Privacy and Confidentiality Considerations in Cancer Registration: A Nexus of Law, Ethics, and Policy

NCRA
(National Cancer Registry Association) editors for the forthcoming 4th edition of Cancer Registry Management Principles & Practices for Hospitals and Central Registries, invited a new chapter to reconcile the public function and purpose of cancer registration with the private nature of individual-level data, patient experiences, and human values that support cancer surveillance.

As is widely recognized in the cancer registry community, cancer data exist because of public demands that individual cases be counted and understood not only in terms of the experiences of individual patients, but also with respect to patterns and trends, with the systematic compilation of data enabling the population-based study of who gets cancer, why, when, under what circumstances, and with what range of outcomes. The activity of cancer registration depends, however, on an extension of the underlying trust and the legal privilege of confidentiality that exist between a patient and his or her doctors. That privilege exists to support the free and clear communication necessary to the provision of the optimal treatment and care. The confidentiality of the relationship relates to the completeness, accuracy, and timeliness of the information a patient provides. These same qualities are essential to the cancer data on which research, surveillance and cancer control depend. *DRAFT*

Approach

An integrated chapter:

I. Legal Aspects of Cancer Registry Data
   - Establishing Cancer as a Priority
   - Privacy of Personal Health Information—Then and Now
   - Confidentiality of Medical Records

II. Health Information Privacy and Security
   - Cancer Registry Data as Confidential Health Information
   - Incidents that Compromise Confidentiality
   - Privacy, Confidentiality, and Security
   - Duty of Care
   - Patient Interests
   - Identifying Confidential Information

III. Registrar Ethics and Professionalism
   - Professional Ethics in the Field of Cancer Registries
   - Professional Resources
   - Professional Development

Implications

The success of cancer registries involves an integration of law, policy, and practice, to enable a comprehensive understanding of the mechanisms of cancer registration and the possibility of clinical surveillance supported by public health decision making and control of the ethical and scientific implications of the confidential relationship between patient and physician.

Results

This chapter is anticipated for publication by the NCRA in Cancer Registry Management Principles & Practices for Hospitals and Central Registries, 4th edition.
Introduction

- Adolescents and young adults (15–39 years) have been historically underserved in the United States (US), and only allowed to stay on their parents’ insurance until age 18 or while in school through age 21 years.
- The implementation of the Affordable Care Act-Dependent Care Expansion (ACA-DCE), which started in October 2010, allowed young adults aged 26 years to remain on their parents’ insurance.
- Previous studies in the US did not distinguish between young adults who had public insurance before cancer diagnosis and who those who were uninsured and became publicly insured through Medicaid at cancer diagnosis.
- We assessed changes in health insurance coverage for young cancer survivors pre/post the ACA-DCE provision and examined differences in coverage by socioeconomic status and race/ethnicity in California.

Methods

- Data were obtained from the California Cancer Registry (CCR) which captures 99% of all cancer diagnoses in the state and California Medicaid enrollment files.
- We included young adults aged 22–34 years diagnosed with a first primary invasive cancer during March 2005 to December 2014 (Figure 1).
- Difference-in-difference analyses were conducted to examine changes in insurance coverage pre/post ACA-DCE among patients aged 22–25 years (“intervention group”) and 26–34 years (“control group”).
- We also examined the combined effect of race/ethnicity and neighborhood socioeconomic status (mSES) on insurance coverage.
- Medicaid enrollment was classified into 3 mutually exclusive categories, focusing on insurance enrollment 6 months prior to and 6 months after diagnosis: (1) continuous enrollees, (2) Medicaid at diagnosis, and (3) discontinuous Medicaid coverage.

Patient’s Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>ACA-DCE Group (22–25 years)</th>
<th>Control Group (26–34 years)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance status</td>
<td>% (n=3906)</td>
<td>% (n=3136)</td>
<td>% (n=15,778)</td>
</tr>
<tr>
<td>Public</td>
<td>56.4% (2,195)</td>
<td>48.7% (1,553)</td>
<td>61.4% (10,045)</td>
</tr>
<tr>
<td>Private/military</td>
<td>32.8% (1,287)</td>
<td>39.4% (1,236)</td>
<td>36.4% (9,127)</td>
</tr>
<tr>
<td>None</td>
<td>8.7% (334)</td>
<td>11.9% (387)</td>
<td>7.2% (2,506)</td>
</tr>
<tr>
<td>Type of insurance</td>
<td>% (n=3906)</td>
<td>% (n=3136)</td>
<td>% (n=15,778)</td>
</tr>
<tr>
<td>Type of cancer</td>
<td>% (n=3906)</td>
<td>% (n=3136)</td>
<td>% (n=15,778)</td>
</tr>
<tr>
<td>Stomach</td>
<td>13.3% (523)</td>
<td>11.8% (370)</td>
<td>15.2% (2,397)</td>
</tr>
<tr>
<td>Breast</td>
<td>10.4% (405)</td>
<td>12.5% (397)</td>
<td>10.3% (1,619)</td>
</tr>
<tr>
<td>Prostate</td>
<td>10.0% (391)</td>
<td>8.6% (271)</td>
<td>10.8% (1,706)</td>
</tr>
<tr>
<td>Lung</td>
<td>7.4% (286)</td>
<td>6.3% (200)</td>
<td>7.3% (1,163)</td>
</tr>
<tr>
<td>Other</td>
<td>52.4% (1,983)</td>
<td>48.4% (1,529)</td>
<td>52.4% (8,502)</td>
</tr>
</tbody>
</table>

Table 1. Characteristics of young adults diagnosed with cancer pre- and post-ACA-DCE implementation in California, 2005–2014.

Results

- Of 32,311 patients included in the analysis, 7,402 were aged 22–25 years and 25,269 were aged 26–34 years.
- Most patients were non-Hispanic whites, had private insurance, and were diagnosed with stage I disease. Compared to the control group, a slightly higher proportion of patients in the intervention group resided in low mSES (Table 1).
- The most substantial differences between the pre- and post-ACA-DCE were a 52.7% reduction in the proportion of uninsured patients and a 33.7% increase in the proportion of patients with Medicaid (Table 2).
- There was a significant reduction in the proportion of patients enrolled in Medicaid at cancer diagnosis (-17.3%) and with discontinuous Medicaid (-27.5%). The proportion of patients with continuous Medicaid or with other public insurance remained unchanged (Table 2).
- There was an increase of private enrollment among non-Hispanic whites living in medium and high SES neighborhoods (54.1% and 50.4%, respectively), as well as among Hispanic and Asian patients living in high SES neighborhoods (50.4% and 78.8%, respectively).
- The proportion of uninsured patients decreased significantly non-Hispanic whites living in medium and high SES neighborhoods (-97.9% and -94.6%, respectively).
- We did not observe differences in health insurance enrollment among young adults who lived in low SES neighborhoods or, whenever numbers allowed comparisons, among those of non-Hispanic black race/ethnicity.

Conclusions

- The ACA-DCE broadened insurance coverage for young adults with cancer, supporting evidence that the implementation of this policy has been important for these high-risk patients.
- Unfortunately, only certain subgroups of young adults benefited from this policy: those of non-Hispanic white race/ethnicity who resided in medium and high SES neighborhoods, and Hispanic and Asian/Pacific Islander patients who resided in high SES neighborhoods.
- Efforts should be made to ensure that enrollment benefits extend to all populations of young adults in California.

Table 2. Changes in health insurance coverage related to the ACA-DCE in young adults diagnosed with cancer during 2005–2014 in California.

California Cancer Registry (CCR) Patients aged 22–34 years diagnosed with a first primary invasive cancer during March 2005 to December 2014 (N = 33,380)

Exclusions
- Patients with no record linkage w/ Medicaid and unknown health insurance in CCR
N= 1,069

The authors declare no conflict of interest.
BACKGROUND

The New Jersey State Cancer Registry (NJSCR) is a population-based registry that collects data on all persons, regardless of residence, who are diagnosed and/or treated for cancer or another reportable condition in the state of New Jersey.

Ensuring complete case capture is necessary in order for the NJSCR to fulfill its state-mandated mission to track trends in cancer incidence and mortality in New Jersey. In 2015, the NJSCR established a case-finding audit program with the purpose of ensuring that all reportable cases are identified and reported to the NJSCR as required by state law. The NJSCR aims to audit each of the state’s 63 acute care hospitals at least once every five years.

To comply with this mandate, NJSCR conducts yearly audits of selected healthcare facilities. Beginning with the reporting year of 2014, NJSCR transitioned from manual onsite facility auditing to electronic remote auditing. This effort was undertaken to reduce cost, improve efficiency and timeliness of the auditing process, and utilize advancing technology.

METHODS

The NJSCR estimates the annual expected number of cases for each reporting facility based on a weighted average of the last five years of submissions. Estimated completeness for the auditing year is determined by the number of cases submitted for that reporting year, divided by the expected number of cases (weighted average).

Each year, NJSCR selects facilities for audit. A facility is scheduled for audit if it meets at least one of three criteria:

- Below 90% estimated completeness
- A total of 30 or more electronic pathology reports (HL7) without a corresponding hospital abstract
- Healthcare facility has not been audited in the past five years

One of three types of audits is performed for each selected facility:

- Disease Index (DI) – The facility is required to submit its annual disease index – a listing of all inpatient and outpatient admissions – filtered for reportability based on the SEER ICD-30-CM Casefinding Lists. NJSCR staff conduct probabilistic linkages with files in the SEER*DMSS registry database using MatchPro to identify unreported cases. The resulting list is provided back to the facility for review and reconciliation.

- Electronic pathology report (HL7) – Several reports are run within NJSCR SEER*DMSS to identify electronic pathology reports without a corresponding cancer registry abstract from the facility. After in-house manual screening, a list of potential missed cases is created and forwarded to the facility for review and reconciliation. Currently, 33 NJ hospitals submit electronic pathology reports.

- Combined (DI/HL7) – A combined audit is conducted for facilities with completeness below 90% and more than 10 unreported HL7 cases. The combo audit merges the two processes defined above to create a collective list of unreported cases for the facility.

During the auditing process, all correspondence and data exchanged between the healthcare facility and NJSCR must be transmitted securely and encrypted following NJSCR current policy.

RESULTS

The results of NJSCR remote auditing are illustrated in Figure 2, Figure 3, and Table 1.

Figure 2: Facilities Audited By Year and Audit Type

Figure 3: Number of Cases Identified By Year and Audit Type

Table 1: Percentage of cases retrieved from audited facilities per year from 2016-2017

Table 2: Percentage of cases retrieved from audited facilities per year from 2016-2017

DISCUSSION

The progress in remote auditing from 2014 to 2017 in the number of facilities audited and the number of cases retrieved is largely attributed to expanding data sources from which audits can be performed.

CHALLENGES

- Visual review labor and time intensive due to increasing volume of electronic pathology reports
- Maintaining confidential communications despite variations in facility-specific encryption capabilities and policies
- Changing/merging healthcare facility affiliations
- Outsourced facility cancer registry and IT personnel
- Adherence to specific audit time frames by facilities and audit team
- Implementing the use of new software technology
- Healthcare facility IT issues

Rewards

- Greater data completeness for both healthcare facilities and NJSCR
- Improving facility casefinding, reporting, and communications with NJSCR
- Process improvements for NJSCR auditing

CONCLUSION

The use of remote auditing has reduced the time consumed by the audit process and costs associated with audits. Efficiency was increased, human error was decreased, and staff travel to facilities was eliminated.

Healthcare facility auditing enhances the awareness, support, involvement and understanding necessary to capture and identify all reportable cases leading to improved routine casefinding procedures. Adopting remote auditing by NJSCR has exceeded our expectations compared to onsite facility auditing.

ACKNOWLEDGMENTS

A special thank you to all our colleagues at the NJSCR as well as NJ hospital cancer registries. Cancer Epidemiology Services, including the New Jersey State Cancer Registry, receives support from the National Program of Cancer Registries, Centers for Disease Control and Prevention under cooperative agreement NU56DP006279-02-00, the State of New Jersey, the National Cancer Institute, and the Rutgers Cancer Institute of New Jersey.
Residential mobility among adults with a history of cancer:
an analysis of the 2013-2018 National Health Interview Survey
Bian Liu, PhD1; Furrina F Lee, PhD2; Francis Boscoe, PhD3

BACKGROUND

• Residential mobility plays an important role in shaping people's health and health-related behaviors.
• We aim to identify sociodemographic factors associated with neighborhood relocation after the first cancer diagnosis among U.S. adult with a history of cancer.

METHODS

• Design: Cross-sectional study
• Data sources: The 2013-2018 National Health Interview Survey
• Study population: A nationally representative samples of non-institutionalized civilian adults (≥18 years), who self-reported to have a history of cancer.
• Outcome: Neighborhood relocation after the first cancer diagnosis
  - T1 = Time since 1st cancer diagnosis: 1, 1-3, 4-10, 11-20, > 20 years.
  - T2 = Neighborhood tenure: 1, 1-3, 4-10, 11-20, > 20 years.
  - If T2 < T1 ➔ Relocation= Yes
• Exposure variables: Demographic and socioeconomic factors
• Statistical analysis: Logistic regression model incorporating the complex NHIS design. Only a subset of the 15 demographic and socioeconomic factors were used as predictors, which were selected from a forward selection steps (entry significance level= 0.05).

RESULTS

• Approximately 40% of the adults with a cancer had resided in their neighborhood ≤ 10 years.
• 25.6% (~ 5.4 Million) relocated.
• Residential mobility was associated with multiple socioeconomic factors:
  - OR>1: below poverty income, no health insurance, not working/not looking for work, living outside of Northeast US.
  - OR<1: age, perceived neighborhood social cohesion, male, high school education, being married.

IMPLICATIONS

• Incorporating and addressing modifiable risk factors associated with residential mobility among cancer patients and survivors may offer new intervention opportunities to improve care delivery and reduce cancer disparities.

Acknowledgements: This work was supported in part by a grant from the National Cancer Institute (1R21CA235153-01).

Disclosure of Potential Conflicts of Interest: None to report.

Ethical approval and Data sharing statement: This article does not contain any studies with human participants performed by any of the authors. This study used the publicly available data from the National Health Interview Survey (NHIS), which is regularly conducted by the U.S. Census Bureau on behalf of the National Center for Health Statistics (NCHS). Survey participants were informed about the purpose and process of the NHIS in an advance letter prior to in-person interview, and verbal consent were obtained at the time of interview. The publicly released data contain no information that could identify any individual participants, and data were available from the NHIS website, https://www.cdc.gov/nchs/nhis/data-summaries-documentation.htm.
BACKGROUND:

- The US Census defines Asians as people having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent.
- For 2011-2015 US Census estimates, Asians constituted 5.9% of the general population in Massachusetts and 5.1% in the US.

MASSACHUSETTS 2011-2015 ASIAN POPULATION

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Population</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese</td>
<td>149,236</td>
<td>37%</td>
</tr>
<tr>
<td>South Asian (India/Pakistan)</td>
<td>86,775</td>
<td>22%</td>
</tr>
<tr>
<td>Vietnamese</td>
<td>47,240</td>
<td>12%</td>
</tr>
<tr>
<td>Cambodian</td>
<td>32,344</td>
<td>8%</td>
</tr>
<tr>
<td>Korean</td>
<td>26,421</td>
<td>7%</td>
</tr>
<tr>
<td>Filipino</td>
<td>12,220</td>
<td>3%</td>
</tr>
<tr>
<td>Japanese</td>
<td>10,819</td>
<td>3%</td>
</tr>
<tr>
<td>Other</td>
<td>36,212</td>
<td>9%</td>
</tr>
<tr>
<td>TOTAL ASIAN</td>
<td>460,675</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: US Census American Community Survey estimates.

- While Asians represent 5.9% of the Massachusetts population, they represent only 2.5% of cancer cases.
- Analyses are limited to the Asian ethnic groups with the largest number of cases (Chinese, South Asian, Vietnamese).

MASSACHUSETTS 2011-2015 ASIAN CANCER RATES

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Population</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Chinese</td>
<td>2,159</td>
<td>43%</td>
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<tr>
<td>South Asian</td>
<td>857</td>
<td>17%</td>
</tr>
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<td>Vietnamese</td>
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<td>Japanese</td>
<td>142</td>
<td>3%</td>
</tr>
<tr>
<td>Other</td>
<td>97</td>
<td>2%</td>
</tr>
<tr>
<td>Not Specified</td>
<td>470</td>
<td>1%</td>
</tr>
<tr>
<td>TOTAL ASIAN</td>
<td>5,003</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: *Massachusetts Cancer Registry

ANALYSES:

**Adjustment for Asian, Not Otherwise Specified Cases (NOS):**

- From 2011-2015, 9% of Asian cases were reported to the MCR without a specific ethnicity (NOS), a percentage that would lead to an underestimate of incidence rates for ethnic groups.

- NOS cases were recorded based on the distribution of selected cancer types among cases with a specified ethnicity.
  1) Distribution of Asian cases with a known ethnicity for a cancer was determined. (For example, 48% of prostate cases were reported as Chinese, 8% were South Asian, and 5% were Vietnamese.)
  2) Prostate cases among Asian, NOS males were then recorded based on these distributions.

**Calculation of Rates:**

- Limited to cancers with highest frequencies (all invasive, female breast, colorectal, liver, lung, thyroid, and prostate).
- Age-adjusted incidence rates with 95% confidence intervals were calculated for the cancers to assess statistical significance. Rates were not calculated for cancers with fewer than 20 cases.
- Rates were compared between South Asians, Chinese, and Vietnamese. These groups were then compared to all Asians and to all invasive cancer cases, regardless of race/ethnicity.

AGE-ADJUSTED CANCER INCIDENCE RATES AMONG SPECIFIC ASIAN ETHNICITIES COMPARED TO ALL ASIANS AND ALL MASSACHUSETTS (MA)* CASES, 2011-2015

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</tr>
<tr>
<td>TOTAL ASIAN</td>
<td>5,003</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: *Massachusetts Cancer Registry

**RESULTS:**

- South Asian and Vietnamese females had significantly elevated rates of all invasive cancers compared to Chinese females, though significantly lower than all MA females.
- South Asian females had a significantly elevated breast cancer rate compared to all Asians but comparable to all MA females.
- Vietnamese males had a significantly elevated rate of all invasive cancers compared to Chinese and South Asian males, though significantly lower than all MA males.
- Vietnamese males had a significantly elevated liver cancer rate compared to Chinese males, all Asians, and all MA males.
- South Asian males had a significantly lower rate of colorectal cancer compared to all Asians and all MA males.
- Vietnamese males had significantly elevated rates of lung cancer compared to South Asian, Chinese, all Asian males AND all MA males.
- The percentage of known past/current tobacco use among all invasive cancers for males was significantly elevated (p<0.05) for Vietnamese males (64%) compared to all males (33%).

**CONCLUSIONS:**

- These analyses showed a significant difference of rates for several cancers by specific Asian ethnicity, underscoring the heterogeneity of the broader Asian category.
- Ethnic-specific data can aid in the development of prevention programs that are culturally specific within this group, such as:
  - Breast cancer screening for South Asian women.
  - Smoking cessation for Vietnamese men.
  - Hepatitis B screening and treatment for Vietnamese men.
- The MA Department of Public Health Women’s Health Network works with various Asian community groups for outreach and education on health screening.

We acknowledge both the Centers for Disease Control and Prevention under cooperative agreement 5U58DD007273-03-00 and the National Cancer Institute under contract HHSN275201300081I for their support of the staff and the printing and distribution of this report awarded to the Massachusetts Cancer Registry by the Massachusetts Department of Public Health. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention.
Epidemiology of Gliomas near Brainstem in Children and Adolescent in the United States, 2000-2016: High-grade gliomas, Ependymomas, and Pilocytic Astrocytomas

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BACKGROUND

- Limited population-based data exists for brainstem gliomas of children, which include
  - high grade, aggressively-growing tumors such as diffuse intrinsic pontine glioma (DIPG or diffuse midline glioma H3-K27M positive) and
  - low grade glioma.
- We examined the overall incidence and survival patterns in children with brainstem gliomas by age, sex, and race and histology.

RESULTS

- Overall, from 2000 to 2016, there were 33,190 patients with primary malignant glioma originating from brain and other CNS locations among children ages 0-19 years.
  - 0.703 (20.5%) patients were identified with gliomas in the brainstem (Figure 1).
- The incidence (AAR=0.32, 95% CI: 0.31-0.33) of high-grade gliomas were higher compared to pilocytic astrocytoma (AAR=0.997, 95% CI: 0.990-0.999) and ependymal tumors (AAR=0.006, 95% CI: 0.005-0.006) (Figure 2).

CONCLUSION AND FUTURE DIRECTIONS

- During the study period (2000-2016), the incidence of primary malignant brainstem glioma in children age 0-19 was increasing, especially that of High-grade glioma.
- High grade glioma was most common and fatal histology compared to pilocytic astrocytoma and ependymal tumors.
- Survival among patients with high grade glioma did not differ by sex, race, ethnicity, age groups and diagnostic confirmation.
- Further research is warranted to determine the advantage or disadvantages of treatment options that provide maximal benefit with minimal risk to these patients.

ACKNOWLEDGEMENTS

Funding for CIBTRUS was provided by the Centers for Disease Control and Prevention (CDC) under Contract No. 2019-GX00506-00, the American Brain Tumor Association, the Sontag Foundation, Novocure, the Maiweiler Foundation, National Brain Tumor Society, the Children’s Brain Tumor Foundation, the June Kory Foundation, the Zelda Dorem Teitelbaum Memorial Fund, as well as private and invited donations. OTG is supported by a Research Training Grant from the Cancer Prevention and Research Institute of Texas (CPRIT RP-160597). Contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

REFERENCES


Figure 1) Distribution of Primary Childhood and Adolescent (age <16 years) Brain and Other CNS Gliomas by A) Site and B) Histology Subtypes within Brainstem (ICD-O-3 site code C71.7).

Figure 2) Age-Adjusted Incidence Rates with 95% Confidence Intervals by Patient Characteristics for Gliomas near Brainstem in Children and Adolescent in the United States: 2000-2016.

Figure 3) Age-Adjusted Incidence Trends With 95% Confidence Intervals of Primary Childhood and Adolescent Brainstem Gliomas by Histology, 2000-2016.

Figure 4) Multivariable Cox Proportional Hazards Model Results (With Hazard Ratio, 95% CI and P-Values) For Primary High-grade Childhood Brainstem Gliomas using SEER 2000-2016 (N = 1,237)
Zaire Simmons MPH, Katura Horton-Perinchief MBA, MPH, OLY
Bermuda Hospitals Board

Invasive cervical cancer is the second most common cancer amongst women worldwide however, in Bermuda, it does not even rank in the top 10 of most-commonly diagnosed sites. The objective of this study was to examine invasive cervical cancer cases during the ten-year period of 2007-2016 and detailed smoking status, HPV status, family history of disease, common comorbidities and age at diagnosis.

### Introduction

<table>
<thead>
<tr>
<th>Race</th>
<th>Population Percentage</th>
<th>Cervical Cancer Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>26.2%</td>
<td>22.7%</td>
</tr>
<tr>
<td>Black</td>
<td>25.5%</td>
<td>28.8%</td>
</tr>
<tr>
<td>Asian</td>
<td>20.1%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Bircual</td>
<td>18.2%</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

### Methodology

- Age at diagnosis ranged from 19yrs to 94yrs
- Study population of N=111, Black (N=18), White (N=10), Asian (N=3).
- Data were stratified by age-group, morphology, comorbidities, race, habits (smokers, ex-smoker etc.) and family history.
- The Bermuda National Tumour registry was used to identify patients between the time-period of 2006-2017 who had invasive cervical cancer.
- King Edward Memorial Hospital IV (KEMH) Health Information Management Services (HIMS) department collected 31 patient charts and the missing fields were then registered and input into CanReg (Tumour Registry Software).
- Histology and morphology codes were defined according to the ICD-O-3.
- Age-standardized rate was calculated using the U.S. Standard Population 2000.
- Bermuda population percentage distribution by race (2016): 54% Black, 31% White, 4% Asian, 8% Biracial

### Results

- Age-group with the highest number of new cases is 50-69.
- Hypertension was the most common comorbidity.
- Asian women had a higher incidence rate than any other race. With respect to morphology, 45 percent of invasive neoplasms were squamous cell carcinoma.
- Race: 50% Black, 22% White, 10% Asian, 8% Biracial
- None of the cases had a positive family history, 17 had a negative family history and 14 had an unknown family history.
- Out of 31 cases, 10 are deceased of those 4 died from invasive cervical cancer. The case fatality rate is 60 percent.
- Out of 31 cases, 4 were HPV positive, other cases were either, not tested, negative or unknown.
- 3 Smokers, 6 Ex-smokers and 2 Drug abusers

### Conclusion

Findings from the analysis of this data should provide Bermuda and researchers some insight into the particulars of invasive cervical cancer cases during a specific time period. Smoking is a known independent risk factor for invasive cervical cancer and 29 percent of the women were smokers. The largest disparity is evident in the Asian race which had the overall highest incidence rate. Although, incidence is relatively low, case fatality is high. More research must be done to decrease the morbidity and mortality on this population.

### Acknowledgements

Thank you to Ms. Sharon Pennyfeather the HIMS department at King Edward Memorial Hospital IV and the Caribbean Public Health Agency (CARPHA).
Ependymoma, NOS and anaplastic ependymoma incidence and survival in the United States varies widely by patient and clinical characteristics, 2000-2016

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5. Department of Internal Medicine, Stanford University, 6. Department of Neurosurgery, University Hospitals of Cleveland, Cleveland, OH.

BACKGROUND

Ependymoma is a rare central nervous system tumor arising from the ependymal lining of the ventricular system. General differences in incidence and survival have been noted, but not examined on a comprehensive scale for all ages and by histology. Despite the rarity of ependymoma, morbidity and mortality associated with an ependymoma diagnosis justifies closer examination.

METHODS

Incidence data were obtained from the Central Brain Tumor Registry of the United States in collaboration with the CDC and NCI, and survival data from SEER, from 2000-2016 for anaplastic ependymoma and ependymoma NOS. Age-adjusted incidence rates (IR) per 100,000 persons-years were analyzed by age, sex, race, location. Survival analysis was performed with Kaplan-Meier curves and multivariable Cox proportional hazards models.

RESULTS

Incidence of anaplastic ependymoma was highest in ages 0-4 years. Black populations had lower incidence but had a 7.8% increased risk of death compared to White populations [HR: 1.78 (95% CI: 1.30-2.44)]. Incidence was highest for anaplastic ependymoma in the supratentorial region. Adults (40+ years) had almost twice the risk of death compared to children (0-14 years) [HR: 1.97 (95% CI: 1.45-2.68)]. For ependymoma, NOS, subtotal resection had a risk of mortality 1.81 times greater than gross total resection [HR: 1.84 (95% CI: 1.32-2.63)].

Figure 1: (A) Age-adjusted incidence rates for 6 (B) Race (API = Asian or Pacific Islander, AMH = American Indian or Alaska Native) (C) Ethnicity (D) and Location by histology (AE = Anaplastic Ependymoma, EN = Ependymoma, NOS) (CBTRUS 2000-2016).

Figure 2: Kaplan-Meier survival curves stratified by gross total resection (GTR), subtotal resection (STR), GTR + radiation (RT) or STR + RT for AE anaplastic ependymoma and EN, NOS. (CBTRUS 2000-2016).
Diagnosis can be commonly used as sentinel eligible cases in population-based cancer studies. Most of studies will include only macroscopically confirmed cases. However, for brain/CNS tumors, the first confirmation is often a diagnosis by radiography such as computerized tomography (CT) or magnetic resonance imaging (MRI) scan. Particularly in brain/borderline (BB) brain/CNS tumors diagnosed, these tumors are frequently diagnosed via radiography without microscopic confirmation. Furthermore, the variation of age- and adjusted incidence of BB brain/CNS tumors among central cancer registries (CCR) is greater than that of malignant brain tumors. It is unclear if this variation is related to the differences in the degree of thorough case-finding process among CCRs.

**Objective**

- To evaluate the unknown rate of brain tumor diagnostic method by radiation stereotactic, subdural, and diagnosis as well as to identify CCRs with higher unknown malignant.

- To compare the diagnostic method of brain tumors by behavior, age, subdural, and CCR.

<table>
<thead>
<tr>
<th>Table 1. Percent of brain/CNS tumors with unknown malignant diagnostic method by behavior and covariate (2012-2016)</th>
</tr>
</thead>
</table>

Two third of the 2,717,346 eligible cases were BB brain tumor cases (66.3%) and of them 66.9% were females. Patients having BB tumor in midline gliomas having or malignant tumor at age 80 years had the highest unknown diagnosis, 1.4% and 8.0%, respectively (Table 1). From 2012-2016, unknown rate decreased from 1.1% to 0.8% for BB cases and from 1.7% to 1.2% for malignant cases. Among 51 CCRs, the average of unknown diagnosis was 1.0% (Range 0.8% - 5.4%) for BB cases with 5 CCRs having unknown rate above upper whisker and 1.4% (Range 0.8% - 8.4%) for malignant cases (Table 2). Patients with malignant tumor aged 45-59 years had the highest percent of microscopic diagnosis (94.9%) and only about 15% of BB tumor patients aged 80+ were diagnosed thus far this method (Figure 1). Among those, percent of radiographic diagnosis increased as age increased for BB tumors. Among subdural, malignant brain tumors had the highest percent of microscopic diagnosis (84%) and meninges tumors BB had the highest percent diagnosed thus radiography (64%) (Figure 2). Overall, 52.4% of BB tumors were diagnosed by radiography (Figure 3a), while 87.4% of malignant cases were macroscopic diagnosis (Figure 3b). Seventeen CCRs had lower percent of radiographic diagnosis as compared to microscopic confirmation for BB tumors and 16 of them had significantly lower BB brain tumor incidence rates than the national rate (p<0.05).

**Materials and Methods**

**Table 2. Diagnostic confirmation and Incidence Rate for Benign/Borderline Brain/CNS Tumor by registry: 2012-2016**

**Conclusions**

Overall the unknown diagnosis decreased over time. The percent of brain tumors with unknown diagnosis and type of diagnostic methods varied by age, subdural, and malignant tumors.

For CCRs with an extremely low percent radiographic diagnosis of BB tumors, the efforts to ensure the complete case ascertainment from hospital and/or radiology log sources may be necessary to further elucidate underreporting. CCR with unknown diagnosis percentage above the upper whisker is considered having data quality issue.

**Acknowledgments**

The authors gratefully acknowledge the hospital and central cancer registers for their diligence in cancer data collection and the support from members of the NAACCR Data Assessment Workgroup.
Neighborhood-based Survival Disparities in Pediatric and AYA Acute Leukemia

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1 UCSF Helen Diller Family Comprehensive Cancer Center, San Francisco and 2 UC Davis Comprehensive Cancer Center, Sacramento, CA

Background
Sociodemographic disparities in survival among patients with acute lymphoblastic ALL and myeloid leukemias (AML), aged less than 39 years have been reported in the United States with some conflicting results

Objective
To evaluate the impact of multiple neighborhood factors, using a novel archetype approach, on survival among young patients with ALL and AML in California

Hypothesis
Living in low SES neighborhoods with predominantly non-White populations is associated with lower survival among young patients with acute leukemia

Methods
Cohort: 8,761 patients aged 0-39 years reported to the California Cancer Registry with a diagnosis of ALL or AML in 2006-2016
Outcome: overall survival (OS)
Neighborhood Exposure (at diagnosis):
- 9-neighborhood dataset: composite index derived from principal components analysis of 7 indicators (education, income, poverty, employment, occupation, house value, rent)
- 9-neighborhood archetype: single classification system derived from latent class analysis of 39 social and built environment attributes

Neighborhood Archetype Distribution in California

Analysis: Cox proportional hazards models were used to estimate hazard ratios (HR), with follow-up from diagnosis through 2016

Table 1: Patient Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ALL (N=5,339)</th>
<th>AML (N=3,422)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>59.8%</td>
<td>32.7%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>34.5%</td>
<td>48.5%</td>
</tr>
<tr>
<td>African-American</td>
<td>5.7%</td>
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</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>3.4%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Other</td>
<td>1.2%</td>
<td>1.2%</td>
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<tr>
<td>Sex</td>
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</tr>
<tr>
<td>Male</td>
<td>41.8%</td>
<td>44.2%</td>
</tr>
<tr>
<td>Female</td>
<td>58.2%</td>
<td>55.8%</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;10 years</td>
<td>21.1%</td>
<td>15.8%</td>
</tr>
<tr>
<td>10-19 years</td>
<td>31.5%</td>
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</tr>
<tr>
<td>20-29 years</td>
<td>24.7%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Leukemia Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-cell</td>
<td>81.3%</td>
<td>71.3%</td>
</tr>
<tr>
<td>T-cell</td>
<td>16.8%</td>
<td>24.2%</td>
</tr>
<tr>
<td>Other</td>
<td>1.9%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Other</td>
<td>1.9%</td>
<td>24.2%</td>
</tr>
<tr>
<td>Bone Marrow Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete Response</td>
<td>95.5%</td>
<td>95.3%</td>
</tr>
<tr>
<td>Relapse</td>
<td>1.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Cure</td>
<td>2.3%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Not Available</td>
<td>0.4%</td>
<td>0.1%</td>
</tr>
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</table>

Table 2: Multivariable Models of Overall Survival

<table>
<thead>
<tr>
<th>Model</th>
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<th>AML</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixture HR</td>
<td>Adjusted HR</td>
<td>Adjusted HR</td>
</tr>
<tr>
<td>Baseline</td>
<td>17.8%</td>
<td>1.00 (reference)</td>
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<tr>
<td>Race/Ethnicity</td>
<td></td>
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<tr>
<td>Non-Hispanic White</td>
<td>12.5%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>15.6%</td>
<td>1.05 (0.93-2.20)</td>
</tr>
<tr>
<td>African-American</td>
<td>18.3%</td>
<td>1.07 (0.83-1.38)</td>
</tr>
<tr>
<td>Levine</td>
<td>19.7%</td>
<td>1.07 (0.83-1.38)</td>
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<tr>
<td>Leukemia Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-cell</td>
<td>16.8%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>T-cell</td>
<td>18.3%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Other</td>
<td>2.3%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Health Insurance Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>30.9%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Private</td>
<td>56.8%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>7.4%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Public</td>
<td>3.5%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Unknown</td>
<td>3.7%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Treatment at a pediatric cancer center</td>
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<td></td>
</tr>
<tr>
<td>No</td>
<td>79.9%</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>Yes</td>
<td>20.1%</td>
<td>1.00 (reference)</td>
</tr>
</tbody>
</table>

Conclusions
- The substantial effect of neighborhood factors on overall survival highlights an important and persistent disparity
- When other aspects of the social built environment in addition to nSES are incorporated into the neighborhood archetypes, stronger associations with survival are observed
- The greater effects of neighborhood and health in survival among patients with ALL (relative to AML) may be linked to the prolonged, outpatient nature of ALL therapy and non-adherence to oral medications

Neighborhood Archetype Characteristics

Legend: 1 SUVr = 0.87, 2 SUVr = 0.69, 3 SUVr = 0.47, 4 SUVr = 0.18, 5 SUVr = 0.02, 6 SUVr = 0.01, 7 SUVr = 0.00, 8 SUVr = 0.00, 9 SUVr = 0.00

1 Both models adjusted for sex, race/ethnicity, age, year, leukemia type, treatment site, receipt of chemotherapy/radiation, and insurance status
2 Because nSES is a composite of the neighborhood archetype, two separate models were created, one for each exposure of interest
Trends in Incidence and Clinical-Pathological Patterns of Thyroid Cancer in New York State

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INTRODUCTION

- New York State (NYS) has one of the highest thyroid cancer (TC) incidence rates in the nation, and, similar to other states, has had a substantial increase in incidence over the past several decades.
- A recent study using SEER data suggested that the rate of TC had slowed and even slightly declined in recent years.
- There were no large differences in health disparities by county in NYS.
- Similar trends were observed in other states in recent years.
- Clinical-pathological patterns of TC in NYS tend to suggest that early-stage diagnosis is important for the overall incidence rate.

METHODS

- Using 1990-2017 NYS Cancer Registry data, we examined TC incidence rates by age, gender, race, and tumor size.
- We used the International Classification of Diseases for Oncology, 3rd Edition, to identify TC cases.
- Using the NYS County Health Rankings (from the Robert Wood Johnson Foundation), we analyzed age-adjusted and standardized "Indicator" measures, including "Clinical Care" and "Health Outcomes," in relation to early-stage TC incidence.

RESULTS

- Trends in Thyroid Cancer Incidence by Sex, New York State, 1996-2017
- Trends in Thyroid Cancer Incidence by Age and Stage at Diagnosis, New York State, 1996-2017
- Trends in Thyroid Cancer Incidence by Sex, County, New York State, 2013-2017
- Five-year average annual percentage change for Thyroid Cancer Incidence by County, New York State, 2013-2017

CONCLUSIONS

- Thyroid cancer incidence in NYS may have reached a plateau, which agrees with the findings of other recent studies in the state. Further analysis is needed to understand the reasons for the decrease.
- Early-stage diagnosis is crucial for reducing the overall incidence rate and improving patient outcomes.

ACKNOWLEDGMENTS

This research was supported in part by...

REFERENCE

INTRODUCTION

- Rapid and effective data monitoring is critical for cancer surveillance systems.
- CDC’s National Program of Cancer Registries (NPCR) modernizing an on-line tracking system (Monitoring Dashboard or MDB).
  - Monitors program activities, data submission and processing, and data quality control.
- Building on the current NPCR-Cancer Surveillance System (CSS).
  - Provides data visualization tools.
  - Allows CDC staff (and eventually NPCR awardees) to monitor program activities.
  - Enhances transparency and communications.
- Quality cancer data is critical for cancer research and for cancer prevention and control at the national, state, and local levels.
- CDC’s NPCR Program has played an important role in building a national cancer data ecosystem that provides quality cancer surveillance data for cancer control and prevention missions.

RESULTS

- Role-based menu items and features for CDC and registry users
- Interactive dashboards for enhanced data visualization
- Flexible querying system to allow users to customize their search
- Modernized functionality and look-and-feel of MDB site

DISCUSSION

- Responsive design allows adjustment to different devices (phones, tablets, laptops).
- Provides export ability in MS Excel or PDF formats.
- Utilizes security best practices for password policies.
- Uses inbuilt .NET Cryptographic libraries to create random salts and hashed passwords.
- Leverages .NET libraries ensuring compliance with NIST security standards.
- Applies scanning software to discover and address security vulnerabilities.
- Ensures Section 508 compliance.

CONCLUSIONS

- Visually displays major programmatic components.
  - Dashboards modules using tables, infographics and maps.
- CDC staff can track awardee activities.
  - Interstate data exchange
  - Program Evaluation Instrument
- State users can generate reports
  - Frequency counts
  - Data trends
- Enhancements expected to improve NPCR program management and contribute to overall improvement in efficiency and accuracy.

Acknowledgement

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Background

- Myelodysplastic syndromes (MDS), a reportable malignant neoplasm in the Surveillance, Epidemiology, and End Results (SEER) Program since 2001, is a poorly understood malignancy consisting of a group of bone marrow disorders where stem cells either fail to mature or are defective.¹
- MDS affects both children and adults. However, it is most prevalent in the older population, with about 90% of the patients being diagnosed at ≥60 years of age and with a median age at diagnosis of 76 years. ²,³
- New information and diagnostic tools available since 2001 have improved both our understanding and identification of this disease. ⁴ This has resulted in multiple revisions of the World Health Organization’s classification of MDS, with the most recent significant changes adopted by the SEER Program in 2010.

Methods

- Incidence data from SEER 21 regions for 2001-2016 period (November 2018 submission) were used to estimate age-adjusted incidence rates using SEER*Stat, version 8.3.6 (SEER, 2018).
- SEER 21 includes data from 21 registries covering approximately 36.7% of the population in the United States (US) and include the following geographic areas:
  - California, Connecticut, Detroit, Georgia, Hawaii, Idaho, Iowa, Kentucky, Louisiana, Massachusetts, New Jersey, New Mexico, New York, Seattle, Utah, and Alaska natives
- All MDS cases diagnosed between January 1, 2001 and December 31, 2016 with the following ICD-3-O histology codes were included: 9982, 9982-9986, 9989, 9991-9992.
- All incidence rates were age-adjusted using the 2000 US standard population.
- Rates were estimated for the total population as well as by histology, sex, age, and race/ethnicity, applying histologic coding changes implemented in 2010 as described below:
  - New ICD-3-O-3 codes, 9991 and 9992, were added to categorize refractory neutropenia and refractory thrombocytopenia separately. These, along with refractory anemia (ICD-3-O-3: 9990) are combined to form refractory cytopenia with unilineage dysplasia for trend analysis by histology in this analysis.
  - Refractory anemia with excess blasts in transformation (RAEB-1, 9984) was combined with RAEB (ICD-3-O: 9983).
  - Therapy-related MDS (9987) was excluded from the analysis since it was recategorized with other therapy-related myeloid neoplasm.

| Table 1. Age-adjusted incidence rates and counts of myelodysplastic syndrome for SEER 21 geographic regions by sex, age, race/ethnicity, and histology: 2001 – 2016. |
|---------------------------------|-----------------|-----------------|-----------------|
|                                | Rate¹ | Count | Rate² | Count | Rate³ | Count |
| Total                           |       |       |       |       |       |       |
| Age at diagnosis                |       |       |       |       |       |       |
| 0 - 19                          | 4.7   | 85,146.0 | 6.5   | 48,293.0 | 3.6   | 37,853.0 |
| 20 - 49                         | 0.1   | 529.0   | 0.1   | 273.0   | 0.1   | 256.0   |
| 50 - 64                         | 0.4   | 3,051.0 | 0.4   | 1,507.0 | 0.4   | 1,544.0 |
| 65 - 74                         | 3.4   | 11,224.0 | 4.6   | 6,130.0 | 2.9   | 4,874.0 |
| 75 - 84                         | 17.4  | 20,576.0 | 22.5  | 12,120.0 | 13.2  | 8,456.0 |
| 85 - 84                         | 42.6  | 31,880.0 | 60.3  | 18,503.0 | 30.3  | 13,377.0 |
| Median                          | 61.2  | 330,026.0 | 96.1  | 90,980.0 | 44.5  | 92,946.0 |
| Race/ethnicity                  |       |       |       |       |       |       |
| Non-Hispanic White              | 5.1   | 68,734.0 | 7.0   | 39,964.0 | 3.7   | 29,270.0 |
| Non-Hispanic Black              | 3.8   | 6,015.0  | 4.9   | 2,974.0  | 2.4   | 3,177.0  |
| Hispanic of all races           | 3.5   | 5,903.0  | 4.3   | 3,066.0  | 2.9   | 2,927.0  |
| Non-Hispanic Asians/ Pacific Islanders | 3.5 | 4,513.0  | 4.5   | 2,484.0  | 2.0   | 2,029.0  |
| Non-Hispanic American/Indian/ Alaska Native | 3.0 | 2,711.0  | 3.7   | 1,491.0  | 4.0   | 1,443.0  |
| Unknown                         | ~484  | ~256   | ~288  | ~228   | ~216  | ~178   |

Histology Subtype (ICD-O-3)      |       |       |       |       |
| Refractory anemia               | 0.4   | 767.0   | 0.5   | 403.0   | 0.3   | 364.0   |
| Refractory anemia with ring sideroblasts (9986) | 0.3 | 613.0  | 0.5   | 344.0   | 0.3   | 287.0   |
| Refractory anemia with excess blasts (9983) | 0.6 | 1,150.0 | 0.9   | 672.0   | 0.4   | 543.0   |
| Refractory anemia w excess blasts in transformation (9984) | 0.0 | 32.0   | 0.0   | 189.0   | 0.0   | 137.0   |
| Refractory cytopenia with multilineage dysplasia (9985) | 0.3 | 517.0  | 0.4   | 337.0   | 0.2   | 180.0   |
| Myelodysplastic syndrome associated with isolated del5q (9986) | 0.1 | 242.0  | 0.1   | 93.0    | 0.1   | 488.0   |
| Myelodysplastic syndrome unclassifiable (9989) | 2.9 | 52,636.0 | 4.3 | 29,193.0 | 2.3 | 23,443.0 |
| Refractory neutropenia          | A     | A      | A     | A      | A     | A      |
| Refractory thrombocytopenia (9992) | 0.0 | 259.0  | 0.0   | 144.0   | 0.0   | 115.0   |

Results

- A total of 86,146 MDS cases were diagnosed during the study period, with the majority diagnosed at age ≥ 65 (83%), non-Hispanic white (80%), and classified as MDS unclassifiable (MDS-U, ICD-O-3: 9989, 61%).
- The overall age-adjusted incidence rate was 4.7 cases per 100,000 population with the rates higher among males than females (6.5 vs 3.6 per 100,000), among non-Hispanic whites (5.1) than other race/ethnicity (3.0-3.8), and among patients aged 65 and older (17.4 – 61.2) as compared to those under age 65 (0.1 – 3.4, Table 1).
- Annual rates increased from 3.7/100,000 in 2001 to 5.6/100,000 in 2010, then slowly declined to 3.8/100,000, making a slightly widened v-shaped pattern.
- This pattern was observed for both sexes, all racial/ethnic groups, and among MDS age groups (Figures 1a-c).
- When assessed by histology, this pattern was observed for MDS-U, but not for other MDS subtypes (Figure 1d).

Conclusions

- The patterns of incidence rates observed during the study period are dominated by the incidence rates for MDS-U, a provisional diagnosis given before all diagnostic information becomes available to indicate a specific diagnosis.
- The decline in rates since 2010, observed mainly for the MDS-U, is most likely a reflection of the following types of diagnostic and coding changes, most of which occurred in 2010 to incorporate WHO’s 2008 guidelines:
  1. definitive diagnostic methods were applied to identify specific subtypes and/or rule out MDS;
  2. therapy-related MDS (9987) is no longer captured under MDS, and
  3. diagnosis criteria for AML were expanded to include cases with 20%-30% bone marrow blasts, which means that most cases previously defined as refractory anemia with excess blasts in transformation (9984) are now classified as AML.
- Further analysis is warranted to conclusively determine all factors leading to the changes observed.

Acknowledgments

This work was supported by the National Cancer Institute Surveillance, Epidemiology, and End Results Program (HHSN261201800099E).

References

Identifying Risk Factors Associated with Subsequent Breast Cancer Diagnosis among Breast Cancer Survivors in New York

Bouchen Qiao, Maria J. Schumacher, April A. Austin, Amy R. Wohl • New York State Cancer Registry

INTRODUCTION

Background: Women with a history of breast cancer have an increased risk of developing subsequent breast cancers. Factors associated with the risk have been evaluated using the public-use data files from the Surveillance Epidemiology and End Results Program (SEER) • National Cancer Institute (NCI). Surveillance, Epidemiology, and End Results (SEER) Program. However, due to lack of critical data elements such as granular treatment information, findings could be underestimated.

Objectives: The purpose of this study is to identify the risk factors that are associated with the development of subsequent breast cancers among female breast cancer survivors by assessing demographic and tumor characteristics as well as the treatment received for the first cancer.

MATERIALS AND METHODS

Data Source: Female invasive breast cancer cases reported to the New York State Cancer Registry (NYSCR) were used for the study.

Case Index Selection: In total, 1,371,541 breast cancer cases (dual and triennials) were included. The data contained fields for race, age at diagnosis, ethnicity, education, income, tumor stage, estrogen receptor (ER) status, progesterone receptor (PR) status, year of diagnosis, radiation therapy, chemotherapy, and hormone therapy. The detailed categories for each factor are shown in Table 1.

Identification of Subsequent Breast Cancer: Women with an invasive breast cancer diagnosis were followed for ten years to identify any subsequent breast cancer diagnoses.

RESULTS

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of Cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at diagnosis</td>
<td>40-49</td>
<td>30%</td>
</tr>
<tr>
<td>Race</td>
<td>White</td>
<td>70%</td>
</tr>
<tr>
<td>Education</td>
<td>Less than high school</td>
<td>30%</td>
</tr>
<tr>
<td>Income</td>
<td>Low</td>
<td>20%</td>
</tr>
<tr>
<td>Tumor stage</td>
<td>Stage I</td>
<td>50%</td>
</tr>
<tr>
<td>ER status</td>
<td>Positive</td>
<td>60%</td>
</tr>
<tr>
<td>PR status</td>
<td>Positive</td>
<td>50%</td>
</tr>
<tr>
<td>Year of diagnosis</td>
<td>2010-2014</td>
<td>40%</td>
</tr>
</tbody>
</table>

Table 1. Percentage of index female breast cancer patients who had developed a subsequent breast cancer within 10 years after the initial diagnosis by demographic/tumor characteristics and treatment status, and rate of multivariate and multistate sub-distribution baseline hazard regression analysis

RESULTS (CONTINUED)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of Cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td>White</td>
<td>70%</td>
</tr>
<tr>
<td>Education</td>
<td>Less than high school</td>
<td>30%</td>
</tr>
<tr>
<td>Income</td>
<td>Low</td>
<td>20%</td>
</tr>
<tr>
<td>Tumor stage</td>
<td>Stage I</td>
<td>50%</td>
</tr>
<tr>
<td>ER status</td>
<td>Positive</td>
<td>60%</td>
</tr>
<tr>
<td>PR status</td>
<td>Positive</td>
<td>50%</td>
</tr>
<tr>
<td>Year of diagnosis</td>
<td>2010-2014</td>
<td>40%</td>
</tr>
</tbody>
</table>

Figure 1. Cumulative incidence function (CIF) of developing a subsequent breast cancer among breast cancer survivors by age at the first cancer diagnosis (Fig. 1A), ER status (Fig. 1B), and hormone treatment status (Fig. 1C).

ACKNOWLEDGEMENTS

This project was funded in part by the Centers for Disease Control and Prevention’s (CDC) National Program of Cancer Registries through cooperative agreement U48DPH001924 awarded to the New York State Department of Health and by the National Cancer Institute, National Institutes of Health, Department of Health and Human Services, under Contract HHSN26120080001E. The contents are solely the responsibility of the New York State Department of Health and do not necessarily represent the official views of the CDC or NIH.
INTRODUCTION

- CDC’s National Program of Cancer Registries (NPCR) represents ~97% of the U.S. population.
- Since its inception, NPCR Cancer Surveillance System (CSS) used the NAACCR flat file format for data submission.
- Custom XML data exchange standard Version 1.0 approved in 2015.
- NAACCR XML data structure challenging with data processing:
  - SAS XML mapper slow and inefficient, even for small XML data.
  - Large data files, sometimes approaching 5GB, especially burdensome.
- Efficient and convenient XML data processing is critical.

This poster presents two solutions to process XML data efficiently — SAS and Python.

DATA

A test XML data provided by a state is used as the foundation to create a series of testing datasets, whose size ranges from 1GB to 30GB, and cases range from 152495 to 4574650.

METHODS

We have tested and evaluated a variety of tools and technologies. This presentation will focus on two methods — SAS and Python.

- SAS/Data Step: This method treats XML data as an ASCII format and parses it as a text file. By leveraging PROC FORMAT, the method can dynamically restrict data items (based on NAACCR V18 dictionary) to those required by the NPCR call for data in order to avoid the burden of reading through all NAACCR data items.
- Python: Python is an open source programming language and has vibrant community that provides robust as well as free data processing and analytical packages. We tested XML etree/ElementTree package in Python to parse the XML data. A lookup table was also used to limit data items to the NPCR required items. A memory reclamation technique was deployed in Python code to control the memory usage by Python application.

RESULTS

Table 1: Comparisons of SAS and Python CPU usage for parsing NAACCR XML data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SAS w/</th>
<th>Python w/</th>
<th>SAS w/ Default</th>
<th>Memory reclamation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Usage</td>
<td>25%</td>
<td>15%</td>
<td>25%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Figure 1: Comparisons of SAS and Python memory usage for parsing NAACCR XML data

- For all test data sizes, SAS managed to use 21 MB memory consistently.
- For Python with XML.etree/ElementTree package, the memory usage increases linearly with data size. For example, on average processing 1 GB XML data used 34 MB memory, 156 MB for 217 MB memory, and 30 GB for 413 MB memory.

Figure 2: Comparisons of runtime performance of SAS and Python for parsing NAACCR XML data

- Both SAS and Python runtime increases linearly with the increase of XML data sizes whereas SAS’ runtime increases more dramatically than Python’s.
- The runtime differences are striking when data size gets relatively large. For instance, for 15 GB and 30 GB XML data, SAS used 34 and 72 minutes, while Python used 22 and 44 minutes respectively.

DISCUSSION

- The single thread operations of SAS and Python limit CPU usage to 25%, which could hinder efficiency in processing NPCR XML data when files get larger over time. Multithreading in SAS and Python may help on this. However, the resources needed to program and maintain multithreading in SAS and Python could be very demanding. We have explored the concurrent processing of SAS with parallel jobs on subdivided XML data. The results are very promising, but it needs states’ involvement in subdividing XML data.

- Regardless of data sizes, Python ran 30-40% faster than SAS. However, Python does use more memory than SAS. The memory usage restriction may become a limiting factor on SAS performance.
- If we can boost SAS memory and CPU usage, the SAS performance might be improved. SAS concurrent processing could be a good candidate.
- SAS programs for parsing NAACCR XML data could be more adaptable since SAS is widely used in cancer registries. Python, however, may require registries more time and resources to implement, even though it provides free, powerful, efficient, and versatile ways in processing XML data.

CONCLUSIONS

- Python performed 30-40% faster than SAS.
- SAS and Python parse XML data reasonably efficiently.
- Python requires more memory than SAS.
- A 30 GB XML dataset requires 413MB memory with memory reclamation technique.
- Reasonable for most servers, even 30 GB.
- Possible parsing performance issue with XML data size >30 GB.
- Especially evident in SAS.
- Further evaluation needed to study SAS concurrent processing.
- Python module used in NPCR-CSS data processing.
- Valuable tool for QC data processing.

ACKNOWLEDGMENTS

The study is supported by the National Program of Cancer Registries of the Centers for Disease Control and Prevention under contract No. 200-2010-37215002.

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Xing Dong: Xing.Dong@icf.com
Reda Wilcom: df08@cdc.gov

NATIONAL CENTER FOR CHRONIC DISEASE PREVENTION AND HEALTH PROMOTION

Using Python and SAS to Efficiently Process Cancer Incidence Data in NAACCR XML Format

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ICF International, Fairfax, VA  *Division of Cancer Prevention and Control, CDC, Atlanta, GA
Use of Polygenic Risk Scores to Select Screening Intervals After Negative Findings From Colonoscopy

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1. Division of Clinical Epidemiology and Aging Research, German Cancer Research Center (DKFZ), Heidelberg, Germany
2. Department of General, Visceral and Transplantation Surgery, University of Heidelberg, Heidelberg, Germany
3. Division of Cancer Epidemiology, German Cancer Research Center, Heidelberg, Germany

Background

- Polygenic risk scores (PRS) have been suggested for defining personalized starting ages for colorectal cancer (CRC) screening, but the potential role of PRS in defining the length of screening intervals after a negative colonoscopy is unclear.
- In this study, we aimed to evaluate CRC risk according to PRS and time since last negative colonoscopy.

Methods

- We collected data from 3827 cases and 2641 CRC-free controls in a population-based case-control study in Germany.
- We constructed a polygenic risk scoring system, based on 90 single-nucleotide polymorphisms, associated with risk of CRC in people of European descent.
- Participants were classified as having low, medium, or high genetic risk according to tertiles of PRSs among controls.
- Logistic regression models were used to assess CRC risk according to PRS and time since last negative colonoscopy.

Results

- While significantly low CRC risks sustained only up to 5 years after negative colonoscopy in medium and high PRS groups of people recruited during 2003-2008, such low risks persisted across more than 10 years after negative colonoscopy in medium PRS group and up to 10 years in high PRS group of people recruited during 2009-2016 (Figure A and B).
- Very low risks of distal CRC were seen within 10 years after a negative colonoscopy and even beyond 10 years for all PRS groups, whereas significantly lower risks of proximal CRC were observed for up to 5 years only after a negative colonoscopy among people with high PRS and for up to 10 years after a negative colonoscopy only among those with low or medium (Figure C and D).

Conclusion & Discussion

- Our study suggests the recommended 10-year screening interval for colonoscopy may not need to be shortened among people with high PRSs, but could potentially be prolonged for people with low and medium PRS.
- Across time periods, low CRC risk after negative colonoscopy uniformly persisted longer for people recruited during 2009-2016 than those recruited during 2003-2008, suggesting a sustained improvement in colonoscopy quality in Germany since the introduction of screening colonoscopy in 2002.
- The persisting low risk of distal CRC across more than 10 years after negative colonoscopy irrespective of PRS suggests the possibility of prolonging screening intervals for flexible sigmoidoscopy beyond the guideline-recommended 5 years.

* Adjusted for age, sex, education, body mass index, participation in a health check-up, family history of colorectal cancer, smoking, ever regular use of nonsteroidal anti-inflammatory drugs, and ever regular use of hormone replacement therapy

Clinical Gastroenterology and Hepatology, 2020
DOI: https://doi.org/10.1016/j.cgh.2020.04.077
Contact: f.guo@dkfz-heidelberg.de
Background
- Tobacco-related cancers are an important cause of death, both in California and worldwide.
- Adolescents and young adults 15-39 years (AYAs) comprise nearly half (45.5%) of the over 3.5 million current smokers in California, and smoking prevalence among California's regions vary from 12.3% to 21.1%.
- Although previous research has examined trends in tobacco-related cancers in the state, little is known regarding the regional differences in trends of tobacco-related cancers among California AYAs.

Purpose
To identify region-specific trends in tobacco-related cancer incidence rates among AYAs in California.

Methods
- 15,680 AYAs ages 15-39 diagnosed with tobacco-related cancers during 2010-2017 were identified by the California Cancer Registry.
- For statistical analysis, the cancer sites were grouped according to anatomic systems, including acute myeloid leukemia (AML), ear nose and throat (ENT), genital and urinary (GU), lung, and gastrointestinal (GI).
- California counties were divided into 9 regions: SEER*Stat and Jointpoint software were used to analyze the average age-adjusted percent change (AAPC) in incidence rates for each group of cancer by anatomic and region, anatomic group and race/ethnicity, and anatomic group and sex within California.

Results
- The AAPC in incidence for the tobacco-related subgroups of AYA cancers differed among the regions of California as well as by race/ethnicity and sex in some cases.
- Consistent with overall state trends, GI cancer incidence increased for Hispanic, Non-Hispanic White, and Non-Hispanic Black AYAs over the study period (Table 1). This increase was shown for both males and females (Table 3), and in the San Diego/Imperial, Inland, Central Valley, and LA/Orange County regions (Table 2).
- GU cancer incidence increased in the Central Coast region (Table 2) and for Asian/Pacific Islander AYAs (Table 1).
- ENT cancers decreased in the Central Valley over the study period (Table 2).

Conclusion
- From 2010-2017, significant trends in the AAPC of tobacco-related cancer incidence among AYAs were identified across the 9 California regions.
- Many trends differed between males and females, and among racial/ethnic groups.
- These results may be helpful in targeting specific regions and demographics of AYAs in the state for screening and interventions for tobacco, other risk factors, and cancer subtypes. Future analyses will incorporate tobacco status data and cancer sites.

Table 1. Significant (p < 0.05) associations between tobacco related cancers by anatomic system and region, race, and sex in California AYAs (ages 15-39) diagnosed from 2010 to 2017

<table>
<thead>
<tr>
<th>Variables</th>
<th>Anatomic System</th>
<th>AAPC</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Valley</td>
<td>ENT</td>
<td>-9.8404</td>
<td>0.0037</td>
</tr>
<tr>
<td>San Diego/ Imperial</td>
<td>GI</td>
<td>6.5042</td>
<td>0.0132</td>
</tr>
<tr>
<td>Inland</td>
<td>GI</td>
<td>5.5955</td>
<td>0.0267</td>
</tr>
<tr>
<td>Central Valley</td>
<td>GI</td>
<td>7.5052</td>
<td>0.03</td>
</tr>
<tr>
<td>LA/Orange</td>
<td>GI</td>
<td>5.6555</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Central Coast</td>
<td>GU</td>
<td>6.9297</td>
<td>0.0466</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>GI</td>
<td>7.321</td>
<td>0.0008</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>GI</td>
<td>4.667</td>
<td>0.0423</td>
</tr>
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<td>Non-Hispanic White</td>
<td>GI</td>
<td>4.836</td>
<td>0.0003</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>GU</td>
<td>3.381</td>
<td>0.0024</td>
</tr>
<tr>
<td>Hispanic</td>
<td>GU</td>
<td>3.137</td>
<td>0.0231</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male and Female</td>
<td>GI</td>
<td>5.2263</td>
<td>0.0001</td>
</tr>
<tr>
<td>Male</td>
<td>GI</td>
<td>4.4905</td>
<td>0.0013</td>
</tr>
<tr>
<td>Female</td>
<td>GI</td>
<td>5.6383</td>
<td>0.0003</td>
</tr>
</tbody>
</table>
COMPLETE PREVALENCE OF PROSTATE CANCER IN THE UNITED STATES
A comparison of estimates obtained using SEER and NHANES data

Narendra Pathir, MPH, Nicole Zhang, MPH, Decision Resources Group, Burlington, MA.
NAACCR 2020 Virtual Conference, June 23-25, 2020 Correspondence: npathir@clarivate.com

BACKGROUND
Complete prevalence of cancer represents the proportion of people alive on a certain day who were diagnosed with the disease, regardless of how long ago the diagnosis was made.

The Surveillance, Epidemiology, and End Results (SEER) program in the United States provides estimates of complete prevalence of cancer.

Self-reported cancer diagnoses from cross-sectional population-based surveys such as the National Health and Nutrition Examination Survey (NHANES) in the US can be used to estimate prevalence of cancer. However, there are concerns over underreporting and misclassification of disease in these surveys (Byrne et al., 1992).

This study aimed to compare estimates of complete prevalence of prostate cancer using data from the NHANES with those from the SEER program.

METHODS

NHANES is a nationally representative cross-sectional survey of the civilian noninstitutionalized population of the United States. We used SAS software (version 9.4, SAS Institute Inc., Cary, NC) to run statistical analysis and combined the NHANES 2011-12, 2013-14 and 2015-16 cycles. Cancers had binary answer choices for prevalence (ever diagnosed yes/no) in the NHANES questionnaire.

Complete prevalence of prostate cancer was estimated by projecting the proportion of respondents who reported a history of prostate cancer diagnosis to the 2016 US national population estimates of males aged 20 years or older (UN, 2018).

SEER Cancer Statistics Review (Howlader et al. 2019) provided counts for complete prevalence of prostate cancer in 2016, based on data from the SEER 13 Areas (excluding the Alaska Native Registry) and 1/1/2016 U.S. male population estimates from the US Bureau of the Census.

SEER estimates of complete prevalence were based on the completeness index method (Capoccia et al. 1997; Merrill et al. 2000).

RESULT

SEER estimated 3.1 million prevalent cases of prostate cancer in the U.S. in 2016, while the estimation using NHANES data led to 2.1 million cases, suggesting a difference of 31%.

NHANES

Complete prevalence (no. of cases) of prostate cancer in the US in 2016

SEER

2.1 M

3.1 M

CONCLUSION
Diagnosed prostate cancer patients undergo frequent monitoring by physicians. It is therefore difficult to comprehend why a third of males comprising SEER-estimated complete prevalence would not remember or not report a history of prostate cancer diagnosis in their response to NHANES questionnaires. Therefore, the reason for the discrepancy between estimates of prostate cancer complete prevalence by SEER and NHANES is unclear.
Evaluating the impact of social and built environments on health-related quality of life among cancer survivors


Background
With over 17 million cancer survivors in the US, understanding factors that impact health-related quality of life (HRQOL) after cancer diagnosis is critical to improving survivorship outcomes.

Few studies have evaluated the impact of neighborhood factors (i.e., SES, poverty, segregation) on HRQOL.

Objective: To examine independent and joint associations between a comprehensive set of social and built environment attributes and HRQOL among cancer survivors.

Methods
We pooled data from three SEER-based studies in CA:
- Assessment of Patients’ Experience of Cancer Care (APEC), PI: Oakley-Girvan; 14,474 patients, colorectal, or leukemia survivors; interviewed 2003-2004 (2-5 years after diagnosis)
- Experiences of Care and Health Outcomes of survivors of Non-Hodgkin’s Lymphoma (ECHOS-NHL), PI: Hamilton-403 non-Hodgkin’s Lymphoma survivors; interviewed 2005-2006 (2-5 years after diagnosis)
- Follow-up Care Use among Survivors (FOCUS), Bay Area PI: Oakley-Girvan and Los Angeles PI: Hamilton; 1,466 breast, colorectal, ovarian, prostate or uterine cancer survivors; interviewed 2005-2006 (4-14 years after diagnosis)

Multilevel data
Survey data: sociodemographic information, treatment, follow-up care, support, coping, cognitive health appraisal, health behavior, HRQOL (physical and mental composite scores, PCS and MCS from SF-36)
California Cancer Registry data: age at diagnosis, stage
California Neighborhoods Data System data (2000): SES, racial/ethnic composition, population density, housing characteristics, street connectivity, commuting patterns, business, food environment, recreational facilities, parks, traffic density

Final analytic study population included 2,477 cancer survivors (excluded 285 missing HRQOL and 86 with addresses that were not geocodable).

Analyses
Used 3-level models with participants nested within block groups, which are nested within study region, we calculated least squares means, with and without adjustment for individual-level covariates, for individual neighborhood attributes and a summary neighborhood variable, or archetypes, developed using latent class analyses (LCA). Analyses accounted for the synergistic effects of social and built environment attributes.

Results
Study population characteristics

<table>
<thead>
<tr>
<th></th>
<th>In (%)</th>
<th>Mean PCS</th>
<th>Mean MCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11.34</td>
<td>46.1</td>
<td>51.2</td>
</tr>
<tr>
<td>Female</td>
<td>1343</td>
<td>43.5</td>
<td>49.9</td>
</tr>
<tr>
<td>Age at interview</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>74.30</td>
<td>51.0</td>
<td>49.7</td>
</tr>
<tr>
<td>50-59</td>
<td>192.70</td>
<td>49.6</td>
<td>48.2</td>
</tr>
<tr>
<td>60-69</td>
<td>432.10</td>
<td>47.4</td>
<td>45.1</td>
</tr>
<tr>
<td>70+</td>
<td>046.20</td>
<td>45.7</td>
<td>50.7</td>
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<td>RaceEthnicity</td>
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<tr>
<td>NH White</td>
<td>1204</td>
<td>43.3</td>
<td>56.3</td>
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<tr>
<td>Hispanic</td>
<td>324</td>
<td>46.1</td>
<td>50.4</td>
</tr>
<tr>
<td>African American</td>
<td>358</td>
<td>44.5</td>
<td>50.9</td>
</tr>
<tr>
<td>API</td>
<td>424</td>
<td>47.1</td>
<td>52.3</td>
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<tr>
<td>Education</td>
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<td></td>
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<tr>
<td>Highschool</td>
<td>612</td>
<td>46.1</td>
<td>51.0</td>
</tr>
<tr>
<td>College or college</td>
<td>299</td>
<td>44.7</td>
<td>48.7</td>
</tr>
<tr>
<td>&gt;College</td>
<td>552</td>
<td>47.8</td>
<td>51.8</td>
</tr>
</tbody>
</table>

Neighborhood associations with HRQOL
Among a diverse cohort of cancer survivors, the following neighborhood attributes were associated with HRQOL:
- PCS: With increasing nSES, cancer survivors reported better HRQOL.
- MCS: With increasing nSES, decreasing population density, street connectivity, parks, fast food restaurants, % rental units and % non-single family households, cancer survivors reported better HRQOL.

Neighborhood archetypes with physical and mental composite score (PCS, MCS)

Summary Results
- Among diverse cancer survivors, some neighborhood attributes including nSES were associated with HRQOL.
- Beyond the independent associations of neighborhood attributes and HRQOL, archetypes provide an approach to capture how neighborhood attributes interact and impact HRQOL.

Limitations
- Data are cross-sectional.
- Data are pooled from studies done of Californian participants and may not be reflective of participants who live elsewhere.
- Uses secondary geospatial data to describe neighborhood environments and may not capture how residents perceive and use their environments.

Conclusions
- As the first study to evaluate a comprehensive suite of social and built environment features on HRQOL in a diverse cohort of cancer survivors, this study will help inform HRQOL interventions by leveraging neighborhood features that are health promoting and mitigating those that present barriers to improved quality of life and to improve survivorship outcomes for the growing number of cancer survivors.
- The strength of this study is the robust set of multivariate data captured by capitalizing on cancer registry data and a population-based sample of cancer survivors, self-reported data for participants’ HRQOL, and neighborhood attributes.
- Elucidating the pathways through which nSES and neighborhood attributes impact HRQOL will be important in improving survivorship outcomes.

Acknowledgements
Funding:
- National Research Service Award fellowship (5T32HP100205, Chu)
- National Cancer Institute grant R03CA132192 (PI: Sharif-McCabe)

Background

Diffuse large B-cell lymphoma (DLBCL) is the most common type of non-Hodgkin lymphoma, with a median age of diagnosis of 70 years. Anthracycline containing regimens are the most common treatments, but toxicity concerns can limit their use in adults >80 years, a growing population that is often excluded from clinical trials. Understanding treatment patterns and associated survival in much older adults >80 (vs. older adults 65-80 years) can help determine effective management strategies in this population.

Objective

To describe the impact of age on treatment regimens used and associated survival in older adults with DLBCL.

Methods

Data for 17,859 patients ages ≥65 diagnosed with DLBCL from 2006 to 2017 were obtained from the California Cancer Registry. Detailed treatment information for each patient was extracted from treatment text fields. Multivariable logistic regression models examined characteristics associated with no treatment and multivariable cox proportional hazards regression models examined the influence of treatment on overall survival (OS). Models were adjusted for insurance, race/ethnicity, neighborhood socioeconomic status, comorbidity score, symptoms at diagnosis, rural/urban residence, year of diagnosis, initial treatment at National Cancer Institute (NCI)-designated cancer center, stage at diagnosis, radiation treatment, sex, and age.

Results

- Across both age groups, the most common treatment was anthracycline regimens followed by other drug combinations (Table 1).
- For patients >80, fewer received anthracyclines (32.4%) and more received other drug combinations (17.6%) or had no treatment (13.1%) vs ages 65-80 (61.6% anthracyclines, 10.4% other combinations, 5% no treatment) (Table 1).
- Greater comorbidity, treatment at non-NCI-designated cancer centers, more recent years of diagnosis, female sex, and increasing age were associated with no treatment (Figure 1).
- For patients >80, anthracyclines, R-CEOP/R-CEPP/R-CNOP, R-CVP conferred a survival advantage compared to other combinations (Figure 2).

Conclusion

In this large, population-based group of older adults with DLBCL, much older patients were less likely to receive initial treatment and more likely to receive other drug combinations despite an overall survival advantage with more standard anthracycline regimen protocols. Further analyses examining patient cardiovascular comorbidities and treatment-related toxicities are warranted.

Table 1. Initial treatments for N=17,859 DLBCL patients 65 years and older, California, 2006-2017

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Age &gt;80, % (N)</th>
<th>Age 65-80, % (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthracycline Regimens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-CHOP, R-EPOCH/EPOCH, mini-CHOP with/without R, other doxorubicin combinations</td>
<td>32.4% (1,924)</td>
<td>61.6% (7,332)</td>
</tr>
<tr>
<td>R-CEOP/R-CEPP/R-CNOP</td>
<td>1.1% (68)</td>
<td>0.7% (83)</td>
</tr>
<tr>
<td>R-CVP</td>
<td>2.0% (116)</td>
<td>0.7% (83)</td>
</tr>
<tr>
<td>R-ICE</td>
<td>1.0% (62)</td>
<td>0.9% (105)</td>
</tr>
<tr>
<td>R-Bendamustimine</td>
<td>2.5% (151)</td>
<td>1.0% (119)</td>
</tr>
<tr>
<td>Methotrexate combinations</td>
<td>1.1% (65)</td>
<td>3.9% (461)</td>
</tr>
<tr>
<td>Other combinations</td>
<td>17.6% (1,044)</td>
<td>10.4% (1,244)</td>
</tr>
<tr>
<td>No Treatment</td>
<td>13.1% (777)</td>
<td>5.0% (594)</td>
</tr>
<tr>
<td>Unknown</td>
<td>29.3% (1,740)</td>
<td>15.9% (1,891)</td>
</tr>
</tbody>
</table>

*Comorbidity Score >1 vs 0
Treated at NCI Cancer Center: No vs Yes
Diagnosis Year 2010-13 vs 2008-09
Diagnosis Year 2014-17 vs 2008-09
Female sex vs male
Age, 1 year increments
Asian/Pacific Islander vs white

Figure 1. Multivariable-adjusted odds ratios (OR) and associated 95% confidence intervals (CI) of associations with no systemic treatment among DLBCL patients >80

Figure 2. Multivariable-adjusted hazard ratios (HR) and associated 95% confidence intervals (CI) of treatments among DLBCL patients 65 years and older, 2006-2017, California

Other combinations=Reference

- Anthracyclines
- R-Bendamustimine
- R-CEOP/R-CEPP/R-CNOP
- R-CVP
- R-ICE
- Methotrexate combinations
- No treatment
- Unknown
Will Data Quality Suffer without Visual Editing Review of “Resolve Patient Set Tasks” in the SEER*DMS?

Background and Methods

“Resolve Patient Set Tasks”—auto-created in SEER*DMS:
- When at least 1 th record+ 1 th record is linked to patient data.
- Demographic, tumor staging data review.

SEER*DMS:
- Detroit requested an enhancement.
- Hospital abstractors’ name initials now come in on abstracts.
- MDCSS can now track quality of individual hospital staff.

Method:
- Random sample, N = 1,320 cases, 9 cancer sites, 25 hospitals.
- 9 Editors (CTRs) reviewed 374 entries.
- VA sites categorized as:
  - Major—Affects staging and treatment
  - Minor—Doesn’t affect staging
- Calculated by case site:
  - N Cases and Errors
  - Overall, Major & Minor error rates (OER) and
  - Average # of errors per case (AEC)
- Calculated by Hospital (those w/40+ cases shown):
  - N Cases and Errors
  - Overall, Major & Minor Avg. # of errors per case (AEC)
  - Cut-offs to automate: <=8% OER and <=12 (AEC).

Conclusions—Detroit automated (highlighted in yellow in grey) 6 tasks as follows:
- Meta norm cancer site
- 3 hospitals
- Individual CTRs with almost no errors (data not shown).
Patterns of Care and Survival in Adolescents and Young Adults with Hodgkin Lymphoma

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1California Cancer Reporting and Epidemiologic Surveillance Program, University of California Davis Health, Institute for Population Health Improvement
2Department of Pediatrics, Columbia University Irving Medical Center, New York, NY
3Center for Oncology Hematology Outcomes Research and Training (COHORT) and Division of Hematology and Oncology, University of California Davis School of Medicine
4Department of Pediatrics, University of California Davis School of Medicine, Sacramento, CA

Background

Hodgkin lymphoma (HL) is one of the most treatable cancers affecting adolescent and young adult (AYA) patients (15-39 years), however optimal therapy for de novo disease in this population remains a subject of debate. Population-based studies in HL consistently report a survival disadvantage for AYAs when compared with younger patients, but analyses are often limited by lack of information about therapeutic exposures.

Objective

To examine initial treatment regimen and the impact of sociodemographic and clinical variables on overall survival (OS) and disease-specific survival (DSS) in AYAs compared to children.

Methods

Data for 4,426 patients aged 0-39 years diagnosed with first primary classical HL (2007-2016) were obtained from the California Cancer Registry. Detailed treatment information for each patient was extracted from unstructured free-text fields. Chemotherapy regimens were classified based on standard treatment approaches for adult and pediatric HL. Multivariable cox models were used to examine the influence of sociodemographic and clinical variables on OS and DSS.

Results

- Specific chemotherapy treatment information was found for 92% of patients.
- Front-line therapy for patients with HL differed significantly across age groups, with 42% of patients <21y vs. 69% of 22-39y receiving ABVD (Table 1).
- In survival models, the hazard of death from HL was two to three-fold higher in patients 15-21y, 22-29y, and 30-39y, than patients <14y (Figure 1).
- Non-Hispanic black patients and Hispanic patients experienced worse OS and DSS than non-Hispanic white patients.
- Having public or no insurance also conferred worse OS.
- Among all age groups combined, initial therapy did not significantly impact OS or DSS.
- Modified treatment regimens (vs. ABVD) among those aged 22-39y were associated with worse OS, but did not significantly impact DSS.

Conclusion

In this large, population-based cohort of children and AYAs with HL, we observed that initial therapy varies, but that the majority of AYAs receive ABVD. Variation in therapy was largely insufficient to explain observed survival disparities, as older age, black and Hispanic race/ethnicity, and public or no insurance each conferred increased risk of death, even after adjustment for chemotherapy regimen.

Table 1. Initial treatment regimen and baseline characteristics of N= 4,426 children and AYAs with classical Hodgkin lymphoma reported to the California Cancer Registry between 2007 and 2016.

<table>
<thead>
<tr>
<th>Age</th>
<th>ABVD*, N (row%)</th>
<th>ABVE-PC*</th>
<th>BEACOPP*</th>
<th>STANFORD V*</th>
<th>CHOP*</th>
<th>MODIFIED*</th>
<th>NONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 – 21y</td>
<td>615 (42)</td>
<td>130 (3%)</td>
<td>91 (2%)</td>
<td>94 (6%)</td>
<td>62 (4)</td>
<td>361 (24)</td>
<td>9 (1)</td>
</tr>
<tr>
<td>22 – 39y</td>
<td>2025 (69)</td>
<td>1 (1)</td>
<td>30 (1)</td>
<td>131 (4)</td>
<td>17 (1)</td>
<td>283 (10)</td>
<td>42 (1)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH White</td>
<td>1328 (62)</td>
<td>42 (2)</td>
<td>29 (1)</td>
<td>132 (6)</td>
<td>28 (1)</td>
<td>264 (12)</td>
<td>28 (1)</td>
</tr>
<tr>
<td>NH Black</td>
<td>190 (61)</td>
<td>8 (3)</td>
<td>10 (3)</td>
<td>7 (2)</td>
<td>4 (1)</td>
<td>60 (19)</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>810 (55)</td>
<td>70 (5)</td>
<td>41 (3)</td>
<td>43 (3)</td>
<td>38 (3)</td>
<td>266 (18)</td>
<td>17 (1)</td>
</tr>
<tr>
<td>Asian/PI</td>
<td>271 (62)</td>
<td>10 (2)</td>
<td>11 (3)</td>
<td>40 (9)</td>
<td>9 (2)</td>
<td>51 (12)</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>1841 (62)</td>
<td>76 (3)</td>
<td>51 (2)</td>
<td>167 (6)</td>
<td>52 (2)</td>
<td>389 (13)</td>
<td>26 (1)</td>
</tr>
<tr>
<td>Public/none</td>
<td>751 (57)</td>
<td>53 (4)</td>
<td>36 (3)</td>
<td>50 (4)</td>
<td>27 (2)</td>
<td>246 (19)</td>
<td>20 (2)</td>
</tr>
<tr>
<td>NCI (for AYAs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>622 (52)</td>
<td>52 (4)</td>
<td>46 (4)</td>
<td>154 (13)</td>
<td>38 (3)</td>
<td>210 (18)</td>
<td>8 (1)</td>
</tr>
<tr>
<td>No</td>
<td>2018 (62)</td>
<td>79 (2)</td>
<td>45 (1)</td>
<td>71 (2)</td>
<td>41 (1)</td>
<td>434 (13)</td>
<td>43 (1)</td>
</tr>
<tr>
<td>Stage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/II</td>
<td>1590 (62)</td>
<td>72 (3)</td>
<td>15 (1)</td>
<td>156 (6)</td>
<td>44 (2)</td>
<td>358 (14)</td>
<td>32 (1)</td>
</tr>
<tr>
<td>III/IV</td>
<td>1004 (61)</td>
<td>58 (4)</td>
<td>17 (5)</td>
<td>67 (4)</td>
<td>33 (2)</td>
<td>269 (16)</td>
<td>9 (1)</td>
</tr>
<tr>
<td>Radiation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>768 (54)</td>
<td>92 (6)</td>
<td>21 (1)</td>
<td>206 (14)</td>
<td>43 (3)</td>
<td>206 (14)</td>
<td>3 (1)</td>
</tr>
<tr>
<td>No</td>
<td>1872 (63)</td>
<td>39 (1)</td>
<td>70 (2)</td>
<td>19 (1)</td>
<td>36 (1)</td>
<td>143 (15)</td>
<td>48 (2)</td>
</tr>
</tbody>
</table>

Unknown/other treatments not shown in table (row percentages do not add to 100%). PI, Pacific Islander; NCI, National Cancer Institute

*Regimens were considered modified if they omitted one drug from a standard protocol. The most common modified regimens were ABV and AVD.

Figure 1. Multivariable-adjusted hazard ratios (HR) and associated 95% confidence intervals (CI) of characteristics of AYAs with Hodgkin Lymphoma, 2007-2016, California

[Table and figure are not included in the natural text representation provided.]
A comparison study of 2016 county-level female breast cancer prevalence using Missouri Cancer Registry and Missouri County-level Study data

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1 Missouri Cancer Registry and Research Center (MCR-ARC). 2 University of Missouri-Columbia (MU), College of Arts & Sciences, Department of Statistics. 3 University of Missouri-Columbia, Department of Health Science & Informatics. 4 Missouri University of Science and Technology, Department of Health Science & Informatics. 5 University of Nebraska-Lincoln, Department of Statistics, Lincoln, Nebraska.

1. BACKGROUND

- For many diseases, including the second most common cancer in women, female breast cancer (FBC), county-level data sources for calculating prevalence estimates are limited due to small sample sizes.
- In Missouri, the Missouri Cancer Registry (MCR) and the Missouri county-level study (CLS) are two available sources to conduct such analyses.
- The MCR, a population-based (since 1985) central cancer registry, collects cancer-specific information and annually updates vital status.
- In contrast, the CLS, which is based on the Behavioral Risk Factor Surveillance System (BRFSS), is a survey of a sample of the population and includes additional risk factor information not collected by cancer registries.

2. OBJECTIVE

- Investigate differences in FBC prevalence and related statistical differences between cancer registry and survey data.

3(A). METHODS

- All the analyses were based on female adults (the target population) in Missouri.
- To reflect the most recent and accurate estimates regarding FBC prevalence in Missouri, we used the latest CLS data (2016) and MCR data through the latest complete (>95% of expected incidence cases) diagnosis year (2016).
- Our analyses were implemented by two steps.

Step 1: Generate county-level FBC prevalence estimates (along with their standard deviations) using MCR and CLS, respectively. 20 years (1996-2016) limited-duration prevalence (LDP) FBC estimates by stage were obtained from MCR via SEERStat software. Complete prevalence (CP) FBC estimates by obesity were obtained from 2016 CLS via SAS software. (See Figures 5-6)

Step 2: Perform Bayesian linear regressions for MCR and CLS with the calculated prevalence estimates, respectively. The models were transformed to the logit-transformed 2016 county-level estimates and the corresponding standard deviations were calculated via the delta method. A conditional autoregressive (CAR) prior was used to account for the spatial variability. A flat prior was used for the overall mean and weakly informative priors were used for the rest of regression coefficients.

4(A). RESULTS

- Compared with the CLS, the MCR showed smaller variability and produced more precise estimates, which were demonstrated by both shorter CIs and more dense scatterplots. (Figures 7-11)
- Among county attributes, women aged 65 and over and living at or above poverty level were associated with higher FBC prevalence while others were not associated. (Figure 7)
- Early stage was associated with higher FBC prevalence while obesity was not associated. This agreed with Figures 10 and 11, where FBC prevalence was well explained by the inclusion of stage instead of obesity. There was less variation across counties for MCR compared with CLS. (Figure 8)
- The overall mean for MCR was significantly smaller than CLS, which indicated MCR had less prevalent cases than CLS. This reflected the possible different underlying true effects due to differing measures. (Figure 9)

5. DISCUSSION

- This study showed FBC was prevalent for women aged 65 and over, living at or above poverty level and diagnosed at early stage. Health care resources should be allocated to these groups.
- Our ongoing project indicates that there exists other health-related information in the CLS (e.g., cholesterol level information) highly associated with the FBC prevalence. Additionally, as county attributes are shown to be important for both data sources, data combining is promising to broaden the analyses.

Acknowledgements: MCR-ARC core activities are supported in part by a cooperative agreement between the Centers for Disease Control and Prevention (CDC) and the Missouri Department of Health and Senior Services (DHSS) (MOUP000129-02-15) and a Surveillance Contract between DHSS and the University of Missouri. We would like to thank the MCR-ARC Quality Assurance staff, and the staff of facilities throughout Missouri and other states’ central cancer registries, for their dedication and desire for continuous quality improvement and submitting their reportable cases to MCR-ARC.

Figure 1: County-level percentages of women in age group 65+

Figure 2: County-level percentages of black race and white race

Figure 3: County-level percentages of women living at or above poverty level

Figure 4: County-level percentages of women who are Hispanic

Figure 5: County-level FBC prevalence estimates by stage based on MCR

Figure 6: County-level FBC prevalence estimates by obesity based on CLS

Figure 7: Posterior means and CIs for the county attributes

Figure 8: Posterior means and CIs for obesity/stage and spatial variability

Figure 9: Posterior means and CIs for the overall mean

Figure 10: County-level FBC prevalence estimates by stage

Figure 11: County-level FBC prevalence estimates by obesity

Figure 12: For county-level FBC prevalence regarding early stage, our estimated values (right) were close to the observed values (left). Similar results applied to late stage.

Figure 13: For county-level FBC prevalence regarding obesity level, our estimated values (right) were underestimated compared with the observed values (left).
Late effects following non-Hodgkin lymphoma in HIV-uninfected and HIV-infected adolescents and young adults: a population-based study

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Division of Hematology/Oncology, 1 University of California, Davis, Sacramento-CA, USA and 2 St. Jude Children’s Research Hospital, Memphis-TN

Introduction

- In the United States, non-Hodgkin lymphoma (NHL) is the 4th and 5th leading cause of cancer deaths in patients aged 20–39 and <20 years, respectively.
- Advances in NHL treatment (chemotherapy, radiation and hematopoietic stem cell transplantation (HSCT)) has led to high cure rates: 5-year survival approaches 80% in young adults.
- In HIV-infected patients, NHL survival improved dramatically after the introduction of antiretroviral therapy in 1996, but survival is still worse than that in HIV-uninfected survivors.
- Unfortunately, treatment is associated with a lifelong risk of severe late effects, such as endocrine and cardiovascular diseases, as well as second cancers.
- To date, little is known about the incidence of late effects in adolescents and young adults (AYA, 15–39 years) of NHL.

Methods

- We used data from the California Cancer Registry (CCR) linked to hospitalization data from the Office of Statewide Health and Planning and Development (OSHPD). Eligible patients were AYAs diagnosed with a primary NHL during 1996–2012 (Figure 1).
- We estimated the cumulative incidence of each late effect up to 10 years after diagnosis accounting for death as competing risk.
- We used multivariable Cox proportional-hazards models to examine whether the occurrence of late effects were associated with sociodemographic and clinical factors.

Figure 1. Study cohort, NHL, California, 1996–2012.


<table>
<thead>
<tr>
<th>Characteristics</th>
<th>HIV-uninfected (N = 4,392)</th>
<th>HIV-infected (N = 425)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race/ethnicity</td>
<td>N %</td>
<td>N %</td>
</tr>
<tr>
<td>Non-Hispanic whites</td>
<td>2285, 52.0</td>
<td>201, 47.3</td>
</tr>
<tr>
<td>Hispanics</td>
<td>1156, 26.3</td>
<td>132, 31.1</td>
</tr>
<tr>
<td>Stage at diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Localized/regional</td>
<td>2417, 55.0</td>
<td>208, 48.9</td>
</tr>
<tr>
<td>Advanced</td>
<td>1638, 37.3</td>
<td>203, 47.8</td>
</tr>
<tr>
<td>Health insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>3186, 72.5</td>
<td>197, 46.4</td>
</tr>
<tr>
<td>Hematopoietic stem cell transplant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>584, 13.3</td>
<td>23, 5.5</td>
</tr>
<tr>
<td>Radiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1274, 29.0</td>
<td>75, 17.6</td>
</tr>
<tr>
<td>Neighborhood socioeconomic status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower (quintiles 1–3)</td>
<td>2270, 51.7</td>
<td>286, 67.3</td>
</tr>
</tbody>
</table>

Figure 2: Cumulative incidence of late effects after NHL, by HIV status, California, 1996–2012.

Results

- The most common NHL subtype was diffuse large B-cell lymphoma in both HIV-infected (52%) and HIV-infected patients (42%).
- HIV-uninfected patients were more likely to have private insurance and receive radiation and a HSCT than HIV-infected patients. In contrast, HIV-infected survivors were more likely to be diagnosed at advanced stage and live in lower socioeconomic neighborhoods (nSES) compared with HIV-uninfected survivors (Table 1).
- The most frequent late effects at 10 years were: endocrine (18.5%), cardiovascular (11.7%), and respiratory (5.0%) diseases, followed by second cancer (2.6%). The incidence of all late effects was higher among HIV-infected compared with HIV-uninfected survivors (Figure 2).
- In multivariable models, HIV-infected patients, AYAs with public/no insurance, residents in lower SES neighborhoods and recipients of a HSCT had a higher risk of most late effects (Figures 3A-C).
- Among HIV-infected patients, those of Hispanic or black race/ethnicity had nearly twice the risk of renal disease than white patients, whereas HIV-infected survivors, had nearly six-fold higher risk of renal disease than white patients (Table 2).

Figure 3: Associations of late effects with: A) Public or none insurance, B) Lower neighborhood socioeconomic status, and C) Receipt of hematopoietic stem cell transplant.

Table 2: Association of renal disease w/ race/ethnicity

<table>
<thead>
<tr>
<th>Race/ethnicity</th>
<th>Hazard Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV-uninfected</td>
<td></td>
</tr>
<tr>
<td>NH White</td>
<td>Reference</td>
</tr>
<tr>
<td>NH Black</td>
<td>1.91 (1.02, 3.57)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.73 (1.11, 2.71)</td>
</tr>
<tr>
<td>NH Asian/PI</td>
<td>0.94 (0.48, 1.85)</td>
</tr>
<tr>
<td>HIV-infected</td>
<td></td>
</tr>
<tr>
<td>NH White</td>
<td>Reference</td>
</tr>
<tr>
<td>Other*</td>
<td>5.64 (1.88, 16.90)</td>
</tr>
</tbody>
</table>

*Adjusted for age at diagnosis, sex, nSES, health insurance, NHL subtype, and year of diagnosis. Stratified by stage at diagnosis and initial treatment. * Refers to Hispanic, non-Hispanic (NH) Black, NH Asian/Pacific Islander (PI) or other/unknown.

Conclusions

- The most frequent late effects after NHL treatment were endocrine, cardiovascular, and respiratory diseases, followed by second cancer.
- We identified higher risk of late effects among HIV-infected patients, AYAs with public/no insurance, recipients of a HSCT, and residents in lower SES neighborhoods.
- Our findings of substantial incidence of late effects among NHL AYA survivors emphasize the need for long-term survivorship care in order to reduced morbidity and mortality in these patients.
Ependymoma, NOS and anaplastic ependymoma incidence and survival in the United States varies widely by patient and clinical characteristics, 2000-2016

Rebecca L Achee, MD,1, Sierra Vo,2 Gino Cioffi, MPH1,4, Haley Gittelman, PhD3,4 Julia Schroer, MS,1 Vishesh Khanna, MD, Robin Buenk, MD,2 Carol Kruchko, BSc,1 Jill S. Barnholtz-Sloan, PhD3,4
1. Department of Neurosurgery, Neurological Institute, Cleveland Clinic, Cleveland, OH; 2 Department of Mathematics, Applied Mathematics, and Statistics, Case Western Reserve, Cleveland, Ohio; 3 Department of Population and Quantitative Health Sciences, Case Western Reserve University School of Medicine, Cleveland, Ohio; 4 Central Brain Tumor Registry of the United States (CBTRUS), Hinsdale, Illinois; 5 Department of Internal Medicine, Stanford University; 6 Department of Neurology, University Hospitals of Cleveland, Cleveland OH

BACKGROUND
Ependymoma is a rare central nervous system tumor arising from the ependymal lining of the ventricular system. General differences in incidence and survival have been noted, but not examined on a comprehensive scale for all ages and by histology. Despite the rarity of ependymomas, morbidity/mortality associated with an ependymoma diagnosis justifies closer examination.

METHODS
Incidence data were obtained from the Central Brain Tumor Registry of the United States in collaboration with the CDC and NCI, and survival data from SEER, from 2000 - 2016 for anaplastic ependymoma and ependymoma, NOS. Age-adjusted incidence rates (IR) per 100,000 person-years were analyzed by sex, race, location. Survival analysis was performed with Kaplan-Meier curves and multivariable Cox proportional hazards models.

RESULTS
Incidence of anaplastic ependymoma was highest in ages 0-4 years. Black populations had lower incidence but had a 78% increased risk of death compared to White populations[HR:1.78 (95%CI:1.30:2.44)]. Incidence was highest for anaplastic ependymoma in the supratentorial region. Adults (40+ years) had almost twice the risk of death compared to children (0-14 years) [HR: 1.97 (95% CI: 1.45, 2.66)]. For ependymoma, NOS, subtotal resection had a risk of mortality 1.81 times greater than gross total resection [HR: 1.44, (95% CI: 1.32, 2.63)].

CONCLUSION AND FUTURE DIRECTIONS
Black populations experienced higher mortality rates despite lower incidence compared to White populations. Extent of resection is an important prognostic factor for survival. This highlights need for further evaluation of treatment patterns and racial disparities in the care of patients with ependymoma subtypes.

ACKNOWLEDGEMENTS
Funding for CBTRUS was provided by the Centers for Disease Control and Prevention (CDC) under Contract No. 75D50119C065056, the American Brain Tumor Association, The Santag Foundation, Novocure, the Musella Foundation, National Brain Tumor Society, the Children’s Brain Tumor Foundation, the Uncle Kory Foundation, the Zelda Dorin Tenenbaum Memorial Fund, as well as private and in-kind donations. QTO is supported by a Research Training Grant from the Cancer Prevention and Research Institute of Texas (CPRIT; RP160097T).

Contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.
INTRODUCTION

New York State (NYS) has one of the highest thyroid cancer (TC) incidence rates in the nation and, similar to other states, has had a substantial increase in incidence over the past several decades.

A recent study using SEER 13 data suggested that the rate of TC had slowed and possibly started to decrease.  

There are large differences in health rankings by county in NYS.

The study's aim was to examine trends in incidence and clinical-pathological patterns of TC in NYS and to assess whether county-level differences in health rankings are correlated with TC incidence.

METHODS

Using 1998-2017 NYS Cancer Registry data, we examined TC incidence rates by demographic and tumor characteristics.

We used the Joinpoint Regression Program (JPR; version 4.6.0) to evaluate secular trends.

Using the 2018 County Health Rankings from the Robert Wood Johnson Foundation, we assessed the overall “Health Factors” measure and the specific domains “Clinical Care” and “Health Behaviors” in relation to county-level TC incidence.

RESULTS

New York State, 1998-2017

Fig. 1 Trends in Thyroid Cancer Incidence by Sex, New York State, 1998-2017

Fig. 2 Trends in Thyroid Cancer Incidence by Sex and Stage at Diagnosis, New York State, 1998-2017

Fig. 3 Trends in Thyroid Cancer Incidence by Sex and Histologic Subtype, New York State, 1998-2017

Fig. 4 Trends in Thyroid Cancer Incidence by Sex and Tumor Size, New York State, 1998-2017

Fig. 5 Thyroid Cancer Incidence by Sex and County, New York State, 2013-2017

Fig. 6 Correlation between 2013-2017 Thyroid Cancer Incidence and Specific Domains of the 2018 County Health Rankings

Fig. 7 Five-year Average Annual Percentage Changes for Thyroid Cancer Incidence by County, New York State, 2013-2017

CONCLUSIONS

Thyroid cancer incidence in New York State may have reached a plateau, which appears to be driven by a decrease in the diagnosis of local-stage papillary microcarcinoma. This change may reflect a positive response from the healthcare system to over-diagnosis warnings.

It appears that, in New York State, higher thyroid cancer incidence is associated with better health behaviors and better clinical care at the county level.

ACKNOWLEDGMENTS

This work was supported in part by:

- Cooperative agreement 6NU58DP000309 awarded to the New York State Department of Health by the Centers for Disease Control and Prevention, and
- Contract 75N91010800005 (Task Order 75N91010800001) from the National Cancer Institute, National Institutes of Health, Department of Health and Human Services.

REFERENCE

Privacy and Confidentiality Considerations in Cancer Registration: A Nexus of Law, Ethics, and Policy

NAACCR Annual Conference Poster

April 27, 2020

Ann Griffin, PhD, CTR • Robert McLaughlin, JD, PhD • Maureen Romero, RHIA, CTR

National Cancer Registrars Association (NCRA) editors for the forthcoming, 4th edition of Cancer Registry Management Principles & Practices for Hospitals and Central Registries, invited a new chapter to reconcile the public function and purpose of cancer registration, with the private nature of the individual-level data, patient experiences, and human lives that support cancer surveillance.

"As is widely recognized in the cancer registry community, cancer data exist because of public demands that individual cases be counted and understood not only in terms of the experiences of individual patients, but also with respect to patterns and trends, with the systematic compilation of data enabling the population-based study of who gets cancer, why, when, under what circumstances, and with what range of outcomes. The activity of cancer registration depends, however, on an extension of the underlying trust and the legal privilege of confidentiality that exist between a patient and his or her doctors. That privilege exists to support the free and clear communication necessary to the provision of the optimal treatment and care. The confidentiality of the relationship relates to the completeness, accuracy, and timeliness of the information a patient provides. These same qualities are essential to the cancer data on which research, surveillance and cancer control depend." (DRAFT)

Approach

An integrated chapter:

I. Legal Aspects of Cancer Registry Data
   - Establishing Cancer as a Priority
   - Privacy of Personal Health Information—Then and Now
   - Confidentiality of Medical Records

II. Health Information Privacy and Security
   - Cancer Registry Data as Confidential Health Information
   - Incidents that Compromise Confidentiality
   - Privacy, Confidentiality, and Security
   - Duty of Care
   - Patient Interests
   - Identifying Confidential Information

III. Registrar Ethics and Professionalism
   - Professional Ethics in the Field of Cancer Registries
   - Professional Resources
   - Professional Development

LAW & ETHICS

Practice

Professionalism

Results

The final text is anticipated for publication by the NCRA in Cancer Registry Management Principles & Practices for Hospitals and Central Registries, 4th edition.

"Tomato Lymphoma, Pancreasoblitera Involvement of Bone Marrow" by Ruthman is licensed under CC BY 2.0
Epidemiology of Pediatric Cancer in New Mexico’s American Indian, Hispanic, and Non-Hispanic White Populations

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3 New Mexico Tumor Registry. 4 University of New Mexico, School of Medicine, Department of Internal Medicine, Division of Epidemiology, Biostatistics, and Preventive Medicine

Background

Childhood cancer is the second leading cause of death in children ages 1 to 14, and the primary cause of death by disease.1 Every year approximately 15,300 children will be diagnosed with cancer, and childhood cancer rates have been rising slightly in the past few decades.2 Based on a report from the Centers for Disease Control and Prevention (CDC), the incidence rate of pediatric cancers was 158.7 per million people during the time period 2003-2014 in New Mexico, estimating about 100 new diagnoses of childhood cancer each year.3 The epidemiology of childhood cancers in New Mexico was last assessed in 1982.4 The population-based data highlighted the racial/ethnic variation of our population and the relationship to the variation in the incidence of cancer providing insights into cancer etiology.

New Mexico is the fifth largest state in geographic area, but ranks 46th in population size. As a result, many New Mexicans reside in rural areas that are physically distant from high-quality cancer-related care. New Mexico’s resident population is comprised of Hispanics (47%), Non-Hispanic Whites (41%), American Indians (10%), and other racial/ethnic groups (2%).

Purpose

The investigators will use existing, population-based cancer surveillance data to characterize the incidence rates of pediatric cancer in New Mexico’s American Indians, Hispanics and Non-Hispanic Whites.

Data Sources and Methods

The population-based New Mexico Tumor Registry (NMTTR) was queried to identify all incident cases of pediatric cancer (0-14 years of age) that were diagnosed among New Mexico residents during the time period 2000-2016. Pediatric cancers were identified and classified in accordance with the International Classification of Childhood Cancers (ICCC), and restricted to cases with malignan disease (Behavior Code of 3 as designated in the International Classification of Disease for Oncology – Third Edition (ICDO-3)), but included intracranial neoplasms with an ICDO-3 Behavior Code of 0 (benign), 1 (uncertain), 2 (in situ) and 3 (malignant). Results were restricted to New Mexico’s three largest race/ethnic groups (American Indian, Hispanic, Non-Hispanic White) as they account for the overwhelming majority of childhood cancers in the state’s resident population. Age-adjusted incidence rates (per million person-years) were calculated by the direct method using the United States 2000 standard population. Corresponding 95% confidence intervals (CI) were calculated using the Tiwari adjustment. Statistical significance of comparisons was assessed at an alpha level of 0.05.

Table 1. Incidence of selected pediatric cancer ICC types by race/ethnicity among New Mexico children (0-14 years), 2000-2016

<table>
<thead>
<tr>
<th>Selected ICCC Subtype</th>
<th>Rate** (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Ia): Lymphoid leukemias</td>
<td>35.5 (24.9-42.9)*</td>
</tr>
<tr>
<td>(Ib): Acute myeloid leukemias</td>
<td>11.0 (5.5-19.7)</td>
</tr>
<tr>
<td>(IIa): Hodgkin lymphomas</td>
<td>2.1 (0.2-7.3)</td>
</tr>
<tr>
<td>(IIb): Non-Hodgkin lymphomas (except Burkitt lymphoma)</td>
<td>4.0 (0.0-3.6)*</td>
</tr>
<tr>
<td>(IIIa): Burkitt lymphoma</td>
<td>4.0 (0.0-3.6)*</td>
</tr>
<tr>
<td>(IIIb): Acute lymphoblastic leukemia</td>
<td>5.9 (2.2-12.9)</td>
</tr>
<tr>
<td>(IIIc): Intraductal papillomatosis</td>
<td>3.9 (1.1-10.1)</td>
</tr>
<tr>
<td>(VIIa): Osteosarcomas</td>
<td>1.0 (0.0-5.5)</td>
</tr>
<tr>
<td>(VIIb): Chondrosarcomas</td>
<td>0.0 (0.0-3.9)</td>
</tr>
<tr>
<td>(VIIIa): Rhabdomyosarcomas</td>
<td>4.1 (1.1-10.4)</td>
</tr>
</tbody>
</table>

** Rates are per million and age-adjusted to the 2000 US standard population.
* The rate ratio (not shown) indicates that the rate is statistically different than the rate for Non-Hispanic Whites (p<0.05).

Results

Figure 1. Incidence of pediatric cancer by ICCC group among New Mexico children (0-14 years), 2000-2016

Conclusions

Incidence rates for many types of pediatric cancer vary by race/ethnicity in New Mexico.
Relatively small case numbers in some categories constrain our ability to readily interpret such differences.
Our findings underscore the need for additional research that will explain determinants of racial/ethnic differences in disease patterns.

References


Acknowledgements

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Characteristics and Outcomes of Never Smokers with Lung Cancer
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¹California Cancer Reporting and Epidemiologic Surveillance Program, University of California Davis Health, Institute for Population Health Improvement
²Department of Internal Medicine, University of California Davis Health
³Center for Oncology Hematology Outcomes Research and Training (COHORT) and Division of Hematology and Oncology, University of California Davis School of Medicine

Background
In the United States, approximately 10% to 15% of lung cancer occurs in never smokers and this proportion is increasing. Lung cancer in never smokers is more frequently associated with adenocarcinoma histology, female sex, and Asian American Pacific Islander (AAPI) race/ethnicity. It has been suggested that lung cancer in never smokers is a distinct entity with a different pathogenesis than in ever smokers. Population-based studies in the United States are sparse and have not examined differences among AAPI subgroups in patients with lung adenocarcinoma.

Objective
To describe demographic and clinical characteristics and outcomes of never smoker patients with lung adenocarcinoma with a focus on AAPI subgroups.

Methods
We obtained data for 48,702 lung adenocarcinoma patients diagnosed from 2012 to 2017 from the California Cancer Registry (CCR). Smoking status came from CCR variables on tobacco use and from mining CCR text fields. Multivariable Cox proportional hazards regression models examined overall survival in never and ever smokers as well as in never smokers. Models were adjusted for insurance type, stage at diagnosis, receipt of systemic treatment, comorbidity, sex, age, socioeconomic status (SES), and treatment at National Cancer Institute-designated cancer center.

Results
- Nineteen percent of patients were never smokers, 61% were ever smokers, and 20% had an unknown smoking status.
- More never smokers were female, diagnosed with stage IV disease, AAPI, had high SES, lived in urban areas, and had a low comorbidity score (Figure 1).
- AAPI never smokers were mainly Chinese (40%), Filipino (22%), and Vietnamese (15%) (Figure 2).
- In adjusted models, never (vs. ever) smokers had better overall survival (HR: 0.84, 95% CI: 0.81-0.87).
- Among never smokers, females (vs. males), Chinese, Filipino, Korean, and Vietnamese (vs. non-AAPI) had better survival while those with low SES (vs. high SES) had worse survival (Figure 3).
- The proportion of never smokers increased from 14.5% of the cohort in 2012 to 21.4% in 2017 while the percent unknown decreased from 32% to 18%.

Conclusion
Never smokers with lung adenocarcinoma tend to be healthier, AAPI (mostly Chinese, Filipino, Vietnamese), female, urban, and of high SES; they also experience better overall survival. The proportion of never smokers with lung adenocarcinoma has been increasing in California, warranting further research examining exposures, especially among AAPI subgroups, and possible causative agents in this disease.

Figure 1. Characteristics of adults with lung adenocarcinoma by smoking status, California, 2012-2017, N=48,702

Figure 2. Asian American Pacific Islander subgroup breakdown among never-smoker patients, N=3,180

Figure 3. Multivariable-adjusted hazard ratios (HR) and associated 95% confidence intervals (CI) of characteristics of never smokers with lung adenocarcinoma, 2012-2017, California

*Not shown are 9,813 patients (20.2% of study cohort) with unknown smoking status. Abbreviations: NH, non-Hispanic; AAPI, Asian American Pacific Islander; SES, socioeconomic status.
Will Data Quality Suffer without Visual Editing Review of “Resolve Patient Set Tasks” in the SEER*DMS?

Nancy L. Lozon, BS, CTR; Patrick G. Nicolin, BS, CTR; Jeanne Whitlock, MLS, CTR; Ron D. Shore, MPH; Richard B. Pense, BS; Fawn D. Vigneau, JD, MPH

Background and Methods

“Resolve Patient Set Tasks” – auto-created in SEER*DMS:
- When at least 1 path record + 1 abstract auto-linked to patient
- Demographic, tumor and staging data are visually reviewed and edited in Detroit for this early work-flow task

SEER*DMS:
- Detroit requested an enhancement
- Hospital abstractors’ name initials now come in on abstracts
- MDCSS can now track quality of individual hospital staff

Method:
- Random sample, N = 1,320 cases, 9 cancer sites, 25 hospitals
- 9 Editors (CTRs) reviewed 574 variables
- Variables categorized as:
  - Major – Affects staging and treatment
  - Minor – Doesn’t affect staging
- Calculated by Cancer Site:
  - N Cases and Errors
  - Overall, Major & Minor error rates (OER) and Average # of errors per case (AEC)
  - Cut-points to Automate: <=3% OER and <=1.2 (AEC)
  - Calculated by Hospital (those w/40+ cases shown):
    - N Cases and Errors
    - Overall, Major & Minor Avg. # of errors per case (AEC)
    - Cut-points to Automate: Overall Major/Minor <=1.2 (AEC)

Analysis, Results and Conclusions

Table 1. Cancer Site Analysis of Whether Data Quality would Suffer without Visual Editing Review of “Resolve Patient Set Tasks” in SEER*DMS

<table>
<thead>
<tr>
<th>Site</th>
<th>N</th>
<th>Cases with Errors</th>
<th>Range of Errors per case</th>
<th>Total Errors</th>
<th>Var</th>
<th>OER</th>
<th>AEC</th>
<th>Total Errors</th>
<th>Var</th>
<th>OER</th>
<th>AEC</th>
<th>Total Errors</th>
<th>Var</th>
<th>OER</th>
<th>AEC</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>603</td>
<td>425</td>
<td>0.19</td>
<td>1315</td>
<td>43</td>
<td>6</td>
<td>2.5</td>
<td>1401</td>
<td>34</td>
<td>7</td>
<td>2.3</td>
<td>114</td>
<td>9</td>
<td>2</td>
<td>0.2</td>
<td>Auto</td>
</tr>
<tr>
<td>Colorectal</td>
<td>271</td>
<td>215</td>
<td>0.15</td>
<td>594</td>
<td>41</td>
<td>5</td>
<td>2.2</td>
<td>530</td>
<td>29</td>
<td>7</td>
<td>2.0</td>
<td>64</td>
<td>12</td>
<td>2</td>
<td>0.2</td>
<td>Auto</td>
</tr>
<tr>
<td>Lung</td>
<td>133</td>
<td>108</td>
<td>0.9</td>
<td>285</td>
<td>35</td>
<td>6</td>
<td>2.1</td>
<td>222</td>
<td>23</td>
<td>7</td>
<td>1.7</td>
<td>63</td>
<td>12</td>
<td>4</td>
<td>0.5</td>
<td>Auto</td>
</tr>
<tr>
<td>Ovarian</td>
<td>21</td>
<td>20</td>
<td>0.9</td>
<td>58</td>
<td>35</td>
<td>8</td>
<td>2.8</td>
<td>30</td>
<td>24</td>
<td>8</td>
<td>1.9</td>
<td>20</td>
<td>11</td>
<td>7</td>
<td>1.0</td>
<td>Auto</td>
</tr>
<tr>
<td>Prostate</td>
<td>139</td>
<td>113</td>
<td>0.9</td>
<td>314</td>
<td>39</td>
<td>6</td>
<td>2.3</td>
<td>190</td>
<td>26</td>
<td>5</td>
<td>1.4</td>
<td>124</td>
<td>13</td>
<td>7</td>
<td>0.9</td>
<td>Auto</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>50</td>
<td>43</td>
<td>0.16</td>
<td>171</td>
<td>36</td>
<td>10</td>
<td>3.4</td>
<td>54</td>
<td>13</td>
<td>8</td>
<td>1.1</td>
<td>117</td>
<td>23</td>
<td>10</td>
<td>2.3</td>
<td>Auto</td>
</tr>
<tr>
<td>CLL</td>
<td>13</td>
<td>7</td>
<td>0.6</td>
<td>16</td>
<td>40</td>
<td>3</td>
<td>1.2</td>
<td>9</td>
<td>17</td>
<td>4</td>
<td>0.7</td>
<td>7</td>
<td>23</td>
<td>2</td>
<td>0.5</td>
<td>Auto</td>
</tr>
<tr>
<td>Melanoma</td>
<td>69</td>
<td>56</td>
<td>0.6</td>
<td>64</td>
<td>40</td>
<td>2%</td>
<td>0.9</td>
<td>61</td>
<td>31</td>
<td>3%</td>
<td>0.9</td>
<td>3</td>
<td>9</td>
<td>0%</td>
<td>0.0</td>
<td>Auto</td>
</tr>
<tr>
<td>NETS</td>
<td>26</td>
<td>21</td>
<td>0.9</td>
<td>65</td>
<td>39</td>
<td>6%</td>
<td>2.5</td>
<td>44</td>
<td>29</td>
<td>6%</td>
<td>1.7</td>
<td>21</td>
<td>10</td>
<td>8%</td>
<td>0.8</td>
<td>Auto</td>
</tr>
</tbody>
</table>

Var - number of variables reviewed, OER - Overall Error Rate, AEC - Average number of Errors per Case, Auto - cancer site was automated due to <=3% OER and <=1.2 AEC; visual editing suspended for this site.

Table 2. Facility Analysis

<table>
<thead>
<tr>
<th>Facility</th>
<th>% of Cases at Facility</th>
<th>Total Cases at Facility</th>
<th>Range of Errors per Record</th>
<th>% of Cases at Facility with Errors</th>
<th>Total Errors</th>
<th>Var</th>
<th>OER</th>
<th>AEC</th>
<th>Total Errors</th>
<th>Var</th>
<th>OER</th>
<th>AEC</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>312%</td>
<td>236</td>
<td>0.19</td>
<td>69%</td>
<td>197</td>
<td>23</td>
<td>6%</td>
<td>2.5</td>
<td>189</td>
<td>23</td>
<td>6%</td>
<td>2.5</td>
<td>Auto</td>
</tr>
<tr>
<td>B</td>
<td>270%</td>
<td>198</td>
<td>0.18</td>
<td>52%</td>
<td>135</td>
<td>20</td>
<td>6%</td>
<td>2.5</td>
<td>129</td>
<td>20</td>
<td>6%</td>
<td>2.5</td>
<td>Auto</td>
</tr>
<tr>
<td>C</td>
<td>165%</td>
<td>126</td>
<td>0.12</td>
<td>19.6</td>
<td>115</td>
<td>18</td>
<td>6%</td>
<td>2.5</td>
<td>109</td>
<td>18</td>
<td>6%</td>
<td>2.5</td>
<td>Auto</td>
</tr>
<tr>
<td>D</td>
<td>111%</td>
<td>86</td>
<td>0.8</td>
<td>50.5</td>
<td>75</td>
<td>11</td>
<td>8%</td>
<td>2.5</td>
<td>69</td>
<td>11</td>
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<tr>
<td>E</td>
<td>89%</td>
<td>68</td>
<td>1.10</td>
<td>100.0</td>
<td>81</td>
<td>9</td>
<td>10%</td>
<td>3.5</td>
<td>76</td>
<td>9</td>
<td>10%</td>
<td>3.5</td>
<td>Auto</td>
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<td>F</td>
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<td>94.6</td>
<td>38</td>
<td>5</td>
<td>8%</td>
<td>2.5</td>
<td>34</td>
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<td>8%</td>
<td>2.5</td>
<td>Auto</td>
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<tr>
<td>G</td>
<td>51%</td>
<td>38</td>
<td>0.5</td>
<td>74.5</td>
<td>22</td>
<td>3</td>
<td>5%</td>
<td>2.5</td>
<td>18</td>
<td>3</td>
<td>5%</td>
<td>2.5</td>
<td>Auto</td>
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<td>H</td>
<td>45%</td>
<td>35</td>
<td>0.54</td>
<td>57.8</td>
<td>30</td>
<td>5</td>
<td>7%</td>
<td>2.5</td>
<td>25</td>
<td>5</td>
<td>7%</td>
<td>2.5</td>
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<tr>
<td>I</td>
<td>41%</td>
<td>33</td>
<td>0.5</td>
<td>85.4</td>
<td>28</td>
<td>4</td>
<td>5%</td>
<td>2.5</td>
<td>23</td>
<td>4</td>
<td>5%</td>
<td>2.5</td>
<td>Auto</td>
</tr>
<tr>
<td>J</td>
<td>35%</td>
<td>27</td>
<td>0.52</td>
<td>92.6</td>
<td>23</td>
<td>3</td>
<td>5%</td>
<td>2.5</td>
<td>18</td>
<td>3</td>
<td>5%</td>
<td>2.5</td>
<td>Auto</td>
</tr>
<tr>
<td>K</td>
<td>40%</td>
<td>31</td>
<td>0.5</td>
<td>69.2</td>
<td>22</td>
<td>3</td>
<td>5%</td>
<td>2.5</td>
<td>18</td>
<td>3</td>
<td>5%</td>
<td>2.5</td>
<td>Auto</td>
</tr>
</tbody>
</table>

Var - number of variables reviewed, OER - Overall Error Rate, AEC - Average number of Errors per Case, Auto - hospital was automated due to <=3% OER and <=1.2 AEC; visual editing suspended for the hospitals’ cases.

Conclusions – Detroit automated (highlighted in tables in grey) RPS tasks for:
- Melanoma cancer site
- 3 hospitals
- Individual CTRs with almost no errors (data not shown)