Identifying Target Areas for Colorectal Cancer Screening in Louisiana through Geospatial Analysis

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Introduction

Generally, the smallest geographic unit in which cancer data is available to the public is county. However, significant disparities within counties could be diluted by using such large geographical areas. Cancer registries collect patients' physical addresses at diagnoses, which can be geocoded and assigned to census tracts which are smaller geographic units than county. Analyses and maps based on census tracts can help highlight disparities in small areas. Collaborating with the Louisiana Colorectal Cancer Roundtable (LCCRT), Louisiana Tumor Registry (LTR) explored an innovative method of identifying target areas for colorectal cancer interventions, by analyzing cancer registry data at the census tract level.

Objectives

1. Identify areas of higher colorectal cancer risk who may benefit the most from screening interventions.
2. Present the results to graphically illustrate the targeted areas.

Methodology

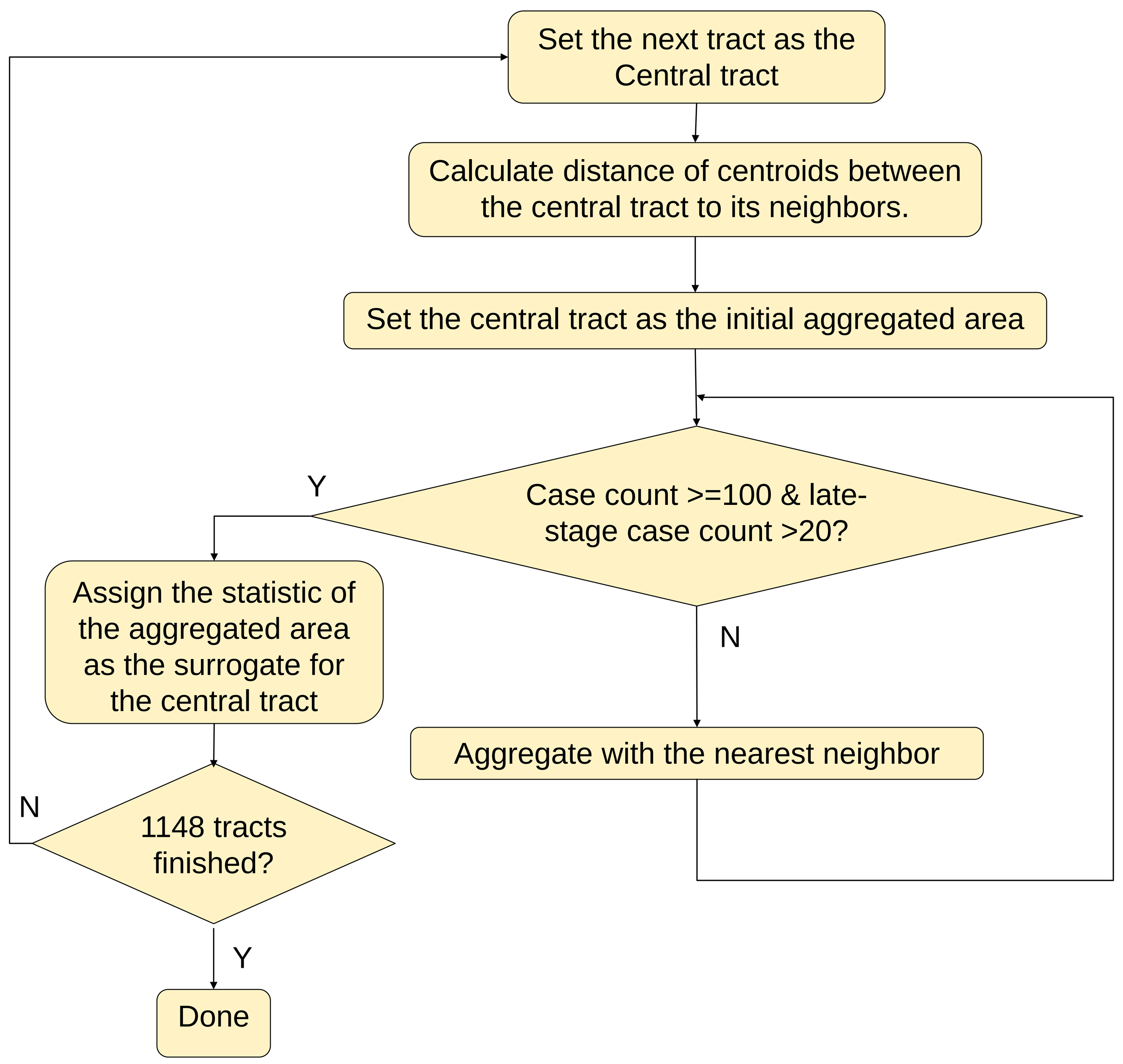
Our approach to illustrate the areas with higher colorectal cancer risks consists of two independent parts. First, we use statistical spatial analysis software to detect clusters. Second, we use a SAS program to calculate the cancer statistics at the census tract level. Finally, we visually combine the results of these two parts in a map.

The statistic we use is proportion of late stage cases, which can be calculated by dividing the regional and distant cases by the total number of cases including In Situ.

We used the Bernoulli model in a spatial analysis software, SaTScan, to detect cancer risk clusters with high late-stage proportions and also tested the statistical significance.

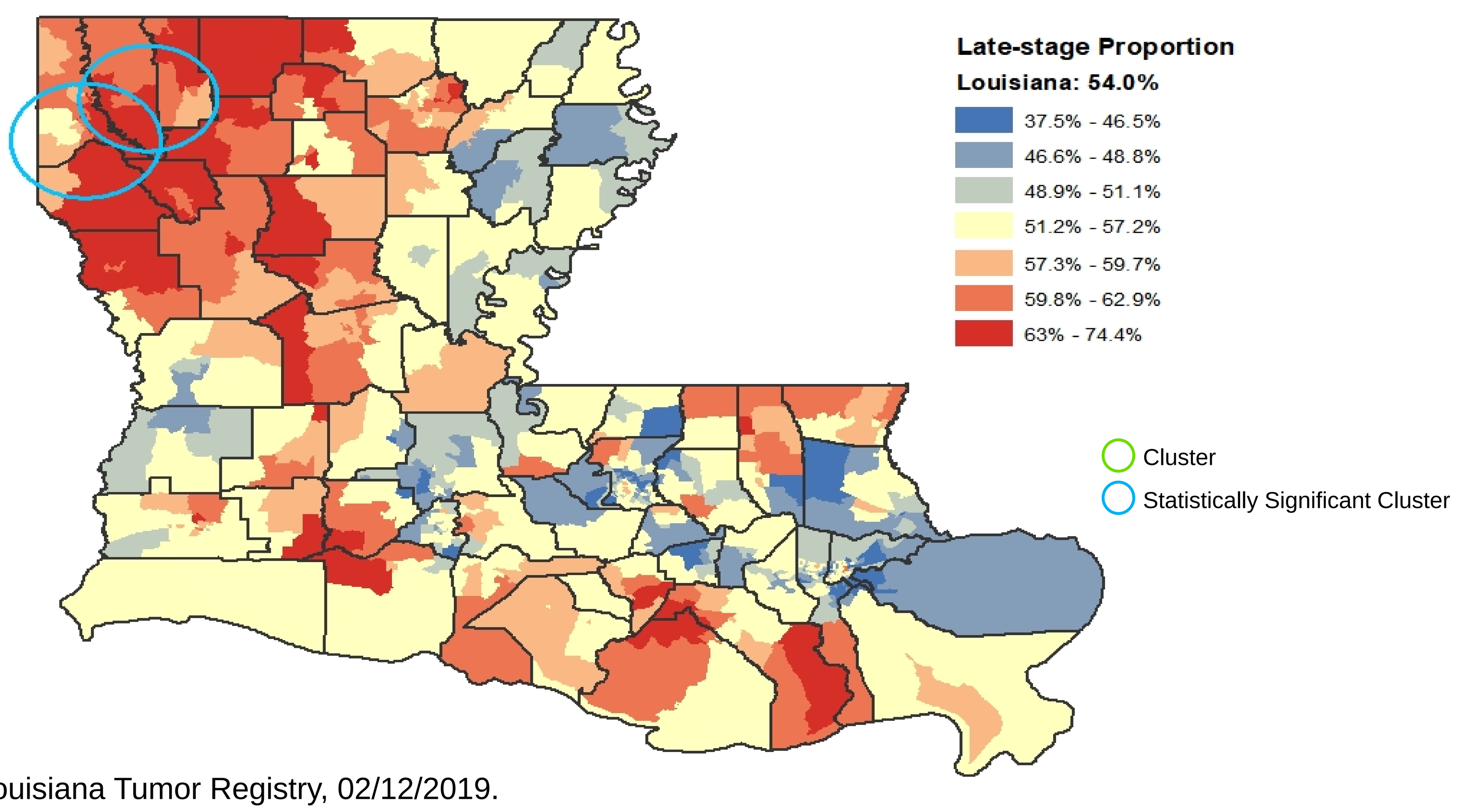
Calculating statistics at the census tract level can be very challenging, especially for Louisiana, where many census tracts are sparsely populated. The incidence counts of census tracts are generally too small for proper analysis. Therefore, in order to get reliable statistics and ensure confidentiality, we used an aggregated statistic for each tract as follows. First, we combined each census tract with its surrounding tracts until at least 100 cancer cases and 21 late-stage cancer cases were reached. Then, the late-stage proportion for the aggregated zone could be calculated and assigned to the original tract. The aggregation algorithm only takes the distance between the centroids into consideration.

The late-stage proportions for all the census tracts were shown in a census tract level map using ArcGIS. Then, the circle-shaped clusters detected by SaTScan were overlaid.



Results

Colorectal Cancer Late-Stage Proportion: Louisiana, 2012-2016
Age 50-74, with SaTScan Clusters



Generated by Louisiana Tumor Registry, 02/12/2019.
Late-Stage Proportion of each census tract is calculated by the aggregated proportion of the surrounding area, centering on the centroid of the census tract, to ensure the stability and confidentiality. Each of the surrounding area contains at least 100 cases and 21 late-stage cases.
Late stage includes "Regional" and "Distant". All Stages include "In Situ", "Localized", "Regional", "Distant", and "Unstaged".
The circles are clusters detected by SaTScan software. Blue circles are statistically significant at 0.05 level.

The census tracts were assigned one of three colors. One-third of the tracts with a statistic around the median were yellow, while the upper third and lower third were red or blue, respectively.

The clusters detected by SaTScan are highly consistent with what the census tract late-stage proportion map shows. As illustrated by the map, Northwest Louisiana and several other areas have higher late-stage proportions when compared to the rest of the state. However, the only statistically significant cluster identified by SaTScan is the cluster in Northwest Louisiana.

Conclusions and Discussions

The late-stage proportion map at the census tract level combined with the spatial cluster analysis not only visually illuminates the target areas for interventions, but also ensures statistical reliability. LCCRT utilizes these maps to educate providers and the public on the depth and breadth of the burden of colorectal cancer in Louisiana.

The statistic we choose to use here is late-stage proportion. To get the full picture of the cancer risk and burden, other cancer statistics should also be considered, such as late-stage incidence rate, screening rate, etc. Each of these cancer statistics reflects different aspects of cancer prevention and cancer care. The same methodology described in this study can be easily applied to these statistics.

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