Cancer care deserts: quantifying and solving the problem from a spatial perspective

Jan M. Eberth, PhD
Assistant Professor of Epidemiology
SC Cancer Prevention and Control Program
August 9, 2013

Food deserts

- Food deserts are recognized as areas having poor access to healthy and affordable food.
- 2008 Farm Bill calls for the measurement of food deserts, however the measures differ substantially.
  - Inclusion of vehicle access indicator?
  - Importance of supermarket sales as inclusion criteria?
  - Distance vs. density of supermarkets?
  - Different thresholds used for urban vs. rural?
  - Accessibility across modes of transportation?

- Limitations: Little to no measurement of local demand or supply (amount and variability of produce within supermarkets)

Food deserts to cancer care deserts

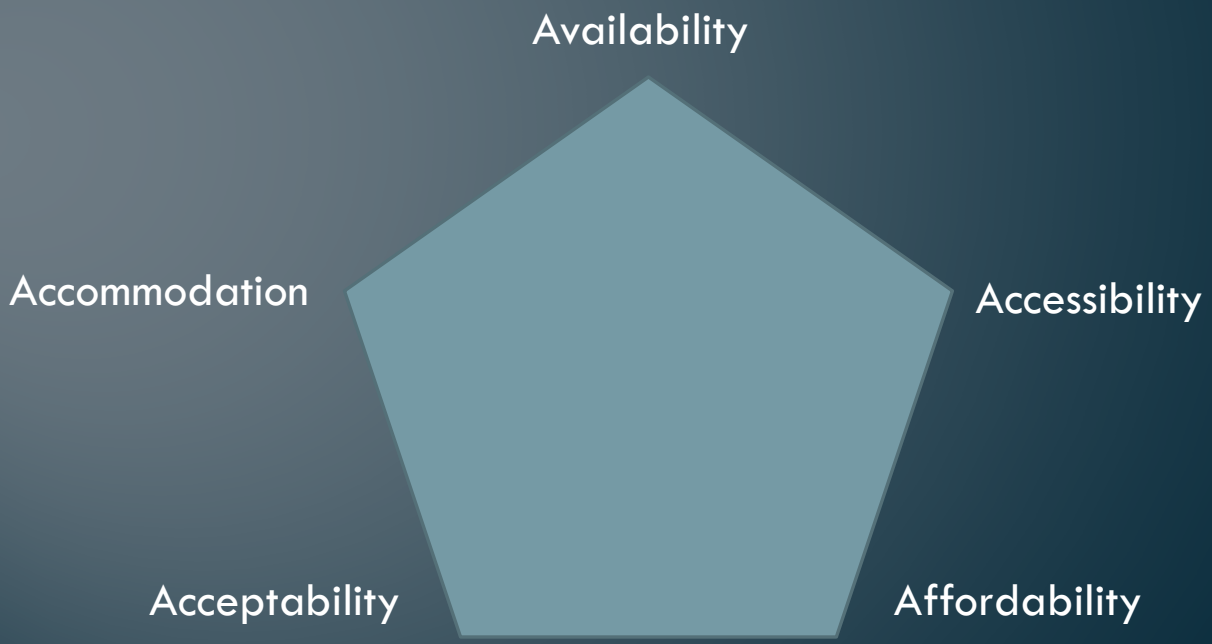
Same principles apply:

- Have to use transportation to get to product.
- Have to obtain the services from a retailer.
- Have to pay for the product.
- Not all retailers have the same quality product.

The idea of cancer care deserts has not been widely recognized, but could be quantified and mapped similar to food deserts.

Measuring access to care

- Access has 5 dimensions describing the fit between patients and the healthcare system (Penchansky & Thomas, 1981).



Terminology

- Availability – Measures distribution of facilities
- Accessibility – Measures ease with which patients can access the facilities
- Capacity – Measures ease of access, along with potential demand for the services located within some distance threshold

Motivations

- Motivations for measuring spatial accessibility to cancer care:
  - Value associated with equitable distribution of services
  - Determining the best sites for new facilities or other provision models
  - Access to care (and capacity) has downstream effects on utilization and quality of care

Research Projects

- Discuss findings from 2 recently completed studies:
  - Equitable distribution of services (Mammography Capacity Study)
  - Access to care has downstream effects on utilization and quality of care (Needle Biopsy Study)

Mammography Capacity Study

Health Serv Res. 2013 Jul 5. doi: 10.1111/1475-6773.12081. [Epub ahead of print]

Geographic Disparities in Mammography Capacity in the South: A Longitudinal Assessment of Supply and Demand.

Eberth JM, Eschbach K, Morris JS, Nguyen HT, Hossain MM, Elting LS.

South Carolina Cancer Prevention and Control Program, Department of Epidemiology and Biostatistics, University of South Carolina, Columbia, SC.

Abstract

OBJECTIVE: Studies have shown that there is sufficient availability of mammography; however, little is known about geographic variation in capacity. The purpose of this study was to determine the locations and extent of over/undersupply of mammography in 14 southern states from 2002 to 2008.

DATA SOURCES: Mammography facility data were collected from the U.S. Food and Drug Administration (FDA). Population estimates, used to estimate the potential demand for mammography, were obtained from GeoLytics Inc.

STUDY DESIGN: Using the two-step floating catchment area method, we calculated spatial accessibility at the block group level and categorized the resulting index to represent the extent of under/oversupply relative to the potential demand.

PRINCIPAL FINDINGS: Results show decreasing availability of mammography over time. The extent of over/undersupply varied significantly across the South. Reductions in capacity occurred primarily in areas with an oversupply of machines, resulting in a 68 percent decrease in the percent of women living in excess capacity areas from 2002 to 2008. The percent of women living in poor capacity areas rose by 10 percent from 2002 to 2008.

CONCLUSIONS: Our study found decreasing mammography availability and capacity over time, with substantial variation across states. This information can assist providers and policy makers in their business planning and resource allocation decisions.

Mammography Capacity Study

- Our goal was to determine the locations and extent of over/under supply of mammography relative to the potential demand for services in the south.
  - Supply = Mammography machines (FDA Data)
  - Demand = Number of women aged 40+ (*Geolytics Inc.*)
- Our methodology expanded upon previous work by considering:
  - Distance to, not just presence of, facilities
  - Ability to cross administrative boundaries to seek care
  - Choice of facilities, not just the nearest one
  - Various demand populations (sensitivity analysis)

Mammography Capacity Study

- Two-step floating catchment area method
  - Step 1: Draw a 60 minute buffer around each mammography facility and calculate:

$$\frac{\text{Number of machines}}{\text{Number of women 40+}/x}$$

where $x = 1$ for annual screening or 2 for biennial screening

  - Step 2: Draw a 60 minute buffer around each block group centroid and calculate:

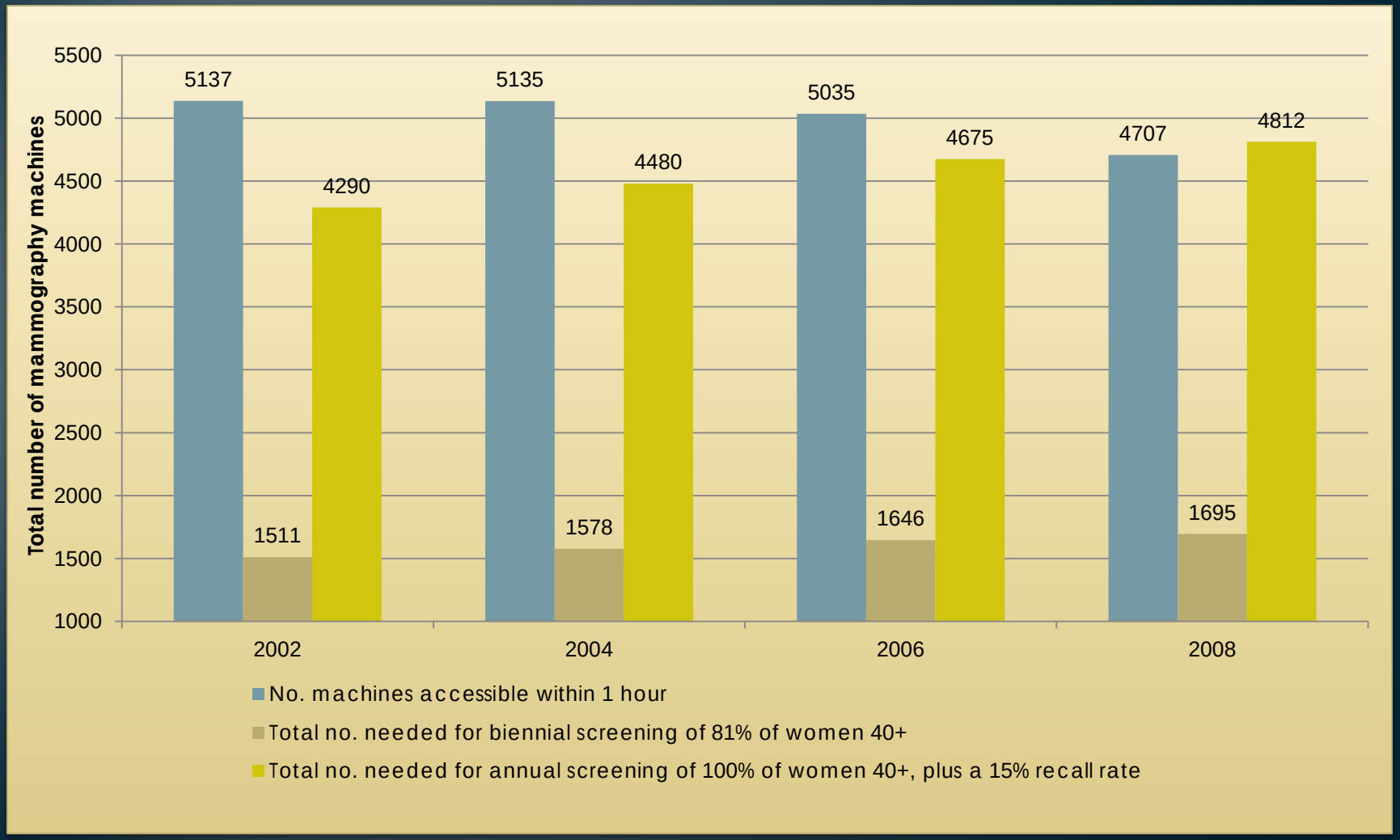
Sum of step 1 ratios for all facilities that fall within the buffer

Mammography Capacity Study

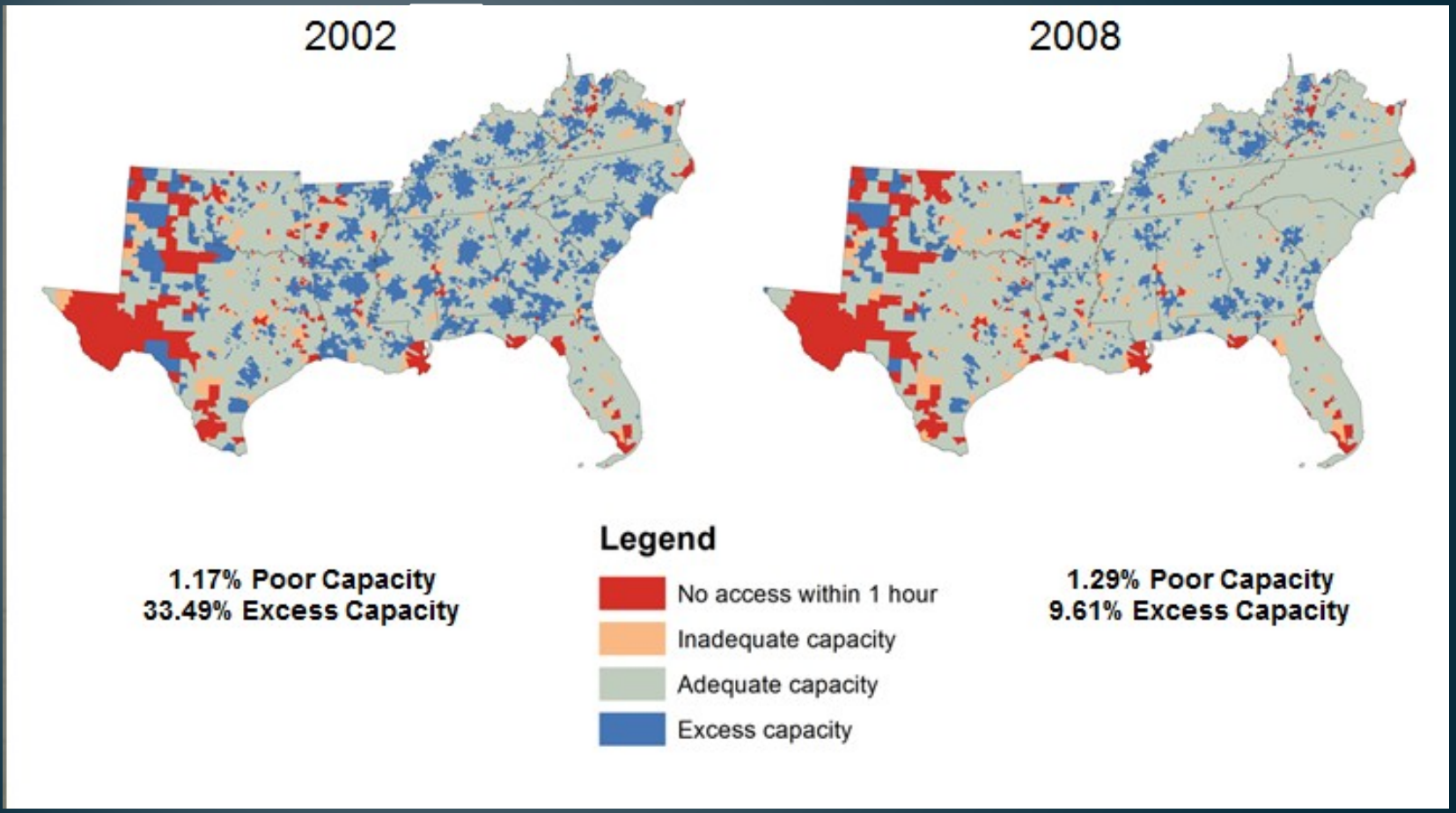
Variable	Definition	Assumptions
No access within 1 hour	No mammography machines within a 1 hour drive from population-weighted block group centroid	N/A
Inadequate capacity	≤0.674 machines/10,000 women *	Biennial screening of 81% of women aged 40+
Adequate capacity	≥0.675 machines/10,000 women	Same as above
Excess capacity	≥1.917 machines/10,000 women	Annual screening of 100% of women aged 40+, plus 15% called back for follow-up

* Based on the estimated 6000 mammograms per year that 1 machine can perform working 8 hours/day, 5 days/week, 50 weeks/year

Mammography Capacity Study



Mammography Capacity Study



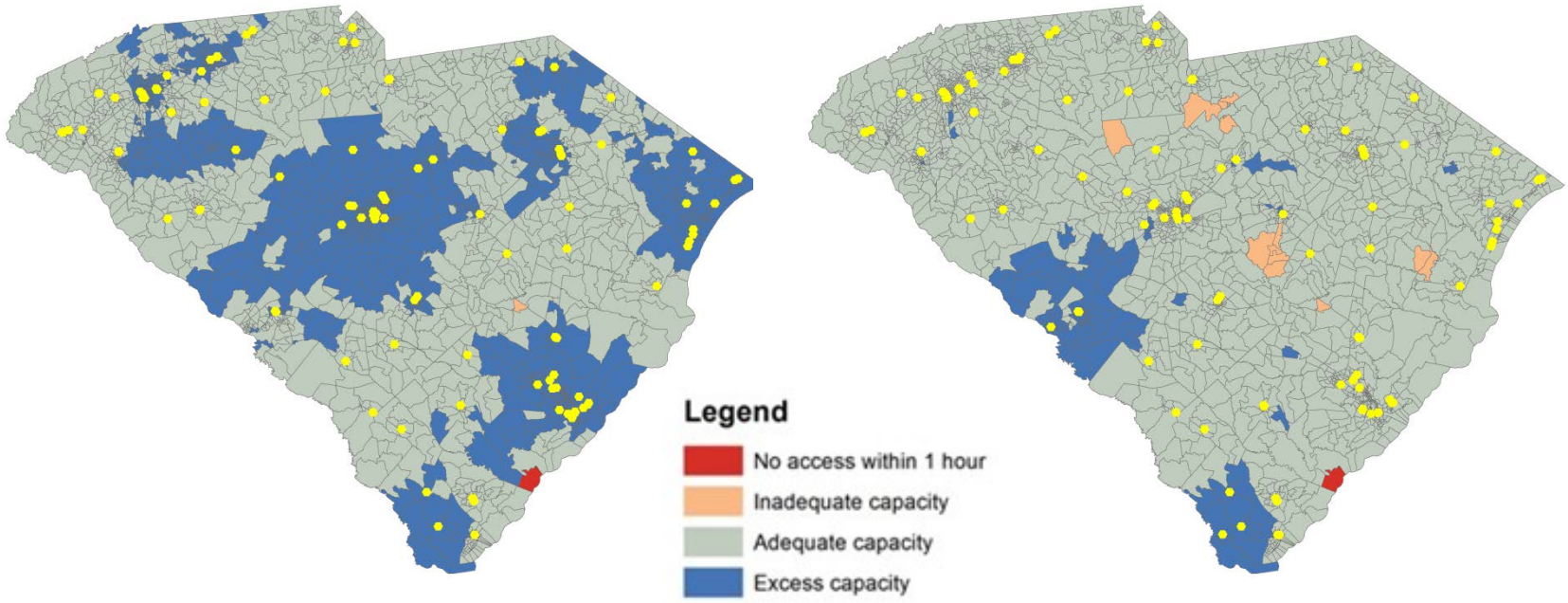
Mammography Capacity Study

2002

128 facilities

2008

114 facilities



Mammography Capacity Study

- The number of available mammography machine decreased over time.
- Poor capacity areas were overwhelmingly rural (82%). Texas had the largest land mass affected, as well as the most women.
- Although there was less oversupply over time, the maldistribution of resources was not remedied.
  - The loss of machines was largely in areas that already had too many.
  - 90% of areas with poor capacity in 2002 remained as such in 2008.

Needle Biopsy Study

Patient, physician, and structural contributions to needle biopsy receipt in breast cancer: A national Medicare study

Jan M Eberth, PhD; Ying Xu, MD, MS; Grace L Smith, MD, PhD, MPH; Yu Shen, PhD; Jing Jiang, MS; Thomas A Buchholz, MD; Kelly K Hunt, MD; Dalliah M Black, MD; Sharon H Giordano, MD, MPH; Gary J Whitman, MD; Wei Yang, MD; Chan Shen, PhD; Linda Elting, DrPH; Benjamin D Smith, MD

Department of Epidemiology and Biostatistics, University of South Carolina (JME)
Department of Biostatistics (YS, JJ, CS, LE)
Department of Radiation Oncology (GLS, TAB, BDS)
Department of Surgical Oncology (KKH, DMB)
Department of Breast Medical Oncology (SHG)
Department of Diagnostic Imaging (GJW, WY)
The University of Texas MD Anderson Cancer Center

Corresponding Author: Dr. Benjamin D. Smith, 1515 Holcombe Blvd, Unit 1202, Houston TX 77030, Phone: 713-563-2380, Fax: 713-563-6940, Email: bsmith3@mdanderson.org

In review at the *Journal of Clinical Oncology*

Needle Biopsy Study

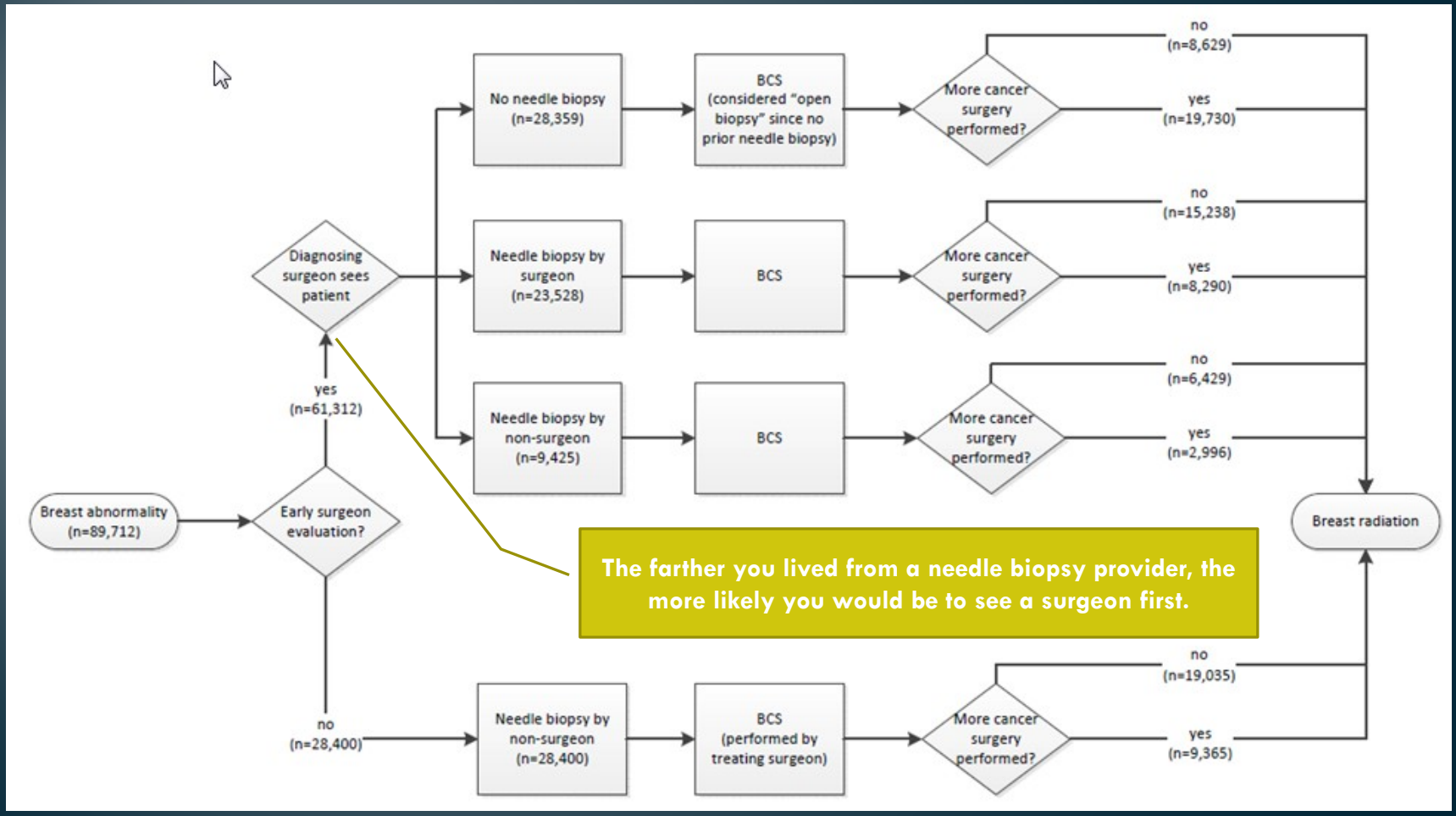
- Needle biopsy has been endorsed by the National Quality Forum as the best method for breast cancer diagnosis.
- Needle biopsy has been underutilized (24%-87% in other studies).
- The goals of this study were to:
  - Evaluate the contribution of patient, physician, and structural factors associated with use of needle biopsy for breast cancer diagnosis
  - Examine geographic variation in needle biopsy use across the U.S.

Needle Biopsy Study

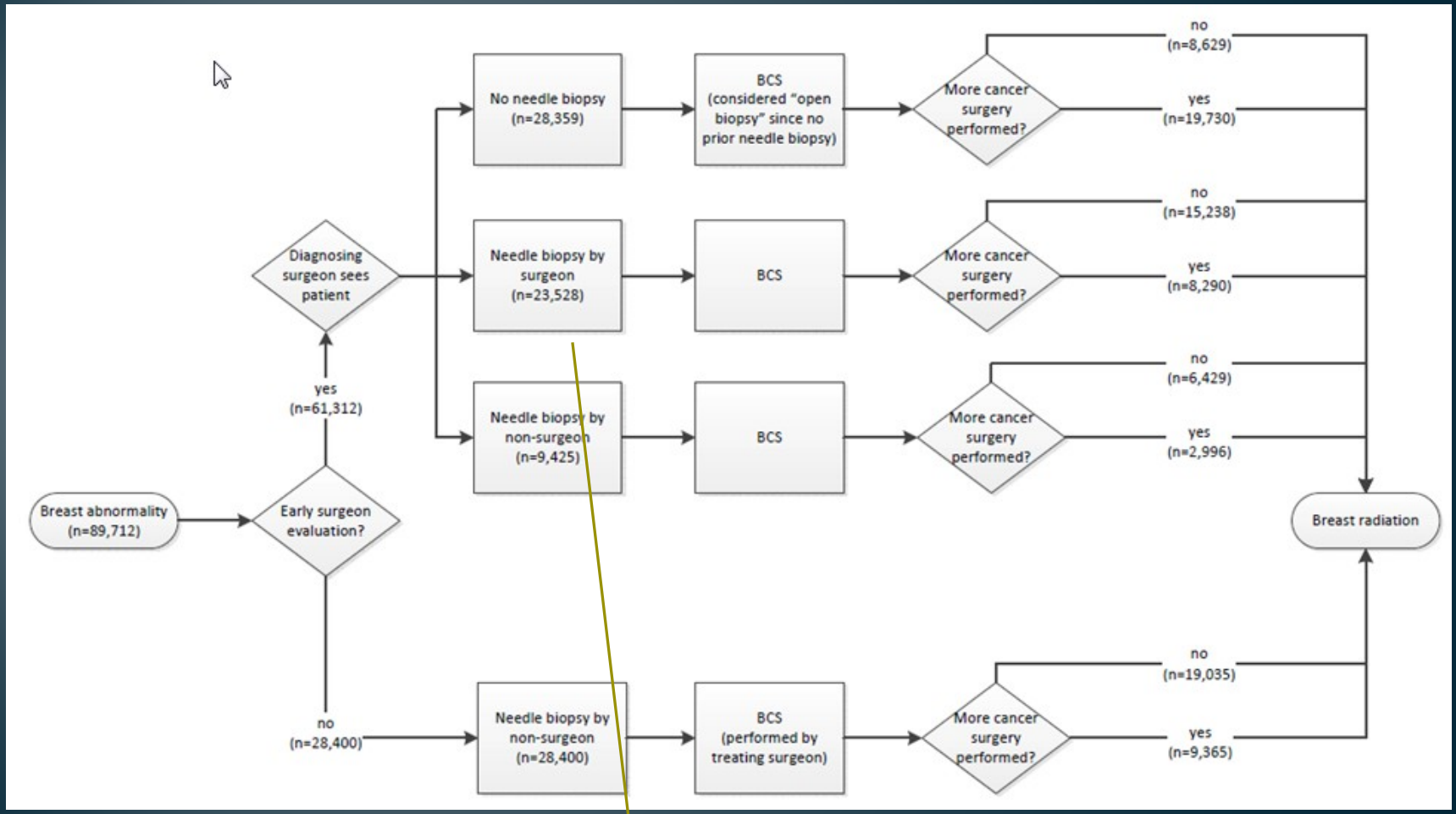
- National Medicare cohort of women 67 years and older from 2003-2007
- Three outcomes tested:
  - Whether you got an surgical evaluation prior to open/needle biopsy
  - Whether you got a needle biopsy prior to BCS (or not)
  - Whether you had only 1 (vs. multiple) BCS prior to starting radiation
- Covariates tested:
  - Individual: Age, race/ethnicity, comorbidity score, receipt of chemotherapy, county of residence, Medicaid coverage, distance to nearest needle biopsy provider, etc…
  - Surgeon: Board certified, U.S. trained, patient volume, medical specialty, gender, decade of medical school graduation, etc…

Needle Biopsy Study

Flow of patients from breast abnormality to breast radiation

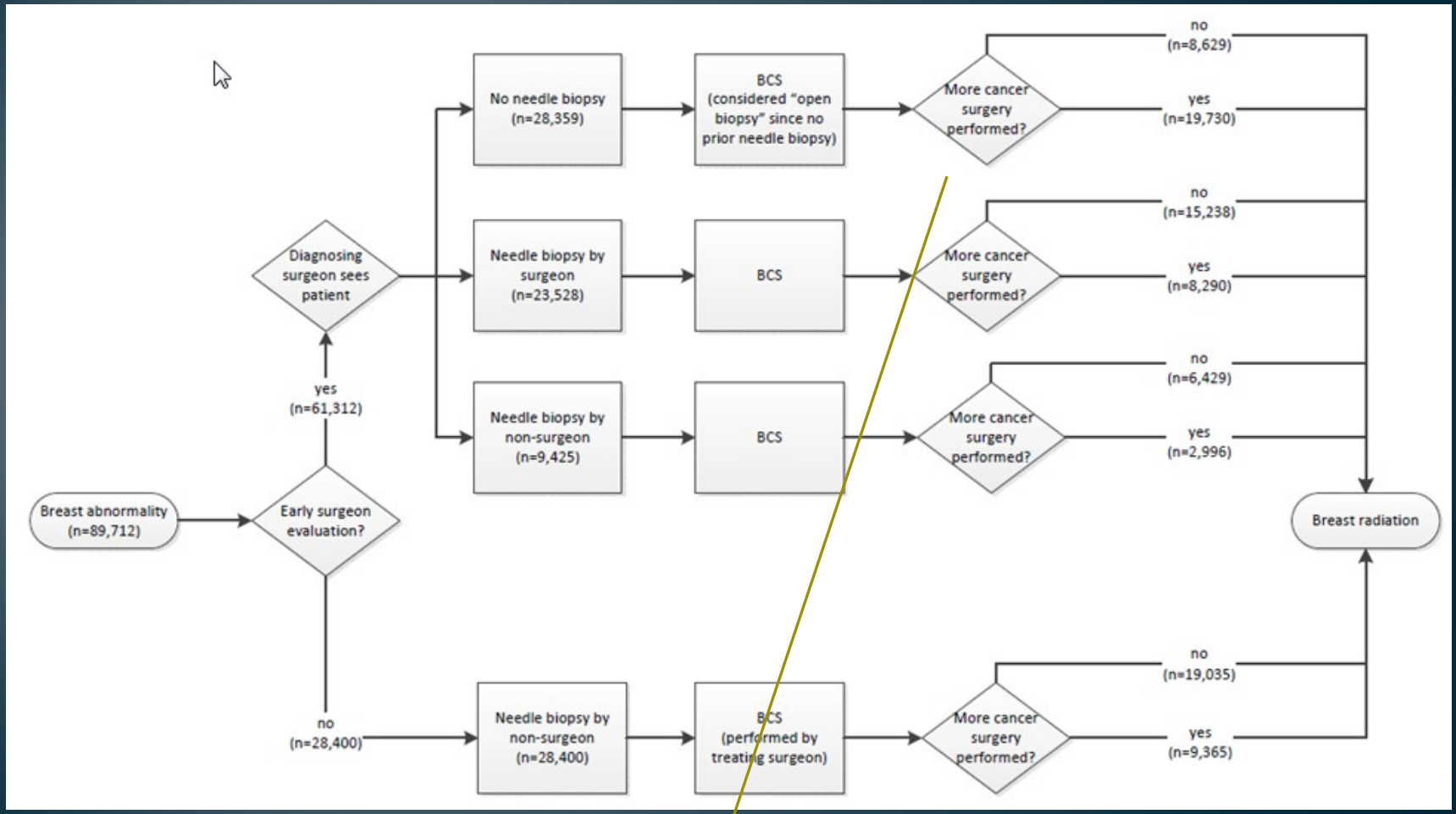


Needle Biopsy Study



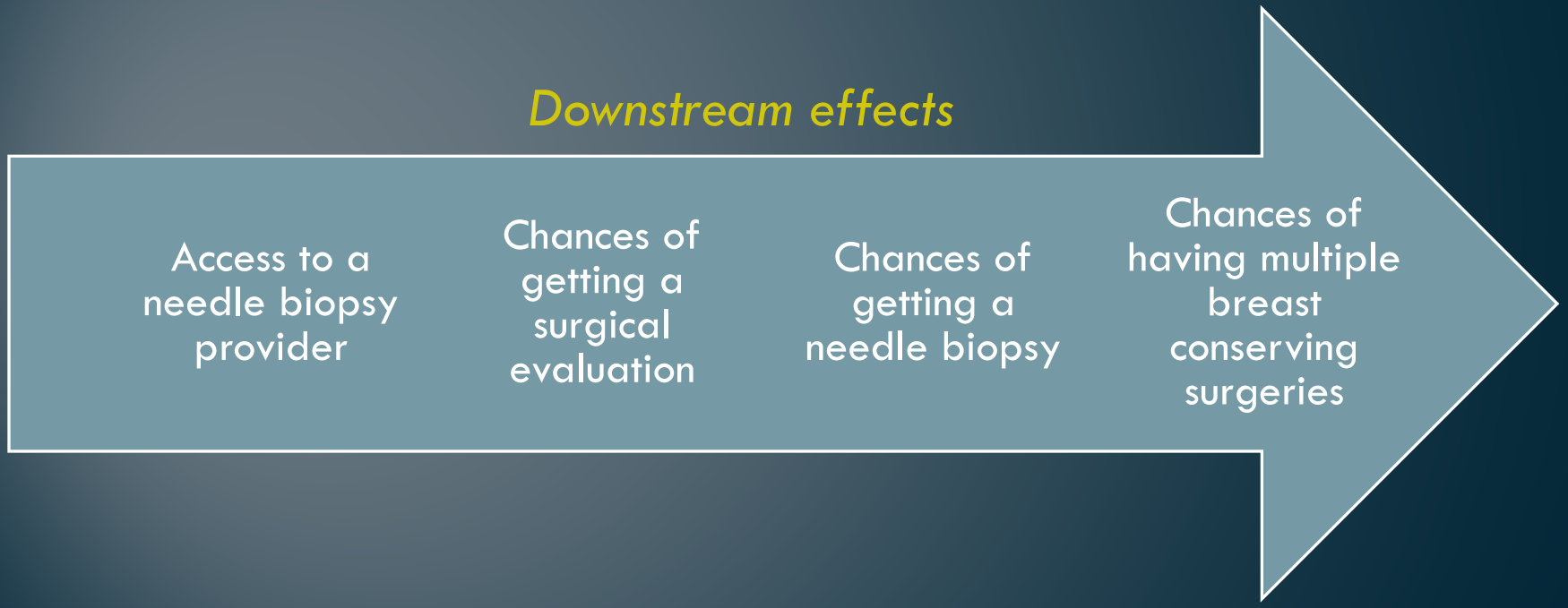
Only half of the women who saw a surgeon first ultimately went on to get a needle biopsy, the best type of diagnostic test.

Needle Biopsy Study



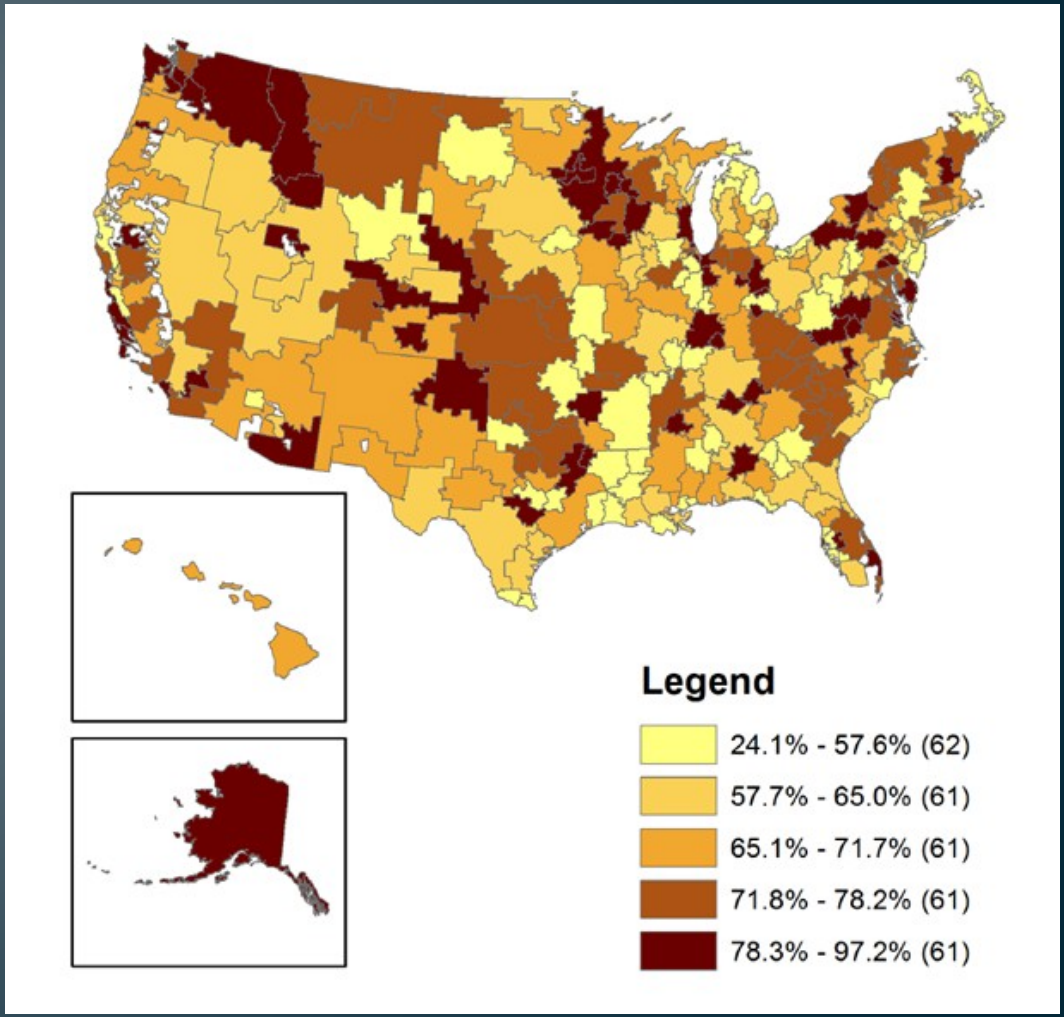
People who did not get a needle biopsy were twice as likely to have multiple (vs. 1) breast conserving surgeries.

Needle Biopsy Study



Needle Biopsy Study

Percent of female breast cancer patients receiving needle biopsy prior to BCS by HRR, 2003-2007

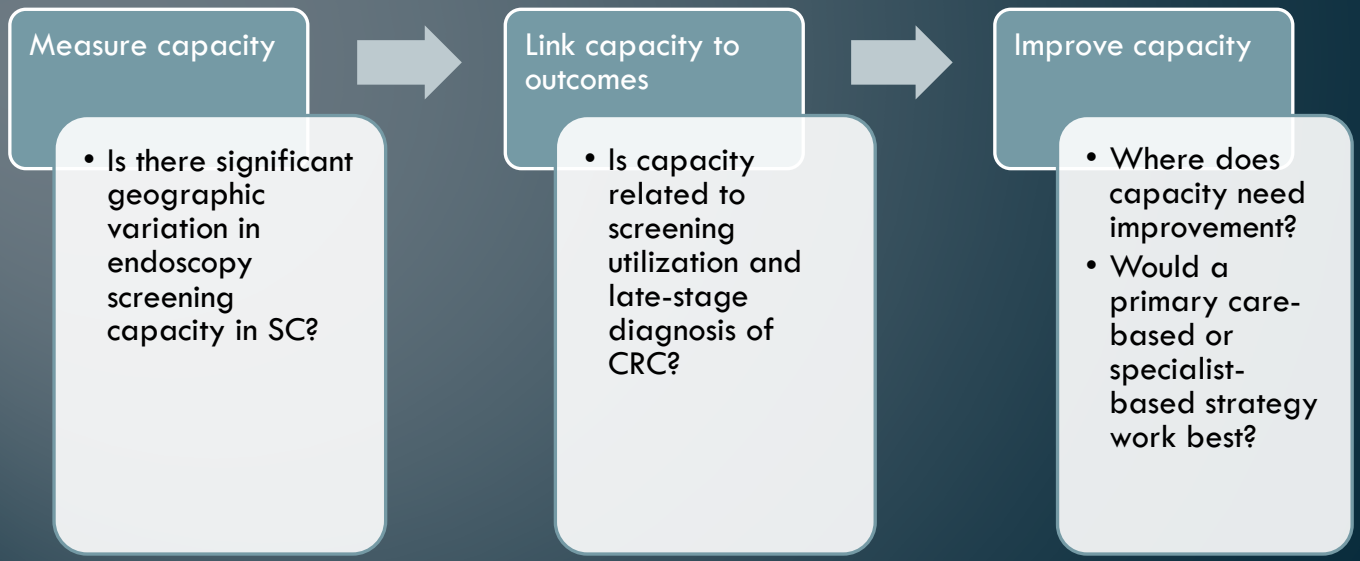


Research Projects

- Discuss plans for 2 projects in development:
  - K07 focused on geographic variation in endoscopy capacity and its relationship to screening utilization and late-stage colorectal cancer diagnosis
  - *SCHeathAtlas.org*, a web-based map service that provides information on:
    - Locations of healthcare providers and health promotion programs in the state of SC (Phase 1)
    - Health care utilization and behaviors (Phase 2)

K07 Application Aims

- Examine local patterns of endoscopy capacity and its relationship with health outcomes, and exploring systems-level solutions to improve CRC screening capacity.



K07 Application Aims

- Aim 1: Determine whether local capacity for endoscopy screening is adequate based on the local demand for services and supply of endoscopy providers
- Aim 1 Methods:
  - Calculate provider-to-population ratios for each block group, accounting for all providers within a 1 hour drive
  - Compare the ratios to a threshold to determine whether capacity is adequate
  - Map block group level capacity estimates across SC

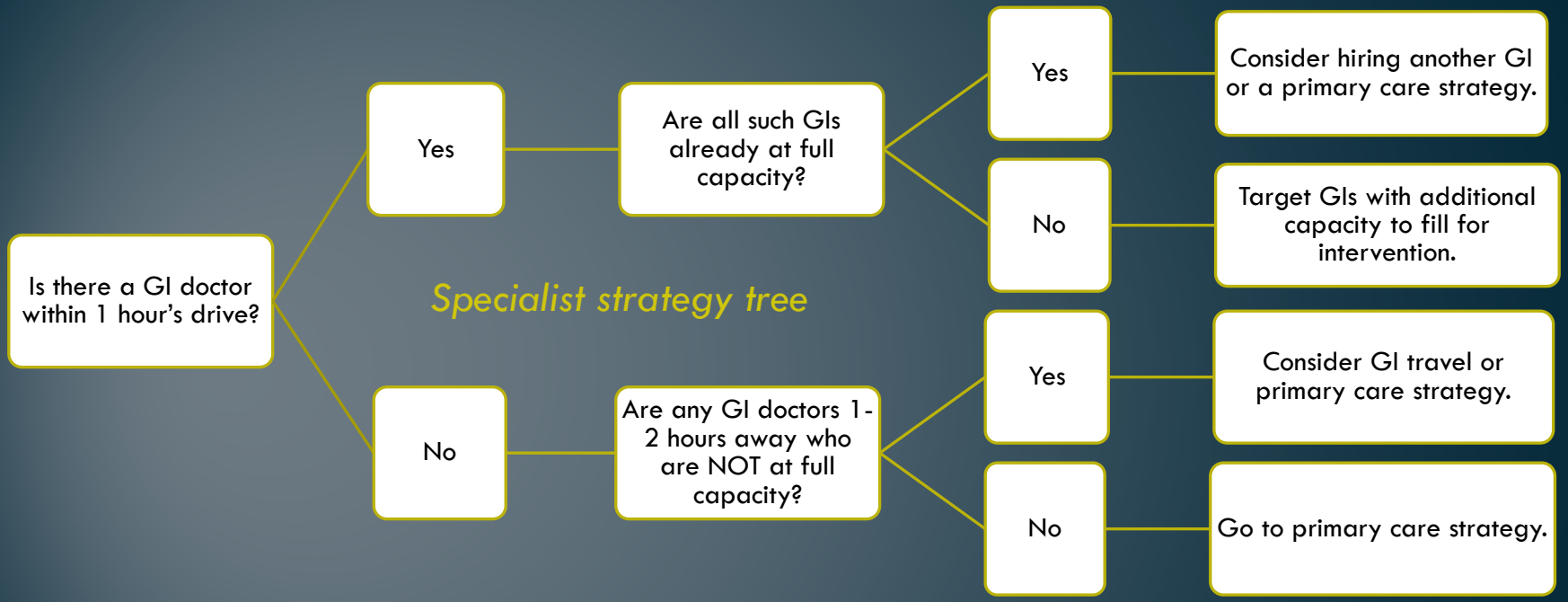
K07 Application Aims

- Aim 2: Examine whether local capacity for endoscopy impacts screening utilization and risk of late-stage colorectal cancer diagnosis, controlling for race/ethnicity, age, and socioeconomic status
- Aim 2 Methods:
  - Model screening utilization (timely vs. delayed/never; NHIS) as a function of local endoscopy screening capacity adjusted for covariates
  - Model probability of late-stage CRC diagnosis for all CRC cases (SC Cancer Registry) as a function of local endoscopy screening capacity adjusted for covariates

K07 Application Aims

- Aim 3: Using a decision analysis, determine whether a primary care-based strategy or a specialist-based strategy would be best suited to increasing local endoscopy capacity problems.
  - Primary care strategies:
    - Encouraging primary use of SIG/ FIT, secondary use of colonoscopy
    - Train primary care physicians to do endoscopic procedures
  - Specialist strategies
    - Hire another GI at an existing screening facility
    - Have a GI from a nearby location travel to poor capacity areas several times/year
    - Target for intervention (e.g., reducing practice inefficiencies) GIs not already at full capacity

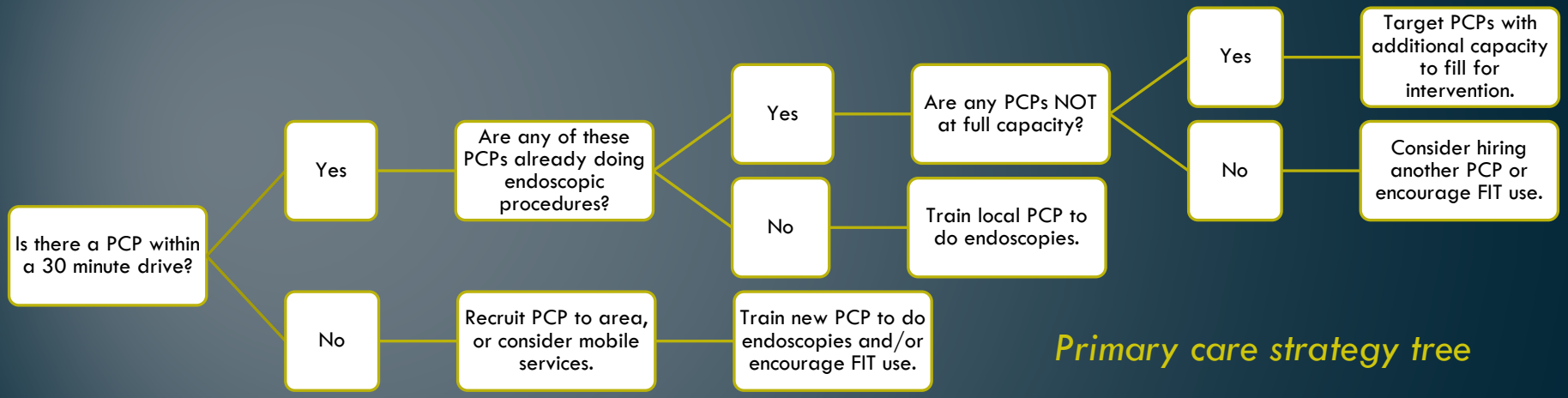
Example decision tree



How do we define if a doctor is at full capacity?

- Ask them how long is their waiting list or if accepting new patients
- Examine the number of Medicare endoscopy claims for that doctor
- Allocate nearby population of persons aged 50+ to each doctor until threshold is reached

Example decision tree



Primary care strategy tree

K07 Application Methods

- Data Sources
  - Supply: SC Medicare claims data, linked with National Provider Identification Registry, to determine the locations of colonoscopy providers
  - Demand: U.S. Census data on number of persons aged 50-85
    - Compare different demand estimates – 100% vs. 70% (Healthy People 2020 Target)
    - Compare different age populations – 50-75 years (USPSTF) vs. 50+ (ACS)
  - Screening utilization data - National Health Interview Survey
  - Late-stage diagnosis data - SC Central Cancer Registry

K07 Application Mentors

- James Hébert (USC)
- Janice Probst (USC)
- Lee Mobley (Georgia State University, formerly ASU)
- Mario Schootman (Washington University, St. Louis University)

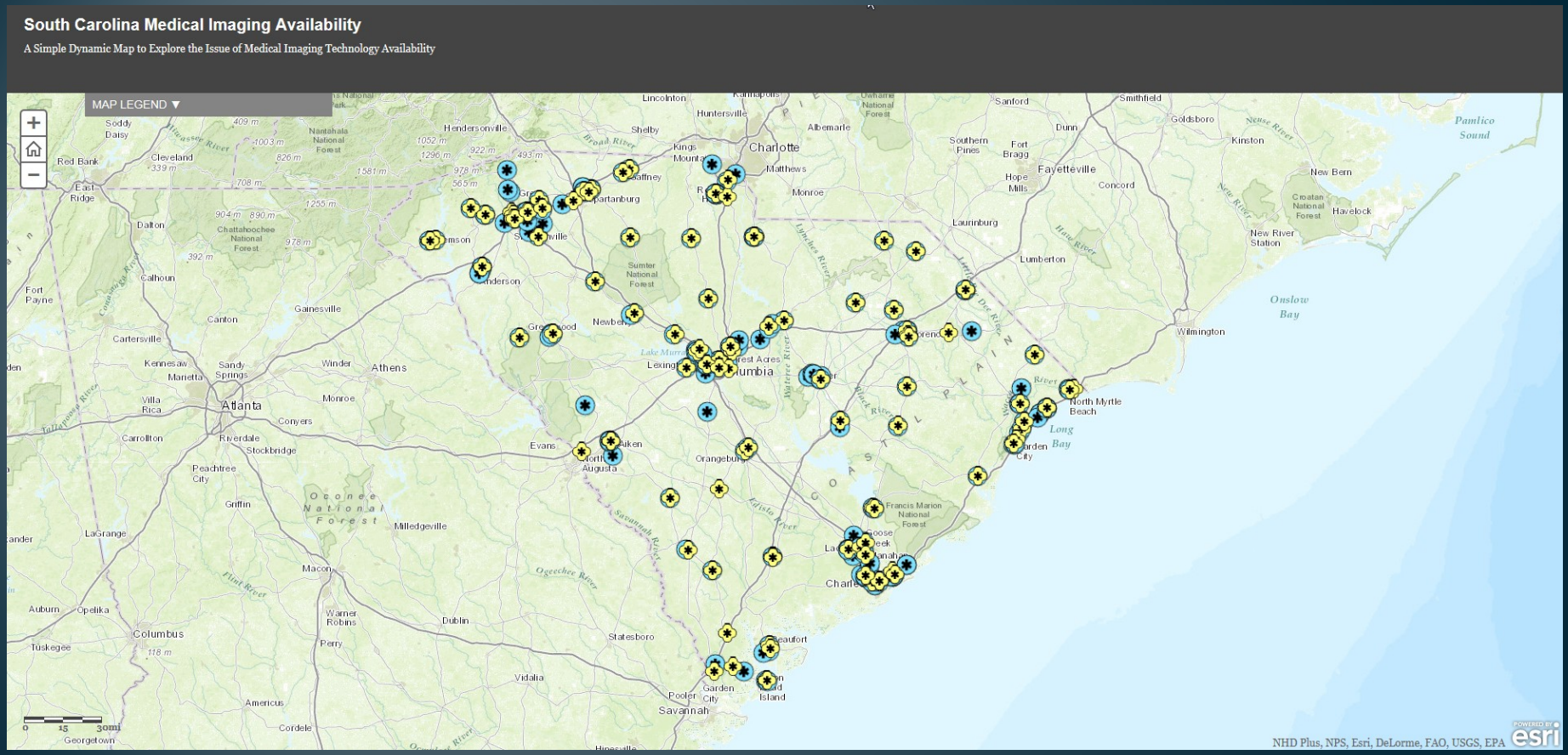
SC Health Atlas

- Develop an interactive, web-based map service that will provide information on the locations and services offered by health care providers in SC.
- Point locations of:
  - Safety-net providers (e.g., FQHCs, Free clinics)
  - Primary care providers
  - Hospitals
  - Cancer screening and treatment facilities
- No current resource directory of all healthcare providers in SC
- Website will have the ability to query locations by services provided and insurances accepted.

SC Health Atlas

- Uses/Advantages:
  - Highlight regions with poor access to care
  - Help determine sites for new health care facilities or interventions
  - Data able to be visualized, printed, or exported (raw data)
  - Use of ArcGIS Online, ESRI's pioneering technology = increased visibility for the university and partner organizations/centers
- Funding/Partners
  - Prototype currently in development through collaboration with USC Department of Geography, Integrated Information Technology, and SC Rural Health Research Center
  - Pilot funding from Blue Cross Blue Shield
  - Potential data partners: Office of Research Statistics, Blue Cross Blue Shield, Others

Example map in ArcGIS Online



Contact information

Jan M. Eberth, PhD

Assistant Professor

SC Cancer Prevention and Control Program

Department of Epidemiology and Biostatistics

University of South Carolina

Email: jmeberth@mailbox.sc.edu

Office: 803-576-5770