

Rural and Urban Differences in Stage at Diagnosis of Colorectal Cancer in Nebraska

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Background

Colorectal Cancer (CRC)

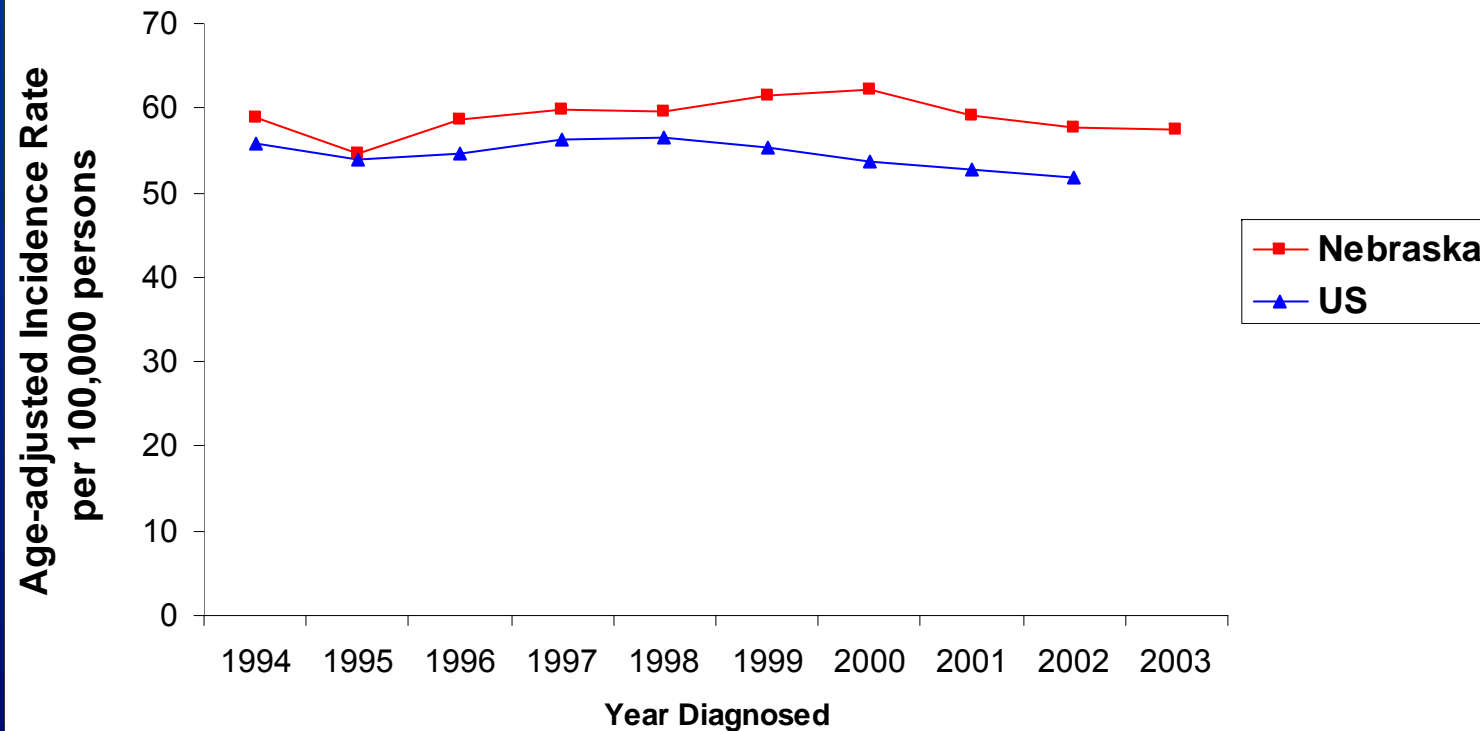
- Cancer of the Cecum, Appendix, Colon, Large Intestine, or Rectum
- Second most frequent cause of cancer related deaths in Nebraska and the US, and the fourth most frequently diagnosed cancer in Nebraska (behind lung, breast, and prostate cancer)
- Screening and early diagnosis is essential to reduce mortality

Risk Factors for CRC

- Physical inactivity
- Overweight or obesity
- Smoking
- High alcohol consumption
- Diet high in red meat
- Diet low in fruits and vegetables
- Older age
- Male

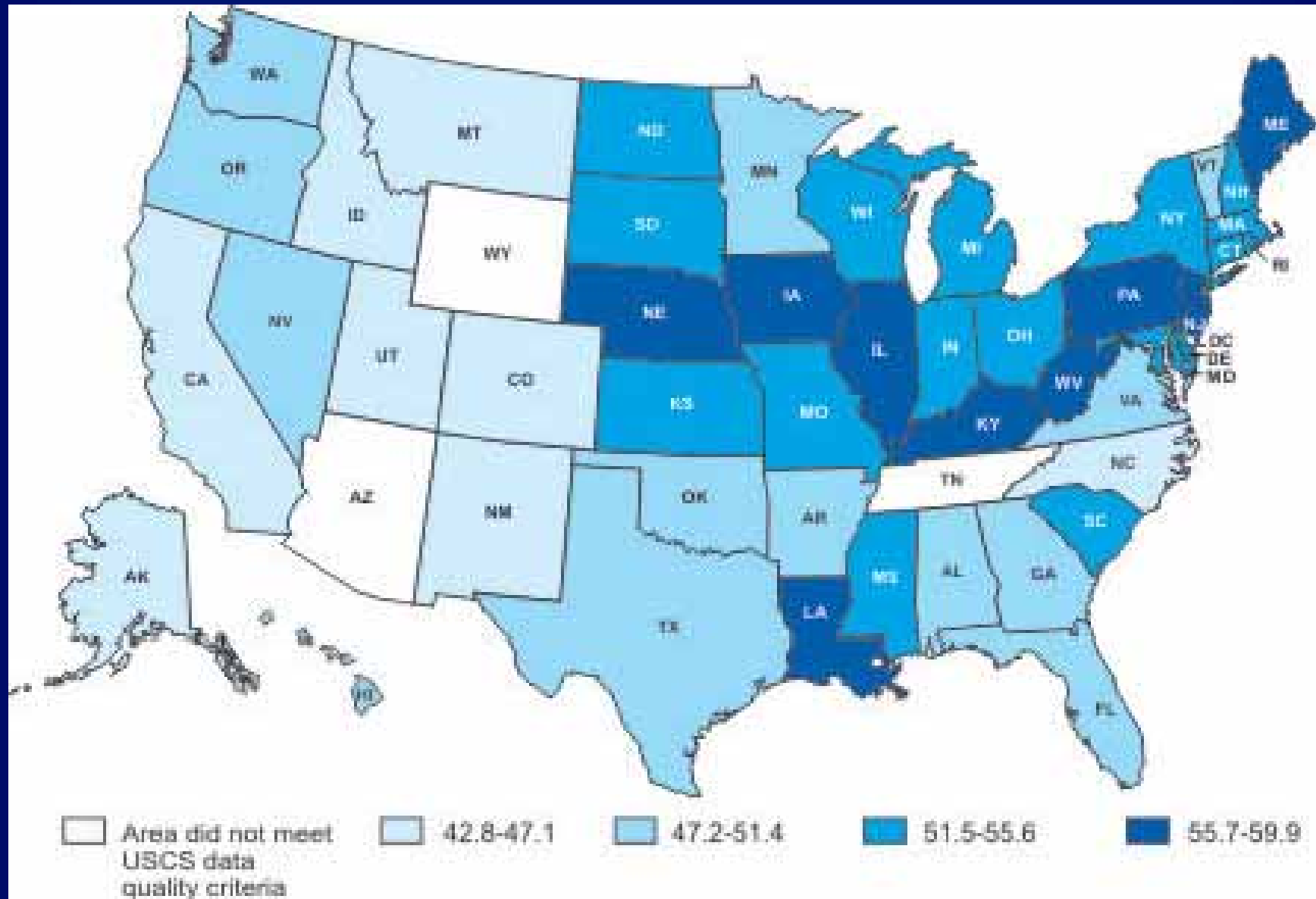
Why are we interested in CRC in Nebraska?

Age-adjusted Incidence Rates for Colorectal Cancer in Nebraska and the United States



Source: Cancer Incidence & Mortality in Nebraska, 2003

Age-adjusted Incidence Rates (2003)



Source: <http://www.cdc.gov/cancer/colorectal/statistics/state.htm>

Mortality Prevention

- Annual/Bi-annual screening
- Early and Effective Treatments
- Because ~30% of Nebraskans are living in rural areas, there is concern that they are less likely to be screened or have difficulty accessing treatment

Early results have identified trends between rural/urban living status and stage at diagnosis

Adjusted Odds Ratio of Stage at Diagnosis for Colorectal Cancer in Rural Residents of Nebraska Relative to Urban Residents (N=11,164)

Stage at Diagnosis¹	Adjusted Odds Ratio (95% CI)	P-Value
In situ	1.00	
Local	1.01 (0.78-1.32)	0.9408
Regional	1.08 (0.89-1.51)	0.5395
Distant	1.30 (0.99-1.73)	0.0636
Unstaged	2.38 (1.66-3.39)	<0.0001

1. Adjusted for age, sex, race/ethnicity, income, and primary insurance.

Study Objective

Use data from the Nebraska Cancer Registry on colorectal cancer cases and DMap IV software to identify potential effects of rural living status on incidence rates and stage at diagnosis.

Methods

Data Sources

- Nebraska Cancer Registry
- 2000 Census Block Group Data
- StreetMap USA 2006 data

Geocoding

- Created an Address Locator using StreetMap 2006
- 11,164 Cases Matched by patient address and zip code
 - Matched 9,740 cases (87.2%) by address initially
 - Manually matched 547 cases (4.9%) by correcting address spellings or zip code transpositions
 - Manually matched 82 cases (0.7%) by replacing apartment/care center name for address.
 - Remaining 795 cases (7.1%) had unknown addresses or only a PO Box and were randomly assigned to point within the listed zip code

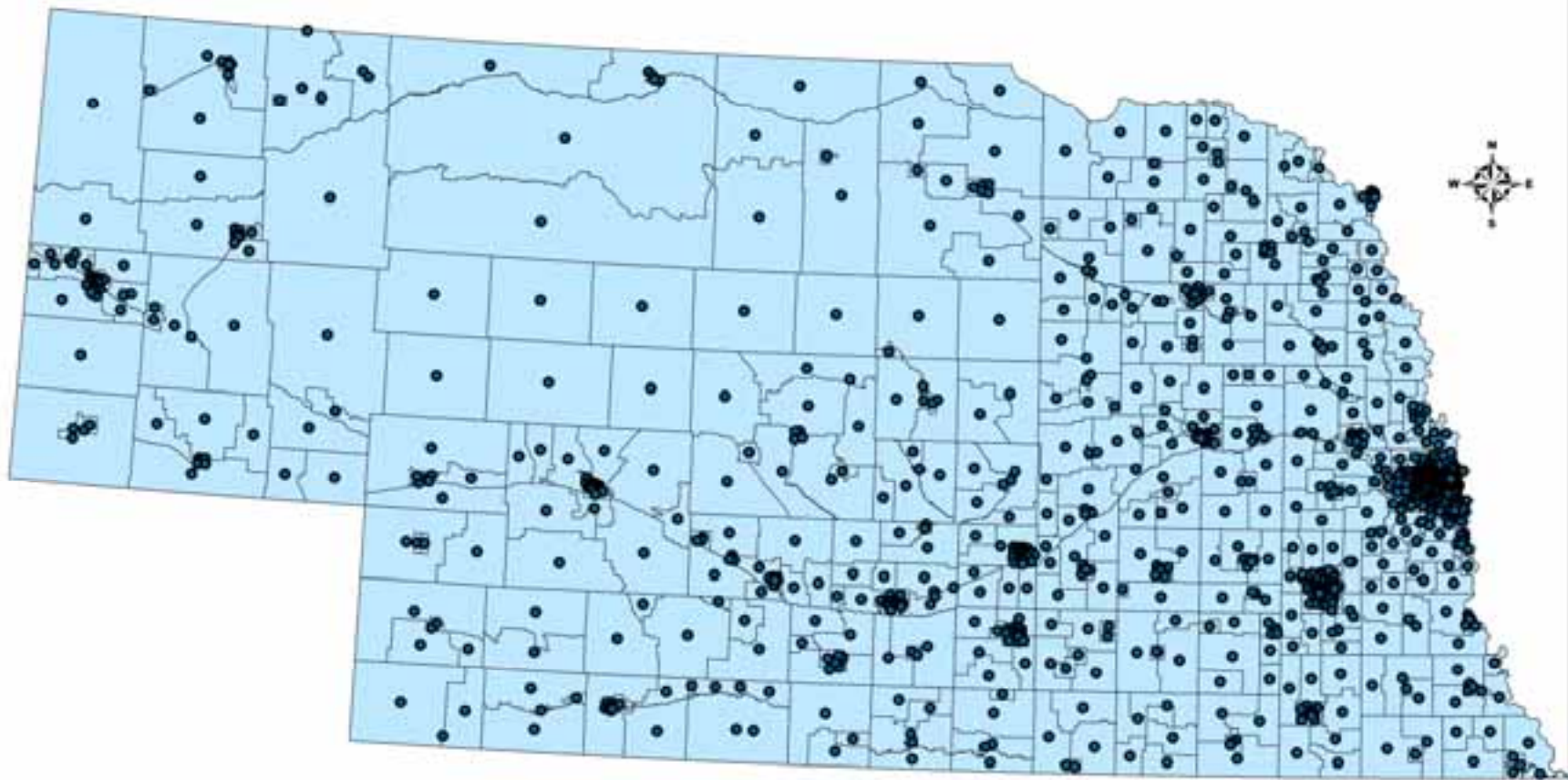
DMap IV Software

- Developed by Dr. Cai and Dr. Rushton at University of Iowa
- Uses disease case counts and population data to compute a standardized incidence rate for grid points at specified locations.
- Data can be used to identify areas of higher or lower than expected incidence rates.

Two Input Files Needed

- Disease Data
 - Colorectal case counts by block group
 - Expected number of cases
 - $E = \sum R*N$
 - R= Nebraska 10-year incidence rates by 19 age groups
 - N= 10-year population average of each block group by 19 age groups
 - Option for categorical area data (rural/urban)
- Grid Points
 - Latitude, Longitude, and categorical area data (rural/urban) of points spaced every three miles

Block Group Centroids

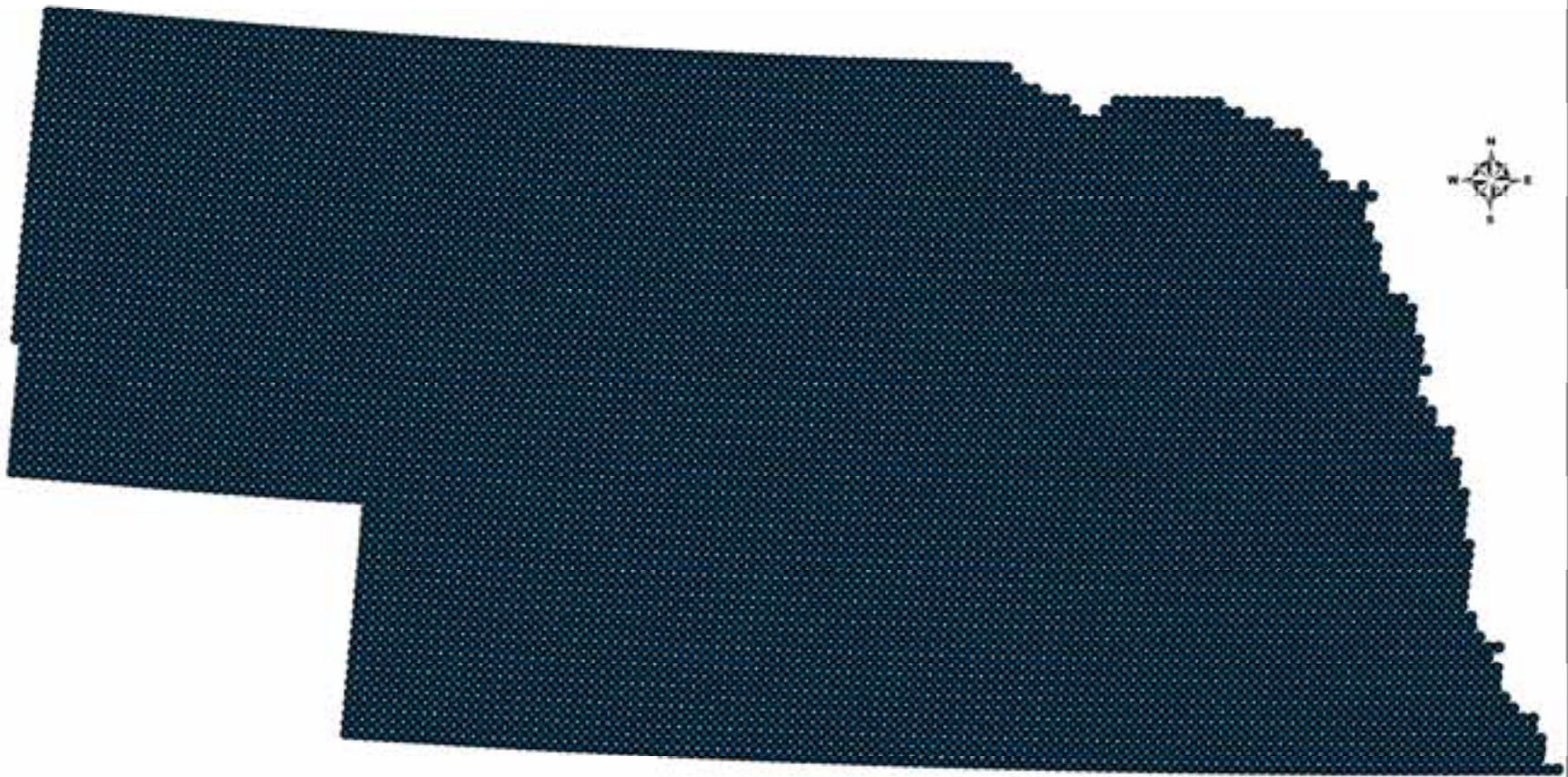


Legend

- Block Group Centroids

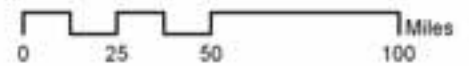


Three - Mile Grid Point File

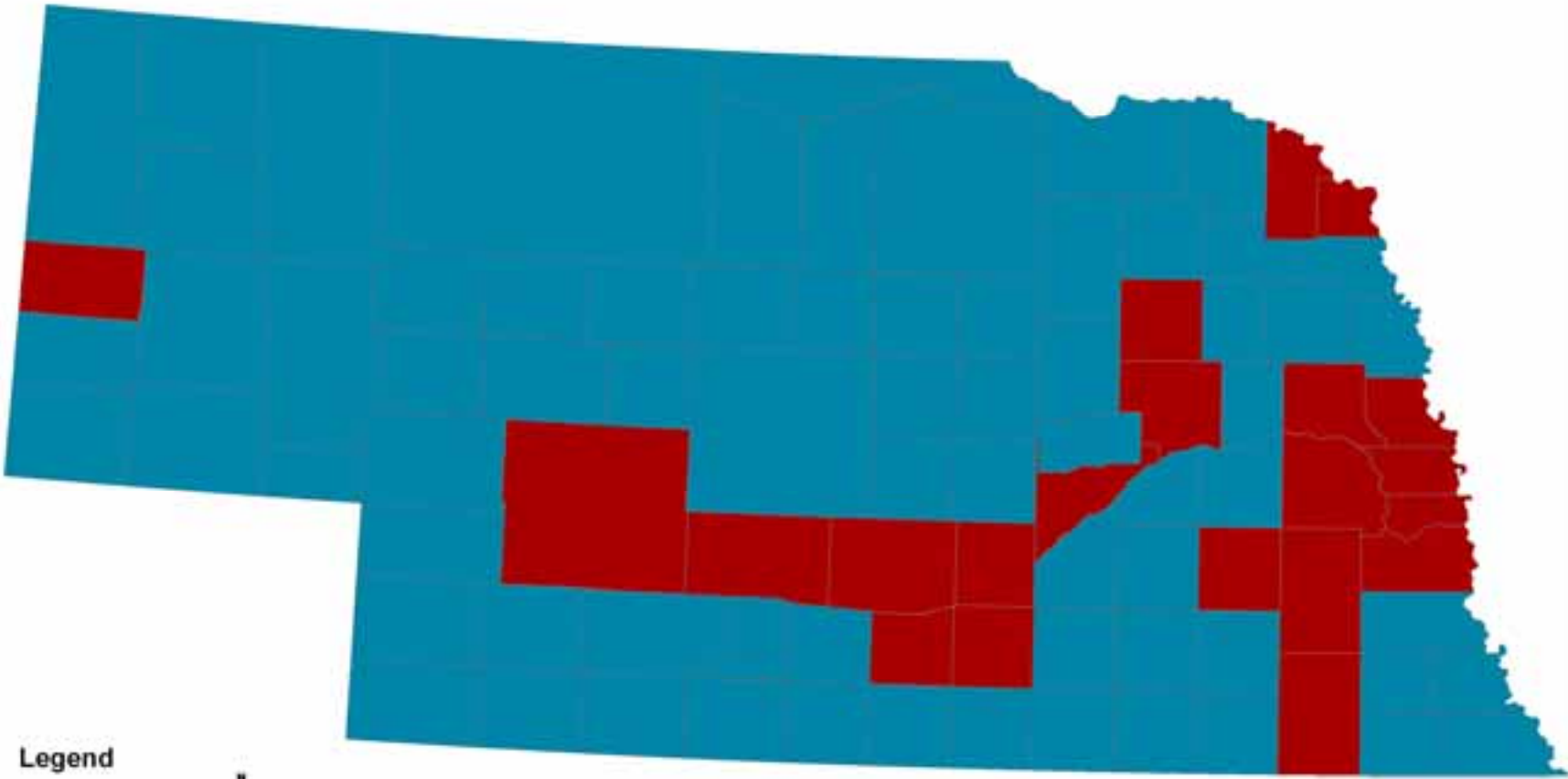


Legend

- 3 Mile Point Grid



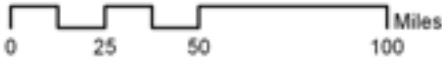
Rural and Urban Counties of Nebraska



Legend

Counties

- Rural
- Urban

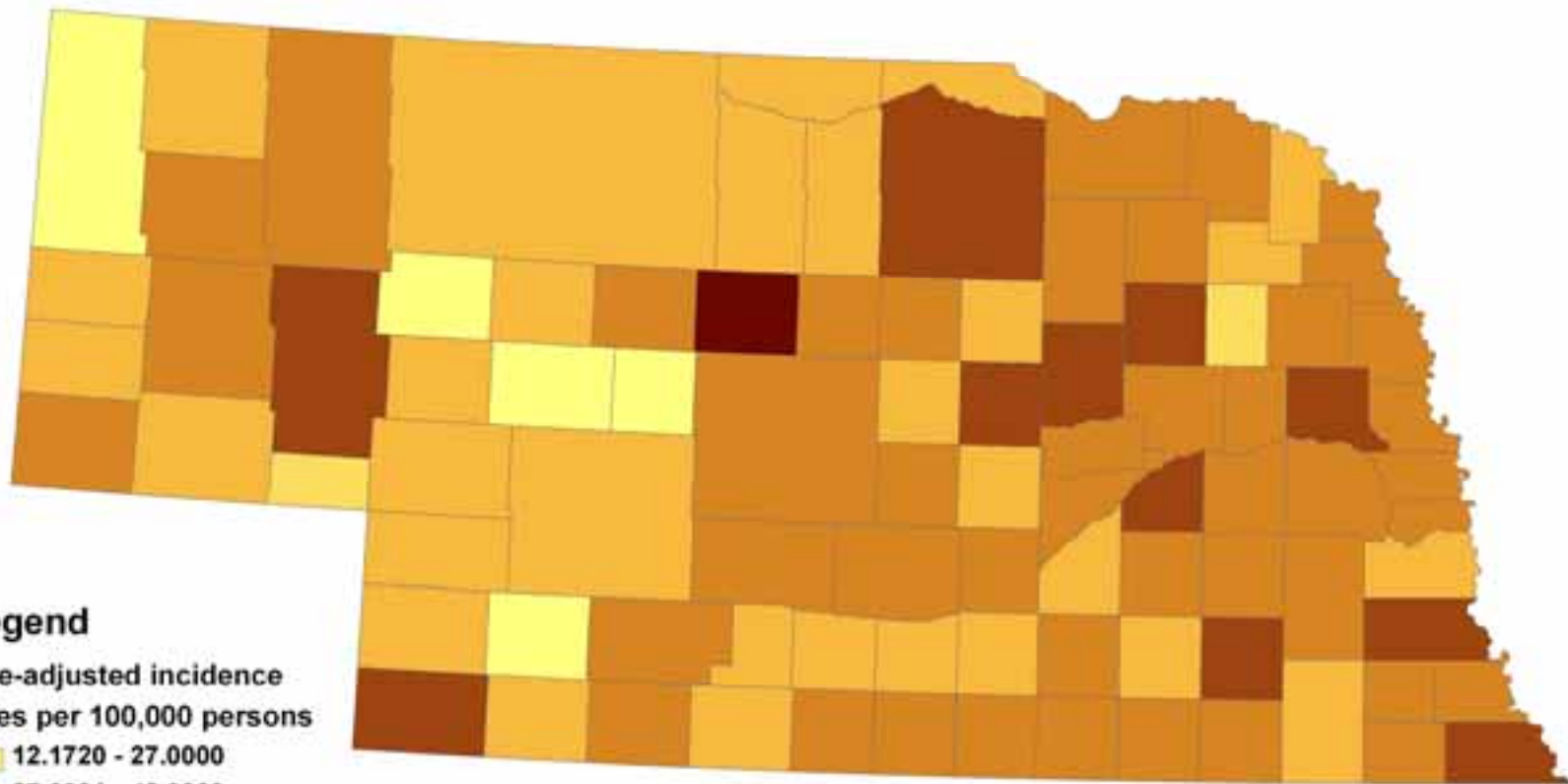


Standardized Incidence Rates

- DMap output gives the standardized incidence rate for each grid point.
 - $SIR = \text{Observed cases} / \text{Expected Cases}$
 - Based on the 50 closest cases (variable search radius)
- Calculated SIR for all colorectal cancer cases, as well as late stage only colorectal cancer cases.
- Standardized incidence rate for each grid point was smoothed using ordinary Gaussian Kriging.

Results

Colorectal Cancer Age-Adjusted Incidence Rates by County (1994-2003)



Legend

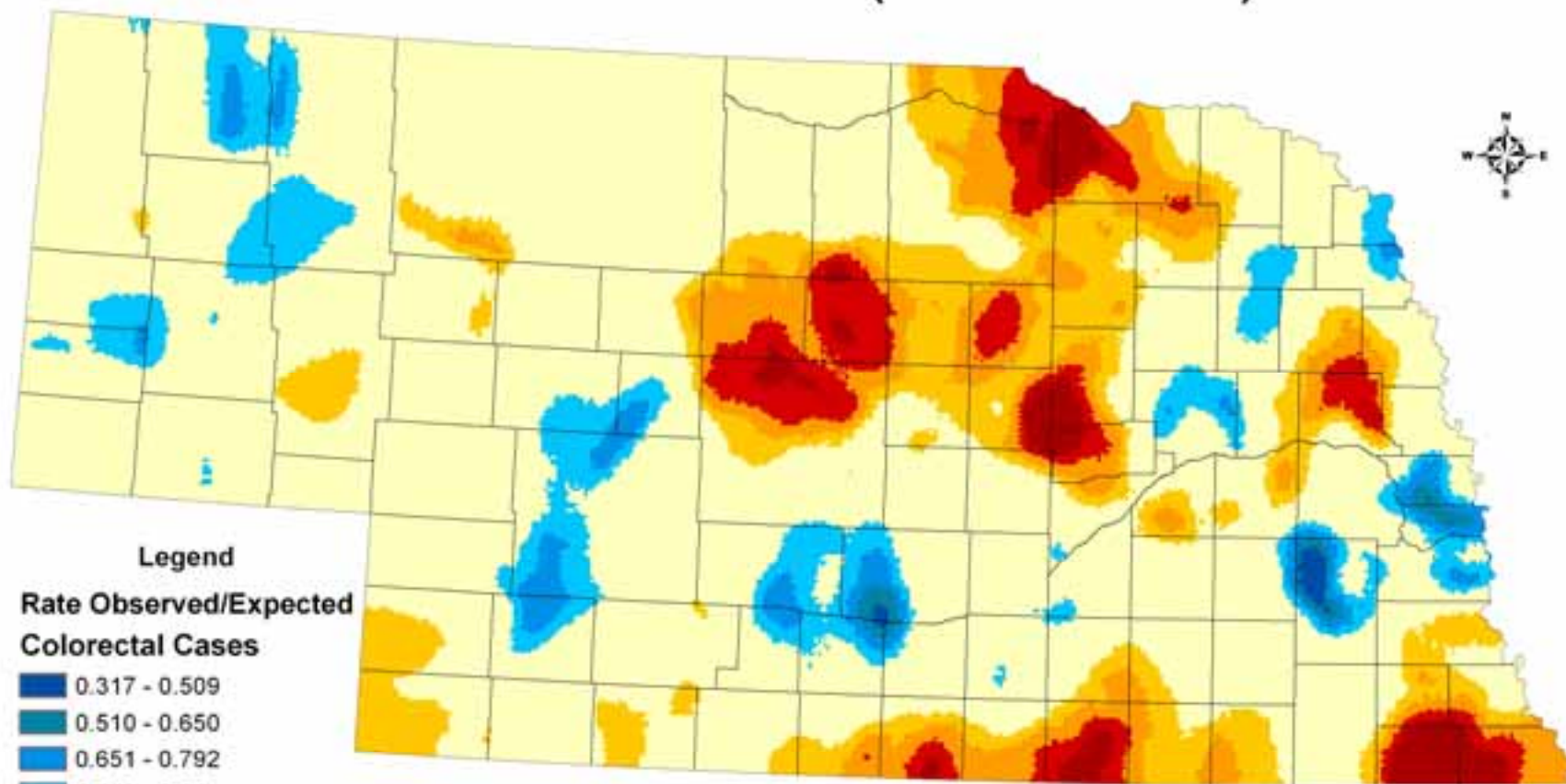
Age-adjusted incidence rates per 100,000 persons

- 12.1720 - 27.0000
- 27.0001 - 42.0000
- 42.0001 - 57.0000
- 57.0001 - 72.0000
- 72.0001 - 87.0000
- 87.0001 - 106.8662

0 25 50 100 Miles



Colorectal Cancer Standardized Incidence Rates (1994-2003)

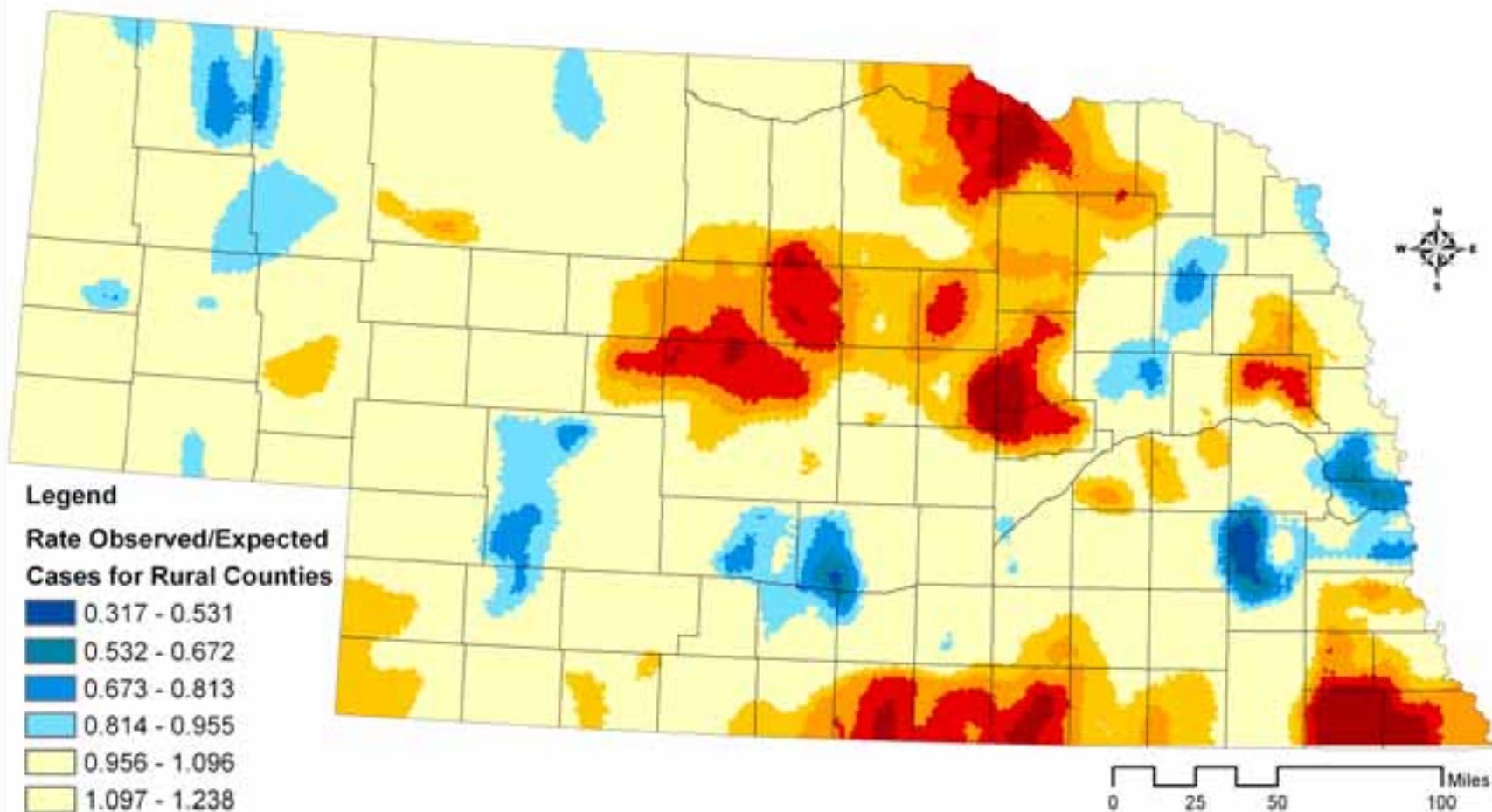


Legend
Rate Observed/Expected
Colorectal Cases

- 0.317 - 0.509
- 0.510 - 0.650
- 0.651 - 0.792
- 0.793 - 0.934
- 0.935 - 1.076
- 1.077 - 1.217
- 1.218 - 1.359
- 1.360 - 1.501
- 1.502 - 1.642
- 1.643 - 1.784
- 1.785 - 1.926
- 1.926 - 2.303

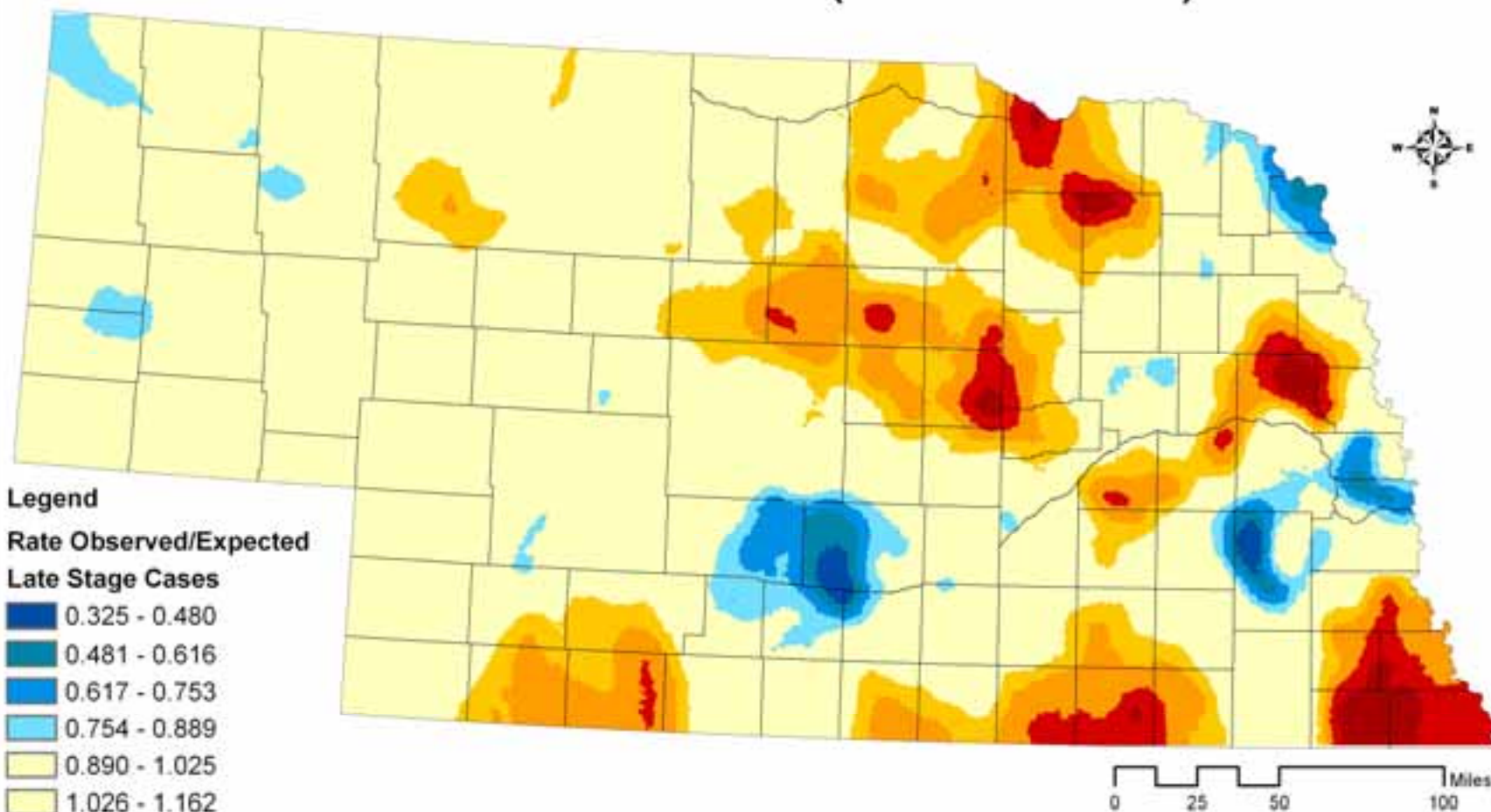
Proportion of observed cases by the expected number of cases. Rates are based on the 50 closest expected cases (aggregated to census block group centroids) on a 3-mile grid. Points were smoothed using ordinary Kriging, where red areas indicate higher than expected rates and blue areas indicate lower than expected rates, based on the overall age-adjusted state incidence rate.

Colorectal Cancer Standardized Incidence Rates for Rural Counties (1994-2003)



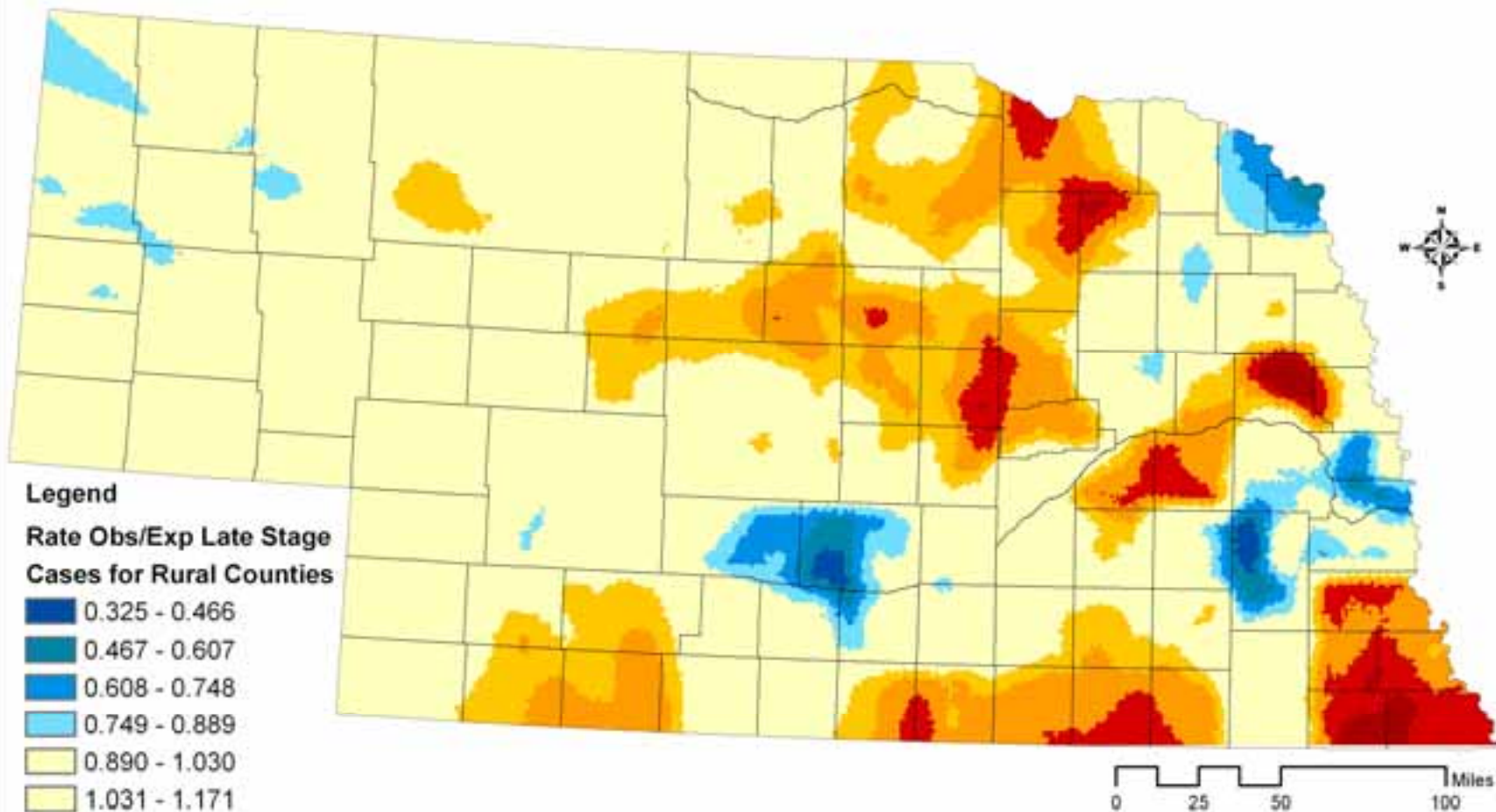
Proportion of observed cases by the expected number of cases for cases falling inside rural counties. Rates are based on the 50 closest expected cases (aggregated to census block group centroids) on a 3-mile grid of rural counties. Points were smoothed using ordinary Kriging, where red areas indicate higher than expected rates and blue areas indicate lower than expected rates, based on the overall age-adjusted state incidence rate.

Colorectal Cancer Standardized Late Stage Incidence Rates (1994-2003)



Proportion of observed late stage cases by the expected number of late stage cases. Rates are based on the 50 closest expected cases (aggregated to census block group centroids) on a 3-mile grid. Points were smoothed using ordinary Kriging, where red areas indicate higher than expected rates of late stage cases and blue areas indicate lower than expected rates, based on the overall age-adjusted state late stage incidence rate.

Colorectal Cancer Standardized Late Stage Incidence Rates for Rural Counties (1994-2003)

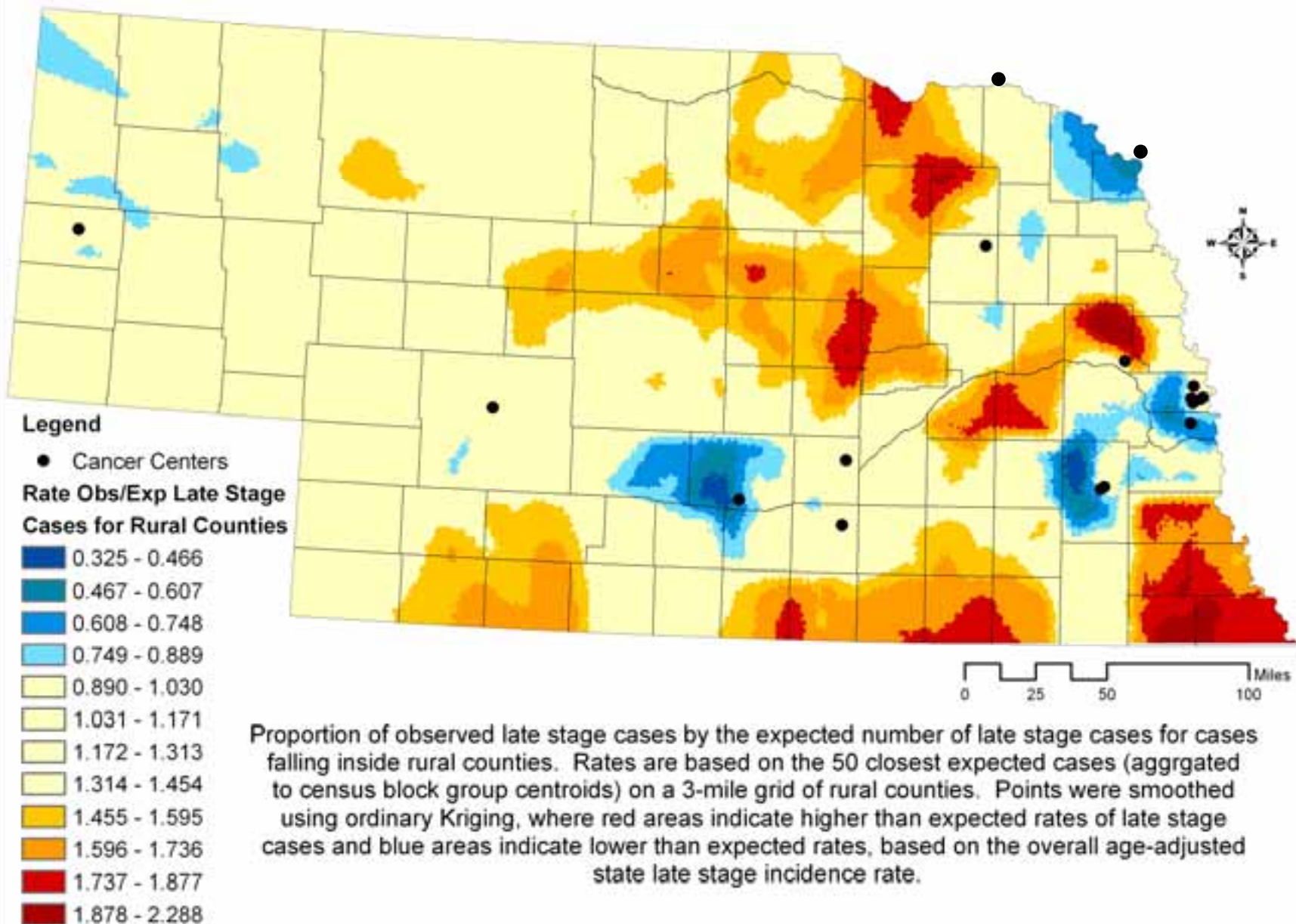


Proportion of observed late stage cases by the expected number of late stage cases for cases falling inside rural counties. Rates are based on the 50 closest expected cases (aggregated to census block group centroids) on a 3-mile grid of rural counties. Points were smoothed using ordinary Kriging, where red areas indicate higher than expected rates of late stage cases and blue areas indicate lower than expected rates, based on the overall age-adjusted state late stage incidence rate.

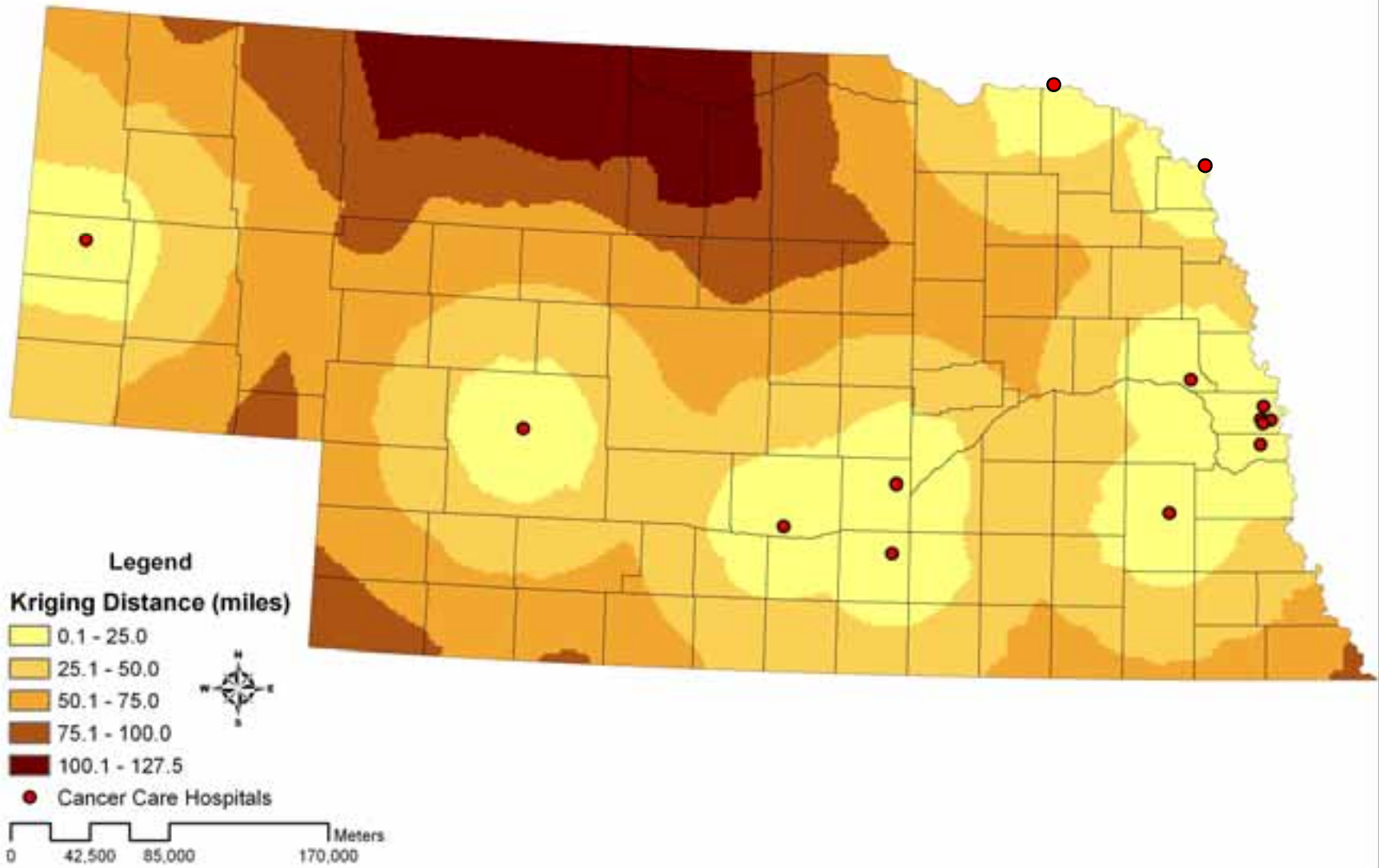
Possible Explanations for the variation of Standardized Incidence Rates across Nebraska

- Differences in resources for CRC screening
- Distance to diagnosing and treatment facilities
- Environmental/Lifestyle factors

Cancer Centers in Relation to Late Stage CRC Standardized Incidence Rates for Rural Counties (1994-2003)



Average Distance from Patient Residence to Accredited Cancer Care Hospitals using Kriging



Conclusions

- Standardized Incidence Rates vary across Nebraska
- Areas that have lower than expected late stage incidence rates appear to be situated close to cancer treatment centers.
- Areas that have higher than expected late stage incidence rates are found more frequently in rural areas of the state, where patients would need to drive further for diagnosis and treatment

Future Directions

- Perform more statistical analysis on colorectal cancer data to identify other possible causes for the disparities in incidence rates
- Perform cluster analysis to identify other trends
- Examine mortality trends
- Examine possible trends over time
- Extend analysis to other cancers (Lung, Breast, Prostate)

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