Hotspotting Preventable Cancers: Done Right

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OBJECTIVE

- Identify Arkansas counties that have high cancer mortality relative to early-stage cancer incidence for colorectal cancer, female breast cancer, and cervical cancer.

BACKGROUND

- **Hotspotting**, a method to identify high-risk counties for cancer screening is an important tool in cancer epidemiology. It has been widely used for cancer screening, prevention, and control.

- Traditional hotspotting uses directly standardized age-adjusted mortality rates for selected cancers to identify counties with high mortality. However, this methodology calculates mortality rates using national age-specific rates which may or may not reflect the demographic distribution of the county/state population, leading to misclassification of high-risk counties.

- We propose a newer methodology to identify high-risk counties for cancer screening that accounts for county/state specific demographic characteristics.

METHODS

- We selected the three preventable cancers namely colorectal, female breast, and cervical cancers that has USPSTF screening recommendations.

- Our hypothesis is that adherence to screening recommendations would increase the incidence of early-stage diagnoses and decrease the mortality rate. The mortality to early-stage incidence ratio (MIR) was used to identify counties with high mortality rates relative to early-stage incidence rates.

- Deaths where the underlying cause was attributed to these cancers were obtained from death certificates and cancer cases were obtained from the Arkansas Central Cancer Registry. Incident cases were classified as early stage (localized) or late stage (regional or distant) based on the SEER Summary Stage.

- A mortality (SMR) to early-stage incidence (SIR) ratio and its standard error was computed for each county. The expected cases were based on age, gender, race, and year adjusted rates for Arkansas. The indirect standardization accounts for the comparisons to the state age-gender-race specific rates instead of comparing to a standard age-specific population for the nation.

- We grouped county MIR's (SMR/SIR) into quartiles to classify counties with high, mid (interquartile range) and low MIRs. We compared the results from our methodology to that of traditional methodology used for hotspotting.

RESULTS

Fig 1. Colorectal Cancer 2009 - 2013

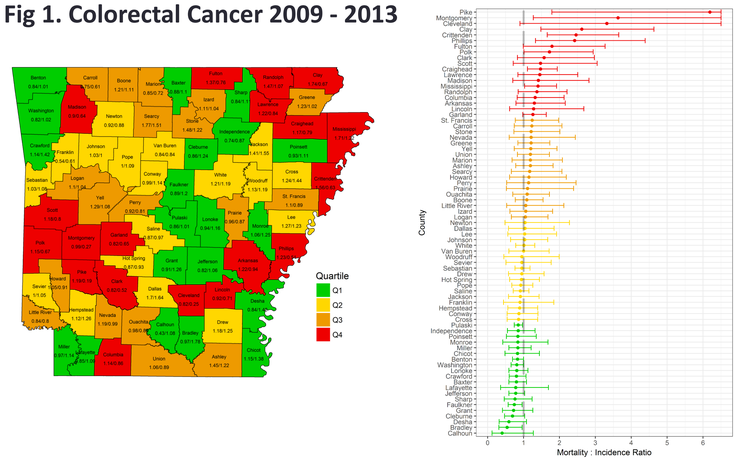


Fig 2. Female Breast Cancer 2009 - 2013

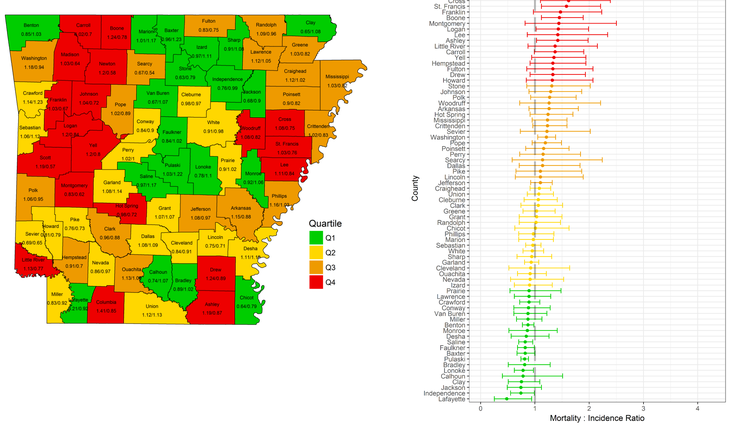
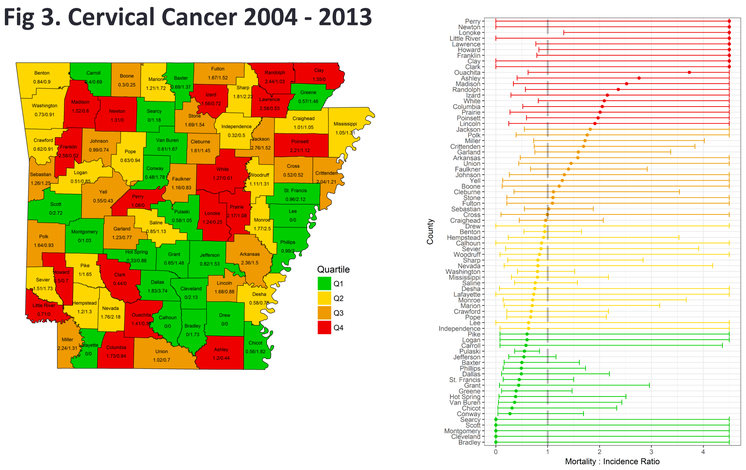


Fig 3. Cervical Cancer 2004 - 2013



RESULTS

Colorectal Cancer 2009 - 2013

- Fig 1. displays the quartiles of county MIRs for **colorectal cancer**. In general, rural counties had the highest mortality to early stage incidence ratio, SMR / SIR, during the period 2009 - 2013.
- The 75 Arkansas counties are ordered by their MIR in the adjacent figure, which also shows 90% confidence bounds. Conceptually only counties where the MIR is significantly larger than 1 are hotspots: Pike, Montgomery, Phillips, Clay, Crittenden, Craighead and Garland. However, these counties were embedded in 'hotspots' – most notable being in the northeast corner and west-central part of Arkansas.
- There was discordance in the counties identified with our method compared to the traditional method.[1] While 10 of the 17 counties identified as "Hotspots" were similar in both methods, our methodology identified 9 new counties as "True Hotspots".

Female Breast Cancer 2009 - 2013

- Fig 2. shows the MIR for **female breast cancer**. It generally shows that rural counties had the highest mortality to early stage incidence ratio, SMR / SIR, during the period 2009 - 2013.
- The 75 Arkansas counties are ordered by their MIR in the adjacent figure, which also shows 90% confidence bounds. Conceptually only counties where the MIR is significantly larger than 1 are hotspots: Scott, Madison, Columbia, Cross, St. Francis, Boone, and Washington. The prominent hotspot is in western Arkansas.

Cervical Cancer 2004 - 2013

- Fig 3. shows the MIR for **cervical cancer**, during the period 2004 - 2013.
- Arkansas counties are ordered by their MIR in the adjacent figure, which also shows 90% confidence bounds. Because cervical cancer is rare, we accumulated deaths and incident cases over ten years. Even so, numbers remain too low for estimates in most counties to have acceptable precision. However, Lonoke County was significant and embedded in a cluster of north central counties.

CONCLUSIONS

- With the roll out of health insurance coverage through Affordable Care Act, a significant proportion of the population increased their coverage. However, screening for preventable cancers remains low. Utilizing our methodology to identify "True Hotspots" could pave a new way in cancer screening, prevention and control.

[1]Siegel, R.L., Sahar, L., Robbins, A. and Jemal, A., 2015. Where can colorectal cancer screening interventions have the most impact?. *Cancer Epidemiology and Prevention Biomarkers*, *24*(8), pp.1151-1156.