Doi: 10.32481/djph.2024.08.08

Development of Sub-County Cancer Reporting Zones in Delaware and Example Use Case for Targeted Interventions

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Abstract

Objective: To describe the Delaware Cancer Registry (DCR)'s participation in the National Cancer Institute (NCI)/North American Association of Central Cancer Registries (NAACCR) Zone Design Project to create sub-county geographic areas ("zones") for use in cancer reporting and geospatial analysis. **Methods:** DCR and other stakeholders reviewed up to ten unique zone configurations for each of Delaware's three counties. The zone configurations were created using AZTool and were set to optimize three objectives: create zones that have a minimum and target population of 50,000; are homogenous based on the variables of percent minority, percent below poverty, and percent urban; and are as compact as possible. The DCR sent a survey to stakeholders to provide input on their preferred zone configuration for each county. Following the final selection of zones, the DCR utilized the geographies for calculating overall and late-stage breast cancer incidence statistics and created choropleth maps to visualize the rates by quintiles. **Results:** The final selections resulted in a total of 15 zones for Delaware, with three in Kent County, nine in New Castle County, and three in Sussex County. The zones ranged in population size from 54,013 to 67,693 people. Zones with higher late-stage breast cancer incidence rates included those near the areas of Wilmington, Middletown, and between Milford and Georgetown. Comparing results of overall breast cancer incidence rates by zone with late-stage rates by zone, there were areas that had lower relative overall breast cancer incidence rates but were relatively higher for late-stage rates by zones or vice versa. **Conclusions:** Aggregating census tracts into zones allows for reporting reliable cancer rates at sub-county levels, which is instrumental in conveying meaningful information about regional cancer trends to stakeholders and the public. Delaware will be able to utilize zone-level cancer information to provide targeted interventions and outreach initiatives.

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Background/Introduction

The Delaware Cancer Registry (DCR) was legislatively established in 1980. The DCR collects information about new cancer cases, including cancer diagnostic and treatment information and patient demographics. All hospitals, laboratories, physicians, and other health care providers are required by state law to report all newly diagnosed or treated cancer cases to the DCR. Cancer registry data are used to monitor cancer trends, promote research to increase survival, guide policy planning, and respond to Delaware residents' cancer concerns.[1]

Since 2008, the Delaware Department of Health and Social Services, Division of Public Health (DPH) has produced an annual report on rates of cancer within census tracts as a method of identifying areas with increased cancer burden within the state.[2] Due to low case counts within census tracts, many of the cancer rates required suppression in the report to ensure patient privacy. In addition, due to calculating cancer rates within a smaller population geographic area, rates had wide confidence intervals and were not reliable. These limitations of census tract-level reporting provided minimal relevant information to stakeholders and made it difficult to communicate this information to the public. There was a desire to analyze and report cancer at sub-county levels, but at the time, census tracts were the only option. Zone Improvement Plan (ZIP) Codes and their associated ZIP Code Tabulation Areas (ZCTAs) are often used for geospatial analysis but are not ideal for this purpose as ZIP Codes often change, do not align well with U.S. Census Bureau or other administrative boundaries, and are designed for mail delivery efficiency, not for public health and epidemiological analysis.[3,4]

In February 2022, the DCR began participating in the National Cancer Institute (NCI)/North American Association of Central Cancer Registries (NAACCR) Zone Design Project to create cancer reporting zones (to be referred to as "zones") that could be used for sub-county reporting in the state. The goals of the NCI/NAACCR Zone Design Project are to work with individual central cancer registries to create zones that will reduce suppression of data for small counties, increase spatial resolution for large counties, and create geographies that are more meaningful to cancer registries and stakeholders for cancer reporting and analysis. Delaware was the 19th state to join the project. Currently 25 states participate in this initiative.

Methods

The methodology developed to create the zones for this project was thoroughly described in the paper "Developing Geographic Areas for Cancer Reporting Using Automated Zone Design" by Tatalovich et al.[5] Briefly, the NCI/NAACCR Zone Design Project team utilized AZTool,[6,7] a program used for automated zone design, to aggregate census tracts within each county in Delaware (Kent, New Castle, and Sussex) to create different zone configurations for consideration. Within the process, up to ten unique zone configurations for each county were created that were set within AZTool to optimize three objectives: create zones that have a minimum and target population of 50,000; are homogenous, based on the variables of percent minority, percent below poverty, and percent urban; and are as compact as possible. The zone configuration options were provided to the DCR for review with the goal of choosing their preferred zone configuration for each county.

To involve Delaware stakeholders in the review and selection of zones for the state, the DCR administered a survey to epidemiologists and other staff at DPH, the Delaware Cancer Registry Advisory Council, select hospital researchers, and local non-profit organizations, such as the Sussex County Health Coalition. Survey respondents were sent information about each of the zone configurations for each county and were asked to select their top three zone configurations for each county and to provide an explanation for their selection. The responses were considered with the DCR ultimately making the final selections for preferred zones. Considerations that reviewers could use to choose their preferred zone configurations included a relative score that compared each zone configuration to a "base" configuration for each county that calculated how it compared on the three objectives previously mentioned (population size, homogeneity, and compactness of the zones). A statistic was calculated for each of the three objectives and these values were averaged to assign a score for each zone configuration. The relative score was then calculated as the ratio of the zone configuration's score to the "base" configuration score, where the highest relative score meant that the zone configuration best met the set objectives. In addition to the relative scores, reviewers could choose their preferred zone configuration for each county by utilizing knowledge about the geography of the areas. For example, they may justify that a specific zone configuration would not be ideal if it split a neighborhood across zones.

Once the final zones were established, the DCR began calculating statistics such as zone-level cancer incidence rates to identify areas that could potentially be the focus of interventions and DPH efforts. Specifically, the DCR calculated overall and late-stage female breast cancer incidence rates by zone and created choropleth maps that displayed rates by quintiles. Late-stage cancer was defined as cases diagnosed at regional or distant stage. Analysis was performed on cases with the following characteristics: sex of the patient was female; the year of diagnosis was in the five-year period 2016-2020; the behavior of the cancer was coded as malignant; and the primary site was breast and excluded ICD-O-3 histology codes 9050-9055, 9140, and 9590-9993 as defined by the SEER Site Recode ICD-O-3/WHO 2008 Definition for the "Breast" site group.[8] Rates were calculated and age-adjusted to the 2000 U.S. Standard Population using DCR incidence data within SEER*Stat,[9] a statistical software available from the National Cancer Institute. Maps were created using ArcMap.

Results

Of the 20 stakeholders who received the preferred zone survey, only 20% responded. The survey participants were provided all ten zone configurations generated by AZTool from which to select in each county. The relative score for each zone configuration was also included to participants. From the responses received, the majority opted to choose zones with the highest relative scores. The final selections resulted in a total of 15 zones for Delaware, with three in Kent County, nine in New Castle County, and three in Sussex County. The zones ranged in population size from 54,013 to 67,693 people.

Figure 1 displays choropleth maps of overall and late-stage female breast cancer incidence rates by Delaware zones for the period 2016-2020. Zones with higher late-stage cancer incidence rates include those near the areas of Wilmington, Middletown, and between Milford and Georgetown. Comparing results of overall breast cancer incidence

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rates by zone with late-stage rates by zone, there are areas that have lower relative overall breast cancer incidence rates but are relatively higher for late-stage rates by zones or vice versa. Areas where there are relatively lower overall rates, but higher late-stage rates include near Wilmington and the area between Milford and Georgetown, while the area near Newark has a relatively high overall rate but a low late-stage rate.

Figure 1. Overall and Late-stage Breast Cancer Incidence Rates per 100,000 Population, by Cancer Reporting Zone, Delaware, 2016-2020

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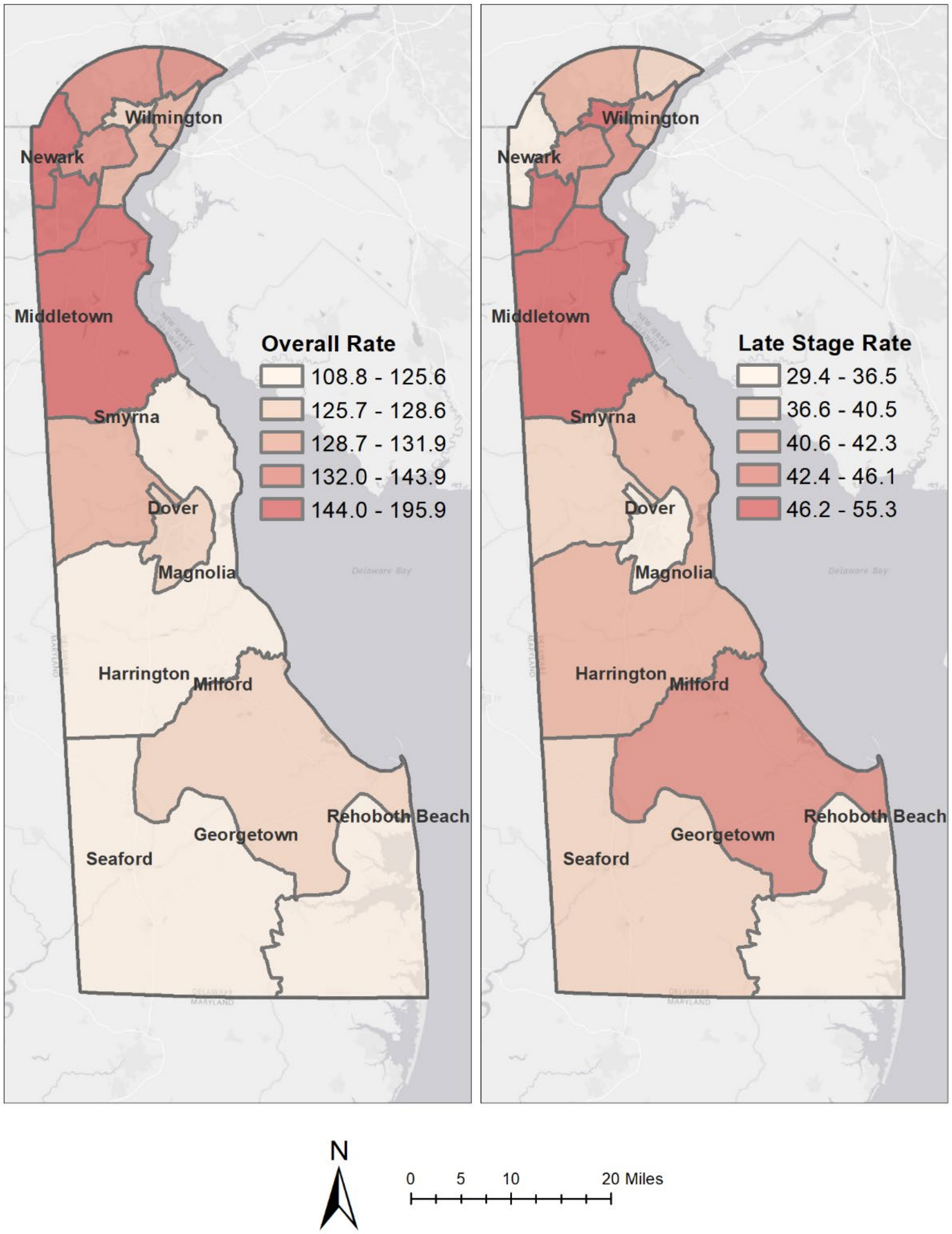

Rates are age-adjusted and are per 100,000 population.

Discussion

The sub-county zone analysis allows for the visualization of DCR data with less suppression than when using census tract analysis. It also offers greater spatial resolution than data displayed by county, given that Delaware has only three counties. The aim of participation in the NCI/NAACCR Zone Design Project was to provide a more useful and reliable display of DCR data for reporting and visualization. The cancer zone maps

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provide visualization of how cancer in Delaware is distributed and provides an example of a tool that can be used to identify areas that require deeper analysis, such as those with low incidence but high late-stage cancer rates. Using the zones provides a more reliable method of presenting the burden of cancer in an area compared to more granular-level calculations such as census tracts where the results can fluctuate dramatically based on low case counts and small populations for this geographic area level.

By employing cancer zones, the DCR established a useful approach to illustrating the burden of cancer within an area, which contrasts starkly with the potentially volatile results derived from calculations using census tracts that are heavily influenced by case counts. Variability in case counts affects the stability of rate calculation due to the limited number of permutations resulting in wide confidence intervals. The instability underscores the importance of a rate calculation to mitigate confusion when presenting this information to stakeholders and the public.[10] The utilization of zones to identify areas with high overall and late-stage breast cancer incidence rates, especially in regions proximate to Wilmington, the stretch between Milford and Georgetown, and the vicinity of Newark, has pinpointed specific areas warranting heightened attention in terms of both education and resource allocation.

The zones present an opportunity for detailed sub-county data analysis, which can be enriched by overlaying additional datasets such as CDC PLACES (Population Level Analysis and Community Estimates), Delaware's Screening for Life (SFL) Program, and U.S. Census data. Since the zones are created using aggregations of census tracts, any data available at the census tract level can be aggregated up to the zone level for analysis and visualization. CDC PLACES data, for instance, offers Behavior Risk Factor Survey[11] estimates, such as the prevalence of cancer screenings at multiple geographic levels, including county, place, census tract, and ZCTA. SFL data, on the other hand, sheds light on cancer screening utilization among Delawareans living at 250% below the federal poverty level. By incorporating U.S. Census data, researchers can gain valuable insights into areas where socioeconomic factors intersect with cancer prevalence and screening behaviors. By utilizing diverse datasets, cancer prevention programs can more effectively allocate resources to the community level where they are most needed. By optimizing resource allocation, programs can reduce spending and expand opportunities to reach a broader spectrum of Delaware residents through targeted education and outreach initiatives.

Conclusion

Aggregating census tracts into zones allows for reporting reliable cancer rates at sub-county levels, which is instrumental in conveying meaningful information about regional cancer trends to stakeholders and the public. Due to Delaware consisting of three large counties, there was a desire and need to report at sub-county levels to provide information at a higher spatial resolution to identify areas for more targeted and actionable interventions and resources and to allow Delawareans to understand cancer in the context of an area more local than county. Geospatial analysis has become a more standard tool in public health within Delaware with the wider availability of data and data tools.[12] This method of information analysis allows for the visualization of data at various levels. However, standard geo-political geographies such as counties are not optimized for cancer reporting and are not ideal for analysis of cancer rates, as they vary widely with regard to population size and sociodemographic characteristics.[5] Delaware will be able to utilize zone-level cancer information enriched with other data sources to provide targeted interventions and outreach initiatives in order to reduce the state's cancer burden and to improve outcomes.

Public Health Implications

By leveraging zones in conjunction with additional datasets, public health agencies gain valuable insights into areas with high cancer burden that may benefit from interventions. The COVID-19 pandemic underscores existing inequities in the public health system that requires states to respond innovatively to address challenges faced when serving clients effectively and more efficiently. In the post pandemic environment, the Division of Public Health has committed to enhancing the state's public health data and surveillance systems which are core to our infrastructure. It is, and continues to be, a collective effort to support state programs in knowing which groups of people are most likely to get cancer. The zones support faster evaluation of cancer control strategies, enhanced program planning and advancing data modernization solutions to safeguard sustainable solutions. Consequently, the zones will increase the response to emerging health threats in Delaware.

In summary, utilizing zones alongside complementary datasets represents a sophisticated strategy for public health analysis and intervention. By harnessing the power of geospatial analysis and data integration, public health agencies can gain deeper insights into cancer burdens and devise targeted, community interventions.

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