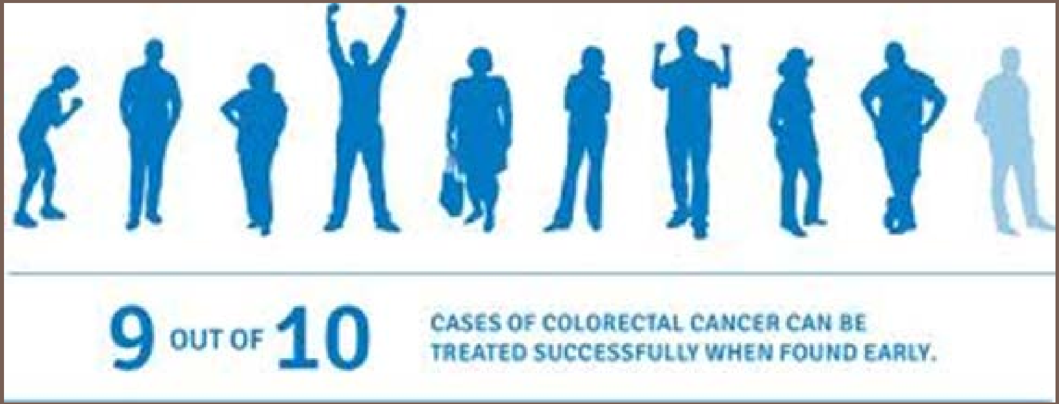
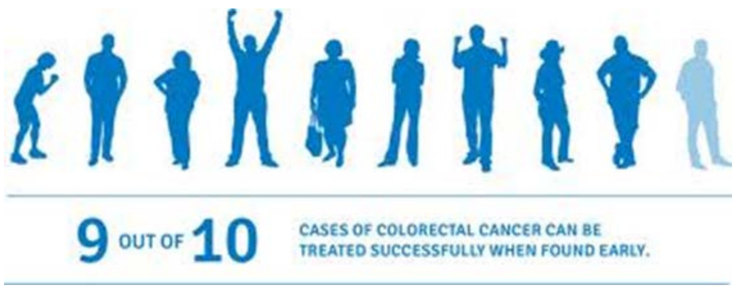


THE IMPACT OF MISSING STAGE AT DIAGNOSIS ON RESULTS OF GEOGRAPHIC RISK OF LATE-STAGE COLORECTAL CANCER

Recinda Sherman, MPH, PhD, CTR
NAACCR Annual Meeting, Wed June 25, 2014

Outline

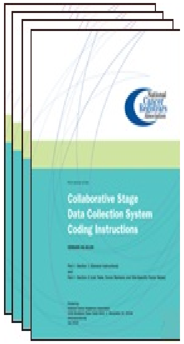
- Background: Missing data, Colorectal Cancer, Colorectal Cancer Screening
- Methods: Cluster Detection, Area-based measures, Distance analysis
- Results: Cluster Detection, Area-based measures, Distance analysis
- Conclusions
  - Future directions



Cancer Registry Purpose

"These data are then used to inform a wide variety of public health decisions and provide rich information for cancer diagnosis and treatment education."

- Guides policy and treatment decisions
  - Reduce the burden of cancer
- Error
  - Inappropriate public health response
  - Fail to protect population; waste of public funds
- Cause
  - Flawed research design, inappropriate assumptions, bias
  - **Data quality in registry data**



Missing data

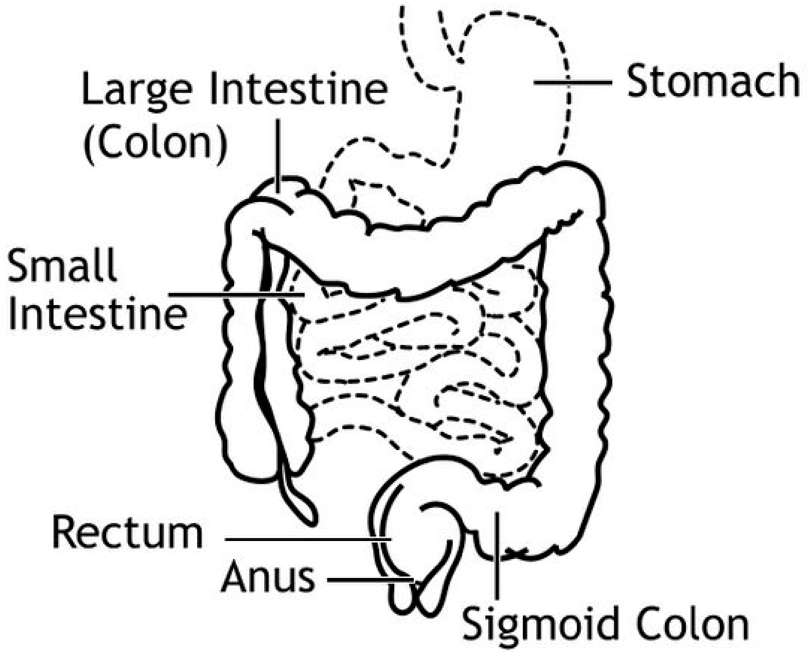
- Random – hard to correct during collection but established methods for analysis
  - Remove cases with missing data, random allocation of missing information, interpolation based on known data
- Systematic – "easy" to correct during collection but no established method for analysis
  - Cartographic selection bias
- Leads to reduced power and possibly biased results

Background: Cancer surveillance

- System of central (state) cancer registries
- Collect incidence, type, anatomic location, extent of disease, treatment, and outcomes
  - National standards, “Gold Standard”
- Systematic analysis of cancer data
  - Identify burden and trends of cancer
  - Generate hypotheses about cancer risk and etiology
- Guides policy and treatment decisions
  - Reduce the burden of cancer

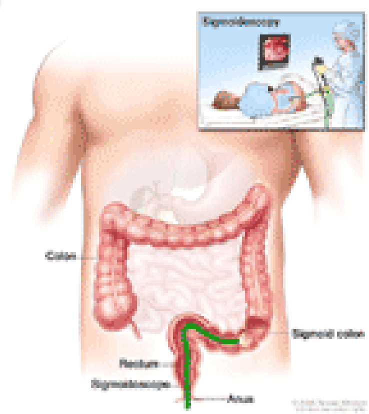
Background: Colorectal cancer

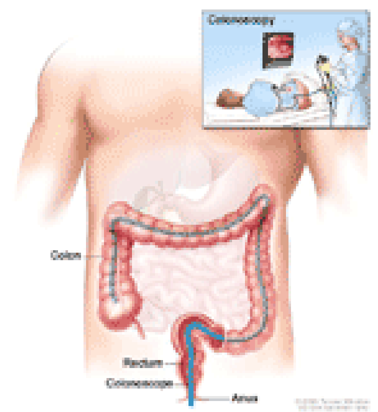
- 2nd Mortality
- 4th Invasive
- Cause ?
  - Multifactorial
  - Diet, exercise, HPV
- 95% adenocarcinomas
  - Pre-cancerous polyps



Background: Screening

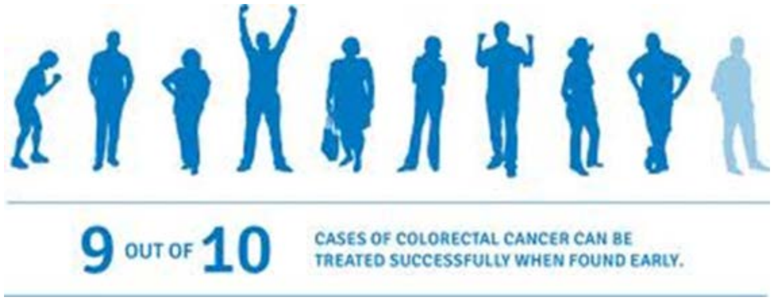
- Multimodal
  - FOBT, sigmoidoscopy, colonoscopy
  - 50+
- USPSTF Grade A recommendation
  - Primary and secondary prevention
- 50% general population
  - Blacks, lower
  - Hispanics, lowest





Stage of disease

- Common outcome measure: early vs late
  - Proxy for screening uptake
  - Proxy for prognosis
- Often missing/unknown
  - Lack of clinical assessment
    - Lack of connection to health services
    - Contraindicated (age, comorbidities)
    - Low survival, likely unscreened
  - Lack of collection
    - Unknown survival/screening



Aim of study

- Evaluate the impact of missing stage at diagnosis for colorectal cancer geospatial research
  - By race/ethnicity
- Three different methods of handling missing stage
  - Remove cases (most common approach)
  - Allocate based on demographics
  - Code all as late
- Three different cancer control questions
  - Where should we target a screening intervention?
  - How should we tailor the intervention based on demographics?

  Are disparities being driving by unequal proximity to clinical care?

Methods: Florida Cancer Data System

- NPCR, Incidence based, 1981+
- 2nd largest cancer registry in US
- 115,000 incident cancer cases annually
  - 200,000 reports, 150,000 Death, 1,000,000 Discharge
- Gold Certification
- System
  - Facilities, physicians, vital statistics, hospital discharge, medical billing, pathology
- Geocoding
  - 95% street level, 3% PO Box
  - Proprietary vendor, no manual follow-up

Methods: Case selection

- Colorectal cases
  - diagnosed 1996-2010
  - 1st primary, age 50+, adenocarcinomas
- Geocoded to 2010 tract or block group
  - based on street address
- Stage at diagnosis
  - Dichotomous “early” & “late”

Methods: Cluster detection

- **First:** Detect high risk clusters of late-stage at diagnosis CRC
  - Blacks, Cubans, White Hispanics, White Non-Hispanics
- SaTScan
  - Spatial Scan
  - Poisson Model
    - Late-stage incidence using age-adjusted rates
  - Bernoulli Model
    - ratio of counts late:early

- Details in upcoming *Preventing Chronic Disease* method paper: *Issues in applying spatial analysis tools in public health: an example of using SaTScan to identify geographic targets for colorectal cancer screening interventions*

Methods: Area-based measures

- 2006-2010 ACS aggregated dataset
  - Tract-level measure
  - Socio-demographic characteristics
- 2010 Florida BRFSS
  - County-level measure
  - Screening uptake
- Hierarchical, logistic regression models
  - Proc glimmix

Methods: Distance analysis

- Travel distance between patient's residence and facility that reported the case
  - Median and mean
- NAACCR Shortest Path Finder Tool
  - Road networks, TeleAtlas

Results:

	Black (n=3,779)			Hispanic White (n=4,989)			Non-Hispanic White (n=28,796)		
	Unknown			Unknown			Unknown		
	=Late	=Exclude	=Allocate	=Late	=Exclude	=Allocate	=Late	=Exclude	=Allocate
Total late cases	2,242	2,058	2,165	3,003	2,778	2,907	16,160	14,782	15,512
All combined	59%	57%	57%	60%	58%	58%	56%	54%	54%
Sex									
female	58%	56%	56%	60%	58%	58%	56%	54%	54%
male	61%	59%	59%	60%	58%	58%	56%	54%	54%
Age									
50-54	61%	60%	60%	62%	60%	60%	58%	57%	57%
55-59	64%	63%	63%	67%	65%	65%	60%	59%	59%
60-64	60%	58%	58%	62%	60%	60%	59%	58%	58%
65-69	57%	55%	55%	58%	57%	57%	56%	54%	54%
70-74	56%	54%	54%	61%	59%	60%	54%	52%	52%
75-79	59%	58%	58%	60%	58%	58%	54%	52%	51%
80-84	57%	53%	53%	57%	55%	55%	54%	51%	51%
85+	60%	55%	54%	58%	54%	54%	57%	53%	53%

Table 1. Distribution of late stage by method of handling unknowns, by race/ethnicity, sex, and age

Results: Cluster detection

	# clusters			# cases in cluster(s)			range of RR^			range of p		
	=Late	=Exclude	=Allocate	=Late	=Exclude	=Allocate	=Late	=Exclude	=Allocate	=Late	=Exclude	=Allocate
Black (B 30%)	1	1	1	581	58	423	1.2	1.5	1.2	0.05	0.1	0.4
Black (P 40%)	1	1	2	86	284	196	1.5	1.4	1.5- 4.2	0.03	0.1	<01 - 0.05
HW (B na)	na	na	na	na	na	na	na	na	na	na	na	na
HW (P50%)	2	3	2	1,860	1,555	1,455	1.4 - 1.7	1.4 - 1.7	1.4 - 1.6	<.001 - <.01	<.001 - 0.05	<.001 - 0.01
nonHW (B 15%)	3	2	4	4,692	3,704	3,380	1.1 - 1.2	1.1 - 1.1	1.1 - 1.2	<.001 - 0.03	<.001	<.001 - 0.02
nonHW (P 25%)	12	11	12	9,823	8,048	8,321	1.2 - 5.2	1.2 - 8.8	1.2-5.1	<.001 - 0.03	<.001 - 0.03	<.001 - 0.05

All = allocate B = Bernoulli, P = Poisson, * maximum cluster size (scale), ^RR = Relative Risk, HW= Hispanic White

note: none of the Bernoulli analysis was statistically significant for comparision.

Table 2. Late-stage at diagnosis colorectal cancer clusters, Florida 2006-2010

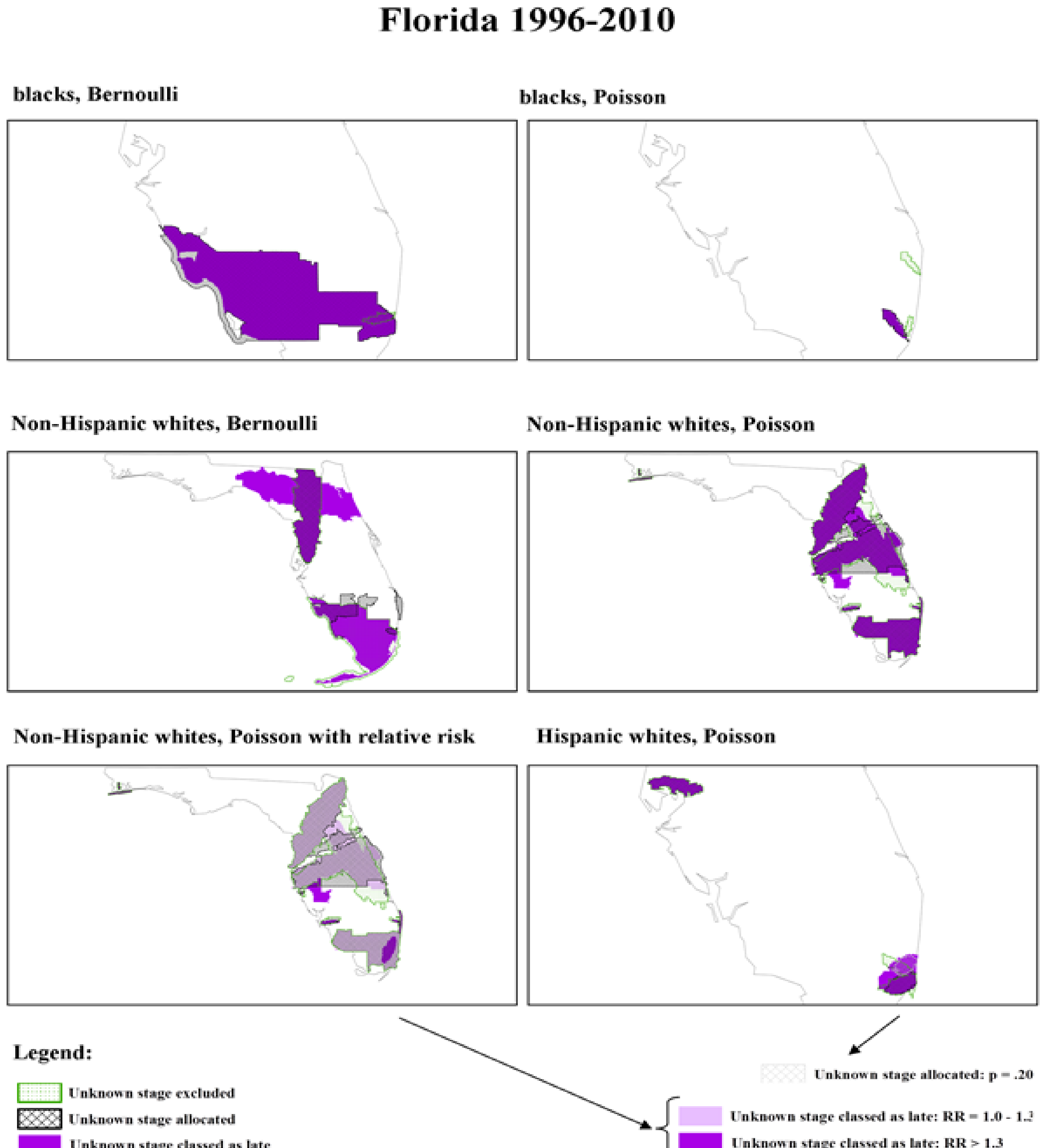


Figure 1. Comparison of tract-based cluster locations by method of handling unknowns, by race/ethnicity and Model type

Results: Area-based measures

Non-Hispanic White:Bernoulli Method	Unknown=Late			Unknown=Exclude			Unknown=Allocate		
Tract Level	OR	p-value	CI	OR	p-value	CI	OR	p-value	CI
% non-white	1.0	<.001	1.0, 1.0	1.0	<.001	1.0, 1.0	1.0	0.04	1.0, 1.0
% hispanic	1.0	0.03	1.0, 1.0	1.0	0.00	1.0, 1.0	*not included*		
% minority	*not included*			*not included*			*not included*		
% foreign born	1.1	<.001	1.1, 1.1	1.1	<.001	1.1, 1.1	1.0	<.001	1.0, 1.1
% not hs grad	*not included*			*not included*			*not included*		
% no English spoken	0.9	0.00	0.8, 1.0	0.9	0.00	0.8, 1.0	0.9	0.00	0.9, 1.0
% below poverty	1.0	0.00	1.0. 1.1	*not included*			1.0	0.05	1.0, 1.0
County Level									
% ever received sigmoidoscopy/colonscopy	0.8	<.001	0.8, 0.8	0.8	<.001	0.8, 0.8	1.0	0.0	0.9, 1.0
% received fobt last 2 years	*not included*			*not included*			1.1	<.001	1.1, 1.1
Non-Hispanic White: Poisson Method	**Unknown=Late**			**Unknown=Exclude**			**Unknown=Allocate**		
Tract Level	**OR**	**p-value**	**CI**	**OR**	**p-value**	**CI**	**OR**	**p-value**	**CI**
% non-white	*not included*			*not included*			*not included*		
% hispanic	*not included*			*not included*			*not included*		
% minority	1.1	<.001	1.1, 1.1	1.1	<.001	1.1, 1.1	1.1	<.001	1.0, 1.1
% foreign born	1.1	<.001	1.0, 1.1	*not included*			1.0	0.02	1.0, 1.1
% not hs grad	*not included*			1.0	0.01	1.0, 1.0	*not included*		
% no English spoken	0.8	<.001	0.8, 0.9	0.9	0.04	0.7, 0.8	0.8	<.001	0.8, 0.9
% below poverty	1.0	0.00	1.0, 1.0	1.0	0.03	1.0, 1.0	1.0	0.0	1.0, 1.0
County Level									
% ever received sigmoidoscopy/colonscopy	0.8	<.001	0.8, 0.8	0.8	<.001	0.8, 0.9	0.8	<.001	0.8, 0.8
% received fobt last 2 years	*not included*			1.0	0.03	0.9, 1.0	1.0	0.01	0.9, 0.9

Results: Distance analysis

Non-Hispanic White:Bernoulli Method	Unknown=Late			Unknown=Exclude			Unknown=Allocate		
Tract Level	OR	p-value	CI	OR	p-value	CI	OR	p-value	CI
% non-white	1.0	<.001	1.0, 1.0	1.0	<.001	1.0, 1.0	1.0	0.04	1.0, 1.0
% hispanic	1.0	0.03	1.0, 1.0	1.0	0.00	1.0, 1.0	*not included*		
% minority	*not included*			*not included*			*not included*		
% foreign born	1.1	<.001	1.1, 1.1	1.1	<.001	1.1, 1.1	1.0	<.001	1.0, 1.1
% not hs grad	*not included*			*not included*			*not included*		
% no English spoken	0.9	0.00	0.8, 1.0	0.9	0.00	0.8, 1.0	0.9	0.00	0.9, 1.0
% below poverty	1.0	0.00	1.0. 1.1	*not included*			1.0	0.05	1.0, 1.0
County Level									
% ever received sigmoidoscopy/colonscopy	0.8	<.001	0.8, 0.8	0.8	<.001	0.8, 0.8	1.0	0.0	0.9, 1.0
% received fobt last 2 years	*not included*			*not included*			1.1	<.001	1.1, 1.1

Non-Hispanic White: Poisson Method	Unknown=Late			Unknown=Exclude			Unknown=Allocate		
Tract Level	OR	p-value	CI	OR	p-value	CI	OR	p-value	CI
% non-white	*not included*			*not included*			*not included*		
% hispanic	*not included*			*not included*			*not included*		
% minority	1.1	<.001	1.1, 1.1	1.1	<.001	1.1, 1.1	1.1	<.001	1.0, 1.1
% foreign born	1.1	<.001	1.0, 1.1	*not included*			1.0	0.02	1.0, 1.1
% not hs grad	*not included*			1.0	0.01	1.0, 1.0	*not included*		
% no English spoken	0.8	<.001	0.8, 0.9	0.9	0.04	0.7, 0.8	0.8	<.001	0.8, 0.9
% below poverty	1.0	0.00	1.0, 1.0	1.0	0.03	1.0, 1.0	1.0	0.0	1.0, 1.0
County Level									
% ever received sigmoidoscopy/colonscopy	0.8	<.001	0.8, 0.8	0.8	<.001	0.8, 0.9	0.8	<.001	0.8, 0.8
% received fobt last 2 years	*not included*			1.0	0.03	0.9, 1.0	1.0	0.01	0.9, 0.9

Table 3c. Heirarchical, area-based risk models for non-Hispanic whites, by method of handling unknowns and Model Type

Conclusions

- Currently no standard method on how to handle cases with unknown stage at diagnosis
- Most remove from analysis
  - Results from this method deviated the most from the other two
  - Reduces power due to reduce n
  - Creates geographic selection bias; can overestimate effects
- Recoding to late/allocation
  - Potential for misclassification bias; more likely to move results to null

Moving forward…

- Re-abstraction studies or links with clinical datasets
  - To determine a more precise allocation method
- Multiple imputation
  - Compare to other methods
- Results consistent among multiple methods can be interpreted with more confidence

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Questions?

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