
Area Poverty	Geographic Accessibility

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Introduction

- Geographic barriers (e.g., lengthy travel) to mammography could discourage screening
- Previous Study Results

Geographic location	Study Period	N	Association of proximity to nearest mammography and stage at diagnosis	Pub Year	Author
Los Angeles	1992-1996	24,993	Yes	2006	Gumpertz
Northern England	1994-2002	28,002	No	2008	Jones
Metropolitan Chicago	1996-1998	4,936	No	2008	Tarlov
Western Washington State	1996-1999	1,012	No	2011	Onega
New Hampshire	1998-2004	6,305	No	2009	Celaya
Detroit Metropolitan Area	1998-2002	12,413	Yes	2011	Dai
Illinois	1998-2000	31,511	No	2010	Wang
Kentucky	1999-2003	12,322	Yes	2009	Huang
Virginia	2000-2001	8,170	No	2009	Schroen

Study Objectives:

Investigate whether geographic access to mammography screening is associated with the stage of breast cancer at diagnosis through two measures of accessibility:

1. Travel time to location of diagnosing facility
2. Travel time to location of nearest mammography

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Study Population and Data

- Female breast cancer cases from ten different state cancer registries (2004-2006)

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

- Histologically confirmed first primary in situ or invasive tumor of the breast (ICD-O3 C500-C509; excluding histology codes 9590–9989(N=174,609)
- SEER Summary Stage 2000
- Aged 40 and older

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Methods

- Two travel distance measures were calculated for each patient:

1. Realized (Actual) access: From the patient's residence to the actual location of diagnosis
2. Potential access: From the patient's census tract to the nearest mammography facility.
   - (Geocoded 2005 FDA Mammography facilities from contiguous United States N=8,770)

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Methods

- Outcome: Odds of late stage (regional, distant) vs. early stage (in situ, localized)
- Two multilevel logistic regression models - each using one travel time measure (facility and mammography)
  - Fixed Effects: travel time, age, race/ethnicity, diagnosis year, insurance, area poverty, rural/urban
  - Random Effects: State
- PROC GLIMMIX, SAS Version 9.2

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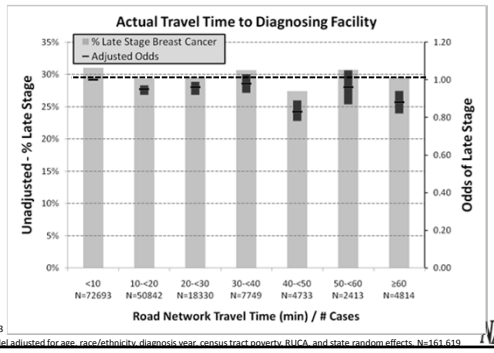
Results



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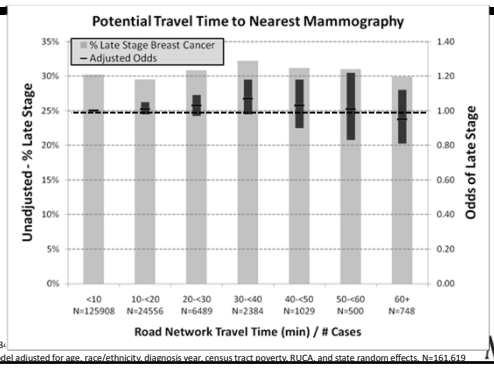
Model adjusted for age, race/ethnicity, diagnosis year, census tract poverty, RUCA, and state random effects. N=161,619

Results



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Model adjusted for age, race/ethnicity, diagnosis year, census tract poverty, RUCA, and state random effects. N=161,619

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Results

- Significant factors associated with late stage breast cancer at diagnosis

Odds of Late Stage	Adjusted OR (95% CI)
Uninsured vs. Insured	1.79(1.64, 1.95)
Medicaid vs. Insured	1.74 (1.67, 1.83)
Age <50 vs. 65+	1.27(1.24, 1.31)
Age 50-64 vs. 65+	1.15 (1.11, 1.19)
Non-Hispanic Black vs. Non-Hispanic	1.31 (1.26, 1.37)
Hispanic vs. Non-Hispanic White	1.15 (1.09, 1.21)
High poverty census tracts (>20%) vs. low poverty tracts (<5%)	1.35 (1.30, 1.41)

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Conclusions

- Travel time to diagnosing facility or nearest mammography facility was not a determinant of late stage breast cancer at diagnosis
- Better geographic proximity did not assure more favorable stage distributions.
- Other factors were more important predictors of stage at diagnosis (e.g., insurance, census poverty, race/ethnicity)
- Additional measures of geographic accessibility should be examined.

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Possible Research Uses of the Shortest Path Tool

Francis Boscoe, PhD, New York State Cancer Registry

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Possible research uses for the Shortest Path Tool

1. Identify underserved areas

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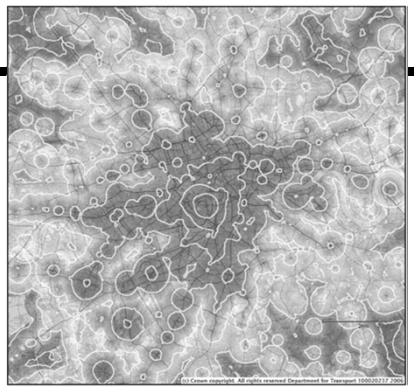
London Travel-Time Map



http://www.mysociety.org/2006/travel-time-maps/

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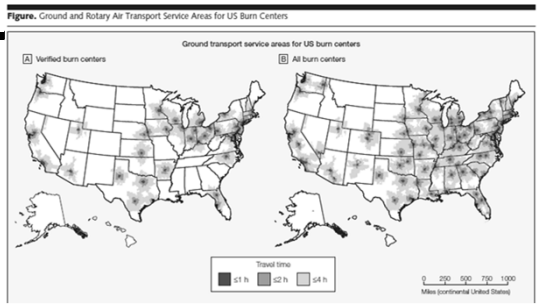

Figure. Ground and Rotary Air Transport Service Areas for US Burn Centers

Klein et al., *JAMA* 2009; 302: 1774-1781.

Possible research uses for the Shortest Path Tool

2. Identify disparities that may be attributable to distance

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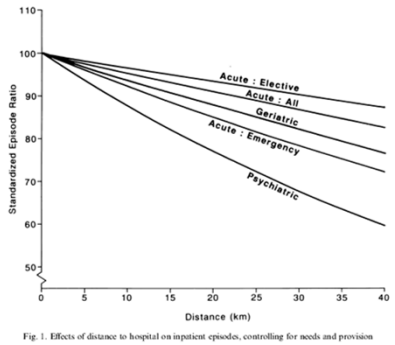
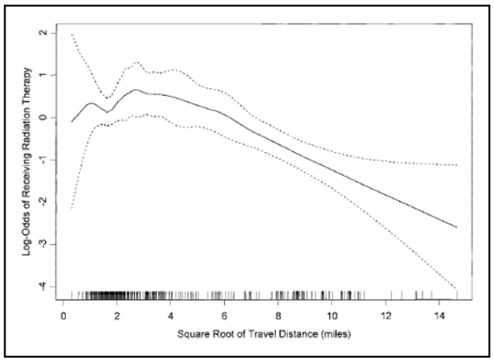


Fig. 1. Effects of distance to hospital on inpatient episodes, controlling for needs and provision

Haynes RM et al. 1999. Effects of distances to hospital and GP surgery on hospital inpatient episodes, controlling for needs and provision. *Social Science and Medicine* **49**(3): 425-433.



from Athas WF et al. 2000. **Travel Distance to Radiation Therapy and Receipt of Radiotherapy Following Breast-Conserving Surgery.** *Journal of the National Cancer Institute* **92**(3): 269-271.

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Possible research uses for the Shortest Path Tool

3. Measure the impact that hospital closures have on travel time and whether this translates to changes in outcomes

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Journal of Health Economics 25 (2006) 740–761

JOURNAL OF HEALTH ECONOMICS

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How far to the hospital?
The effect of hospital closures on access to care

Thomas C. Buchmueller[a], Mireille Jacobson[b,*], Cheryl Wold[c]

[a] University of California, Irvine and NBER, United States
[b] University of California, Irvine, United States
[c] Los Angeles County Department of Health Services, United States

Table 8. Poisson models of death counts: percentage change in deaths due to a mile increase in distance to the hospital in Los Angeles County

	AMI		Unintentional injuries, home		Chronic heart disease		All cancer	
Panel A: changes in distance								
Miles	6.45 (1.89)	7.17 (4.20)	11.7 (6.45)	20.4 (12.8)	−1.34 (1.33)	−1.82 (3.35)	0.85 (0.61)	2.14 (1.67)
Zip trends	No	Yes	No	Yes	No	Yes	No	Yes
Mean deaths	14	14	1.3	1.3	24	24	39	39
Observations	1675	1675	1675	1675	1675	1675	1675	1675

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Possible research uses for the Shortest Path Tool

4. Identify and characterize patients who do not seek treatment at his or her closest location ("bypass patients")

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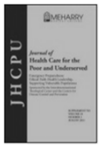

Volume 20, Number 3, August 2009
E-ISSN: 1548-6869 Print ISSN: 1049-2089
DOI: 10.1353/hpu.0.0178

Do Patients Bypass Rural Hospitals? Determinants of Inpatient Hospital Choice in Rural California

José J. Escarce, MD, PhD and Kanika Kapur, PhD

Using data from California hospitals, the paper shows that patients were more likely to choose nearby hospitals, larger hospitals, and hospitals that offered more services and technologies. However, even after adjusting for these factors, patients had a propensity to bypass rural hospitals in favor of large urban hospitals. Offering additional services and technologies would increase the share of rural residents choosing rural hospitals only slightly.

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Possible research uses for the Shortest Path Tool

5. Patient navigation: given facility locations and addresses of patients and volunteers, what is the most efficient way of pairing patients and volunteers?

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QUESTIONS?

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Shortest Path Finder Tool

Dan Goldberg, PhD

Research Assistant Professor of Spatial Science at the University of Southern California

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QUESTIONS?

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Send questions or comments to Jim Hofferkamp jhofferkamp@naaccr.org
A recording of this webinar will be posted to the NAACCR website

THANK YOU!!!

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