



(RESEARCH ARTICLE)



Cancer mapping pilot study of cancer association patients in Anderson County, SC

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Abstract

This study represents a collaboration between the Cancer Association of Anderson (CAA) and the Anderson University Center for Cancer Research (AU CCR), both located in Anderson, SC, with the assistance and support of Anderson University Professional and Lifelong Learning (AU PLL).

The CAA began importing patient information in 2016 into a Microsoft Excel workbook to create a digital record that could store and provide more convenient searching and the production of reports. In a robust collaborative effort between CAA, the AU CCR, and Anderson University students, additional pertinent information from the previous paper files was gathered by contacting patients. The data was imported from the Excel system and put into a reporting system that allowed CAA staff and AU CCR students to refine the information needed to obtain an overview of cancer across Anderson County as a snapshot of those assisted by CAA. The Clemson University GIS data system and the database reports were used to plot the location of cancer incidents (the individual patient's locations) and to produce maps that aided the students in drawing initial conclusions.

By working collaboratively from 2019 through 2020, the CAA and AU students have gathered local Anderson County cancer patient information and created maps to pinpoint different cancers by location. These maps indicate geographic trends of various cancers and support further investigation into the cause of those cancers. They also indicate increased or decreased rates of cancer over time.

Keywords: Cancer mapping; Pilot study; Cancer clusters; Incidence maps; Incidence of cancer

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1. Introduction

The CAA was founded in 2003 and is the only cancer charity in Anderson County. The mission of CAA is to lessen the burden on Anderson County residents who are battling cancer and their caregivers and families. CAA provides local cancer patients with treatment-related financial assistance, counseling, emotional support, education, and referrals at no cost, regardless of a patient's socioeconomic status or where they choose to receive treatment. It is a place for patients, their caregivers, and their families to receive moral support, resource information, and financial and material help. In addition, CAA provides exceptional experiential, educational opportunities for Anderson University students and other interested persons within the community.

Lead by Professor of Biology, Dr. Diana Ivankovic, the Center for Cancer Research (CCR) is an innovative, award-winning institution of significant asset to the Anderson University sciences program. CCR students complete initial steps in the training process of becoming accomplished cancer researchers. Students gain knowledge of how pharmaceutical companies research collecting samples, preparing compounds, and examining results. The center's goal is to educate undergraduate students to do basic cancer research and support them on the path to becoming healthcare professionals. The program officially began in 2011 when AnMed Health Medical Center donated a building directly across from the hospital's main campus in Anderson, South Carolina. Each semester, an AU Sciences committee carefully selects a maximum of thirteen students to participate in the Cancer Scholar program, where they complete a yearlong research project and present their findings. Criteria for selection include a strong grade point average, class rank, professors' recommendation, and laboratory skills.

The AU CCR, founded in 2011, is located near the CAA and supports these students in designing, completing, presenting, and publishing their cancer research work. CAA, a local charity engaged in and significantly affecting the Anderson County community by disseminating information and improving awareness regarding cancer prevention and early diagnosis, provided AU CCR students the opportunity to engage with actual patients visiting CAA while participating in bench research and data analysis.

When CAA first opened its doors, it utilized a paper filing system to store patient information. In 2016, CAA began importing patient information into a Microsoft Excel workbook to create a digital record that could store and provide more convenient searching and the production of reports. In a robust collaborative effort between CAA and the AU CCR, Anderson University students Ryan Deweese, Ryan Hunter, and Connor Davey began assisting the CAA Director and staff in gathering additional pertinent information from the previous paper files by contacting patients. Carey Cole, Senior Solutions Architect at ZeroDay Technology Solutions, brought his database and data security expertise to the team by providing a computer server to house a database that he created. He imported the data from the Excel system and built a reporting system that allowed CAA staff and AU CCR students to refine the information needed to obtain an overview of cancer across Anderson County as a snapshot of those assisted by CAA. Abi Stringer Roberts, Environmental Engineering graduate student at Clemson University and 2020 ESRI Development Center Student of the Year, utilized Clemson University GIS data system and the database reports to plot the location of cancer incidents (the individual patient's locations) and to produce maps that aided the students in drawing initial conclusions. Additionally, Fynn Jacobsen (Wofford College undergraduate student), Alyssa Edwards (Clemson University undergraduate student), and Laura Ivankovic (D. W. Daniel High School student) joined the team to complete the ambitious task of plotting this snapshot of cancer occurrence in patients assisted by CAA throughout Anderson County.

Researchers use cancer incidence maps to show geographic trends in different types of cancers. These can help locate cancer clusters, determine the cause of cancer incidents, and provide information about cancer prevention or early diagnosis. By working collaboratively from 2019 through 2020, the CAA and AU students have gathered local Anderson County cancer patient information and created maps to pinpoint different cancers by location. Unfortunately, no other organizations are actively creating cancer incidence maps specific to by County, and cancer patient information is limited. Through the continued collection of patient data, CAA, and AU CCR hope to build the database and create more comprehensive cancer incidence maps in the future. These maps will include more patients from Anderson County and expand to Pickens, Oconee, Greenville Counties, and beyond.

The CAA database is now quite extensive and stores information from thousands of cancer patients across Anderson County. The relationship between all of these students and a local non-profit has been highly beneficial to all parties. Students have aided the CAA in expanding its database, which has become a vital tool in CAA's ability to attract donors and secure grant funding to continue its mission. The project has also bolstered collaborative efforts between academic, medical, and community stakeholders in working to reduce the incidence of cancer across Anderson County. Simultaneously, CAA granted these students access to patient information for AU CCR research projects, carefully

adhering to HIPPA compliance guidelines, exposing them to actual patients, which is beneficial to participating students pursuing careers in the healthcare field. AU CCR students regularly participate in professional association conferences and contact educators and those serving in future desired industries. The opportunities afforded by a partner project with CAA provide a new perspective to students, the chance to view our community thru a different lens due to interacting with actual human beings who are in the fight of their lives and are dealing with the medical, financial, and emotional consequences of cancer. Students develop empathy, embrace the patients they meet, and speak with respect and interest, not just data or names written on paper.

CAA, AU CCR students, and other program participants developed lasting relationships within the local community throughout this process. Meeting and visiting with cancer patients from across Anderson County is beneficial to all program participants as it provides the opportunity to understand the patient experience from outside the clinical perspective. In many cases, CAA and AU students have been able to re-connect with previous patients. This project has also helped fortify a community resilience and an alumni "Survivor" atmosphere for CAA and others who have been affected by cancer and are living in Anderson County.

CAA and AU CCR students will continue adding patient information to the database, including future patients, plotting more data points, and producing annual, individual maps to support an even more extensive and comprehensive study. CAA can produce highly accurate maps of cancer incidence in cancer patients assisted by CAA across Anderson County with additional information. These maps indicate geographic trends of various cancers and support further investigation into the cause of those cancers. They also indicate increased or decreased rates of cancer over time. Armed with this data, CAA can provide better resources for their patients. In addition, this knowledge will enhance CAA's ability to write grants, increase funding, and expand collaborative research in nearby counties with potential access to patient data from Prisma Health in Greenville, Self Regional Healthcare in Greenwood, and AnMed Health in Anderson. The next step is to expand the database and research by mapping adding counties, one at a time.

Unfortunately, no other organizations are actively creating cancer incidence maps specific to by County, and cancer patient information is limited. Through the continued collection of patient data, CAA, and AU CCR hope to build the database and create more comprehensive cancer incidence maps in the future. These maps will include more patients from Anderson County and expand to Pickens, Oconee, Greenville Counties, and beyond.

2. Methods

A Clemson University graduate student enrolled in the Environmental Engineering program mapped different cancer types onto the Anderson County map. She has grouped the different cancer types as "very low," "low," "moderate," and "very high" incidence, and according to these groupings, created figures that indicate occurrence. The initial data held in the Excel workbooks were imported into the newly created Access Database. Before the mapping process, individual reports were created in the Access Database, with patient data stripped of their corresponding unique identifiers. The data was entered into the GIS system. Data were accurately plotted based on the patients' street, city, and zip codes, and more specifically, street number ranges in blocks of 50. Such a level of mapping has supported the definition of cancer categories, as well as their subcategories. Findings based on patient data were collected, providing information regarding cancer types and patients' geographic location. Eight thousand five hundred individuals residing in Anderson County are represented in the study since the CAA mission currently serves only Anderson County residents.

3. Results



Figure 1 Incidence of breast, lung, gynaecological, colorectal, and head/neck types of cancer

As seen in Figure 1, the highest incidence of cancer in patients assisted by the Cancer Association of Anderson in Anderson County includes breast, lung, gynecological, colorectal, and head/neck types. The patients who suffer from these types of cancer are scattered evenly throughout the County. However, there is a high concentration of affected patients in and near the City of Anderson.

Figures 2, 3, and 4 depict the following types of cancer in patients assisted by the Cancer Association of Anderson in Anderson County: testicular, thymoma, squamous, gallbladder, appendix, abdomen, bile, abdominal, sarcoma, peritoneal, penile, and neuroepithelial. The incidence of all these twelve types of cancer is very low. However, in further studies, we plan to investigate whether other factors affect the patient's decision to seek CAA support and assistance.

In Figure 5, we can observe endocrine, skin, gastric, and kidney cancer in patients assisted by the Cancer Association of Anderson - occurrence mapped through the County at a low rate.



Figure 2 Incidence of eye, bile duct, appendix, and abdomen types of cancer.



Figure 3 Incidence of peritoneal, penile, neuroepithelial, and sarcoma types of cancer



Figure 4 Incidence of squamous, testicular, thymoma, and gallbladder types of cancer

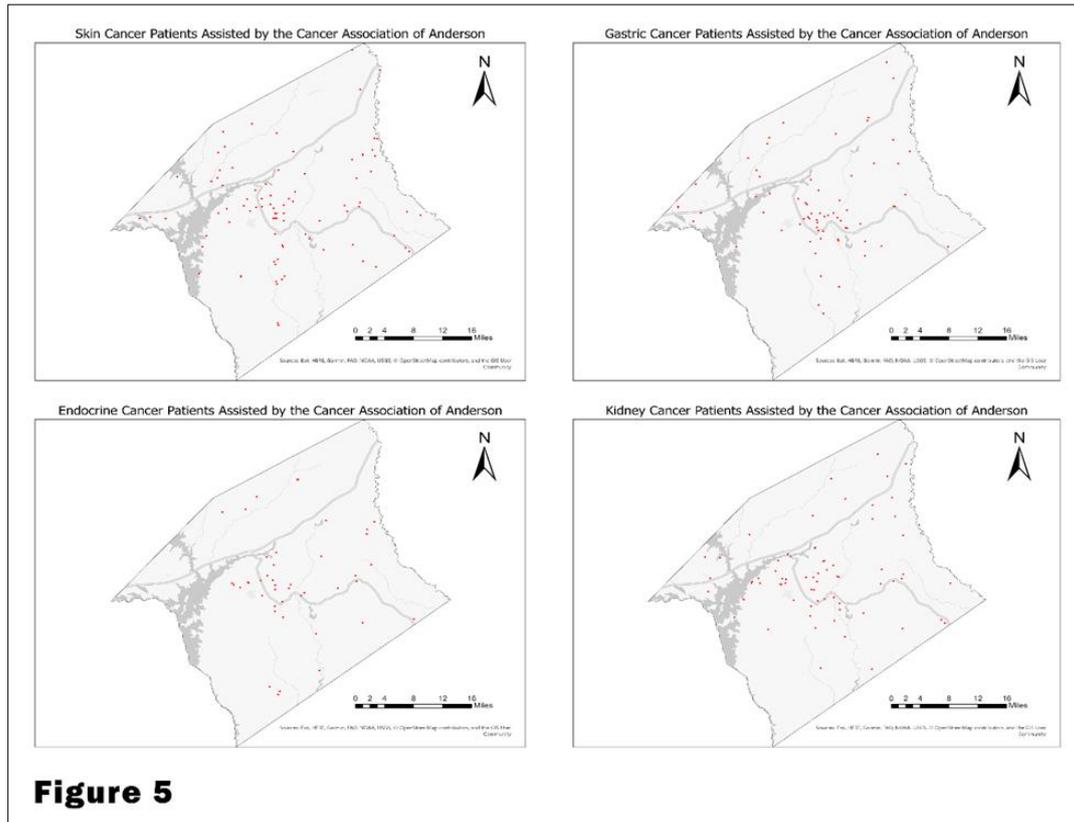


Figure 5 Incidence of skin, gastric, endocrine, and kidney types of cancer

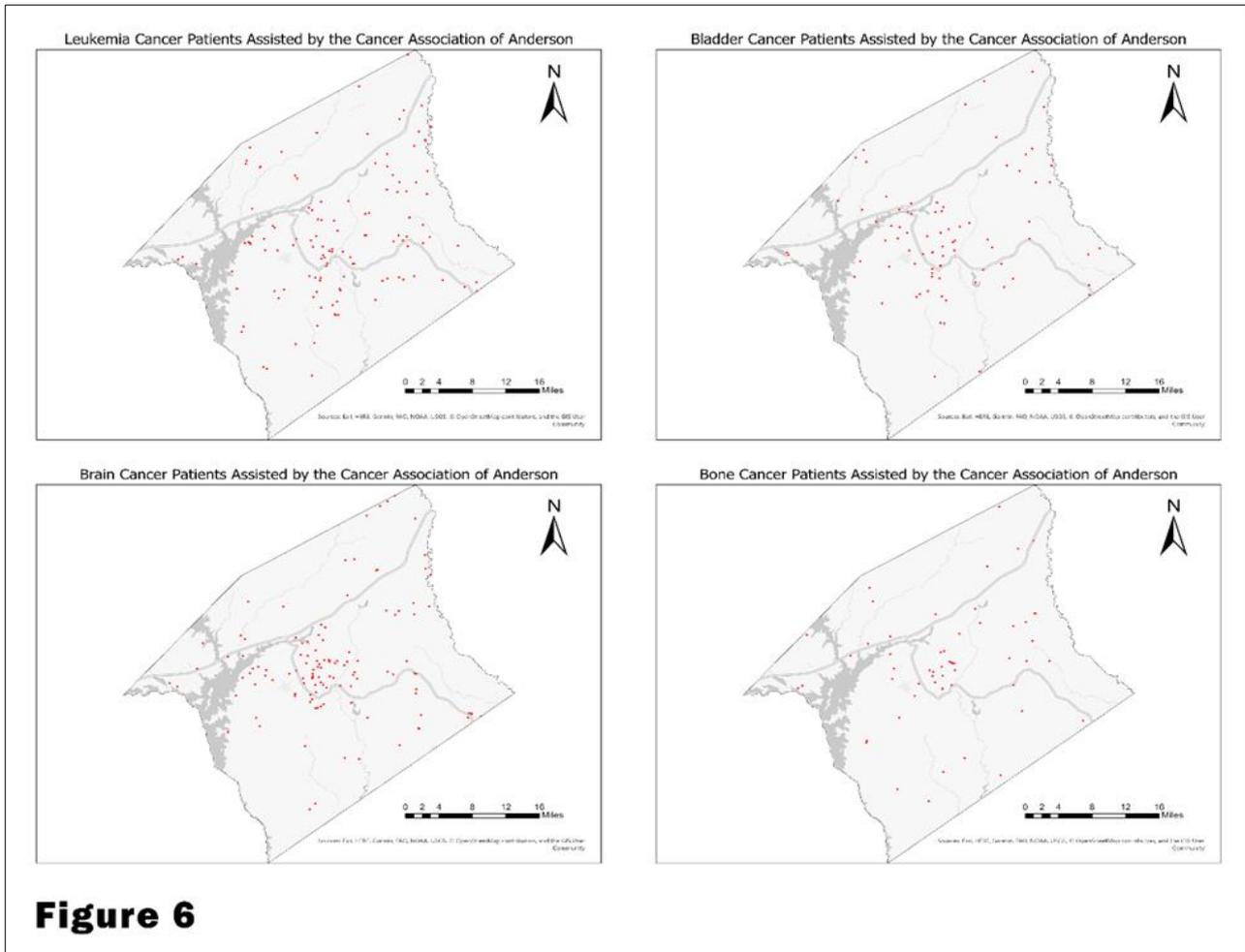


Figure 6 Incidence of leukemia, bladder, brain, and bone types of cancer

Figures 6 and 7 represent leukemia, bladder, brain, bone, prostate, pancreatic, lymphoma, liver, and multiple myeloma cancer in patients assisted by the Cancer Association of Anderson, demonstrating a moderate level in Anderson County.

Figure 8 represents the overall incidence of all types of cancer in patients assisted by the Cancer Association of Anderson. This map contains all cancers mentioned in the previous seven figures, with the highest concentration in Anderson, SC. Further study will investigate factors that can contribute to these findings. As the Cancer Association of Anderson provides more services and raises awareness throughout the County, we assume the number of patients assisted will continue to increase, as has been the trend thus far.



Figure 7 Incidence of prostate, multiple myeloma, pancreatic, lymphoma, and liver types of cancer

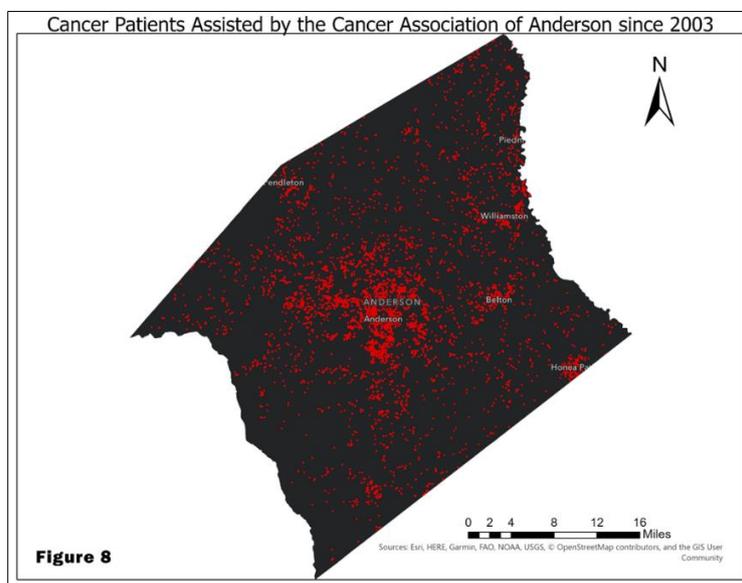


Figure 8 Incidence of total cancer patients treated by the CAA since by 2003

4. Discussion

CAA, AU CCR students, and others enrolled in nearby institutions have collectively gathered cancer patient information consisting of patients assisted and supported by CAA to create maps that pinpoint different cancers by zip code and, more specifically, by street and house number range in blocks of 50. The data plotted in the eight figures above show the highest concentrations of all types of cancers inside the City of Anderson. Overall, the highest cancer incidence includes colorectal, breast, head/neck, gynecological, and lungs. As mentioned earlier, we hope to access Prisma Health data in Greenville, Self Regional Healthcare in Greenwood, and AnMed Health in Anderson. Further phases will entail collecting cancer patient data in neighboring counties throughout the state of South Carolina.

This research may be limited by the possibility of skewed information regarding incidences of malignancies within Anderson County due to a higher number of elderly study participants as the incidence rate of cancer increases with age. This report represents the initial research step. The current data is a snapshot of cancer patients assisted by CAA and does not represent all cancer patients across Anderson County. However, CAA's reputation has positively impacted the increase in cancer patients seeking emotional support and financial assistance, evidenced by the growth of referrals from treatment facilities both within the County and outside South Carolina, including MUSC in Charleston, Levine Institute in Charlotte, Emory in Georgia and beyond. AU CCR and CAA will continue data collection and research by inviting additional partners, including AnMed Health, Self-Regional Healthcare, and Prisma Health, and other treatment facilities where Anderson County cancer patients may seek treatment in order to obtain more complete results for Anderson County and eventually surrounding counties to produce a robust, comprehensive map of the State of South Carolina.

The access to this type of data has helped all the research contributors build more significant relationships between the local community, the CAA, and the AU CCR. The project has built resiliency for the community and this non-profit organization. During this research project, health care providers and the patients residing in various parts of the County have gained awareness of CAA and their offered services.

Anderson University's Professional and Lifelong Learning (AU PLL) Director, Andria Carpenter, worked with CAA and AU CCR to develop survey tools for students to utilize during the initial phase of the research project and has remained a vital advisor. Dr. Diana Ivankovic, Anderson University Professor and Director of The Center for Cancer Research and Cancer Association of Anderson Director, Angela Stringer, facilitated a Lifelong Learning Institute course introducing the two community organizations. The course presented the research for discussion and demonstrated the positive impact of the community organizations. Participants of the Lifelong Learning program were impressed with the collaborative effort and encouraged the group to develop ways to disseminate information regarding the excellent work accomplished throughout the community.

With more data collection and robust, statistically significant findings, this research may very well lead to breakthroughs in environmental or other causations affecting the high incidence rate of certain types of cancer across Anderson County and beyond and could be implemented as a tool for diagnostic and educational outreach and to focus future cancer screenings, leading to more aggressive prevention and earlier diagnosis.

One of the Lifelong Learning course attendees who is also a patient of CAA and has terminal breast cancer remarked, "It is too late for me, but knowing that this kind of collaborative work is going on right here in Anderson gives me great hope for the future of the community that I love so much!"

5. Conclusion

This study identifies the occurrence, rates, and trends of cancer clusters in Anderson County. Clients of the CAA freely contributed to collecting data, many expressing a sense of duty and pride in participation. Multiple learning communities collaborated in the data collection, entry, and plotting to develop overlaying maps that provide an aggregate report of specific and collective cancer clusters. This type of reporting is unique to the state and will support continued efforts to eliminate this disease. In addition, the unified efforts of learning communities represented in this study demonstrate the concept that all learning matters and that through collaboration, a new tool may be utilized to provide help and hope to communities across South Carolina.

Compliance with ethical standards

Acknowledgments

We wish to acknowledge the good work and support of the Cancer Association of Anderson, the Board of Directors, staff, volunteers, and patients for their tireless work in lessening the burden and increasing the quality of life for Anderson County residents who battle cancer. We appreciate student employee Addison Powell and Anderson University's academic and community learning organizations who consistently engage in Anderson County to provide access, build community relationships, and break down barriers to learning.

Disclosure of conflict of interest

Individuals involved in this research were fully informed of the nature of the survey questions, consented freely to participate, and did so voluntarily. Accordingly, no remuneration has been given or received from any individual or organization supporting this research.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study at the data collection point via Qualtrics Survey.

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