Disparities in Cancer Stage Outcomes by Catchment Areas for a Comprehensive Cancer Center

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JAMA Network Open

Original Investigation | Health Policy

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Abstract

IMPORTANCE The National Cancer Institute comprehensive cancer centers (CCCs) lack spatial and temporal evaluation of their self-designated catchment areas.

OBJECTIVE To identify disparities in cancer stage at diagnosis within and outside a CCC's catchment area across a 10-year period using spatial and statistical analyses.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional, population-based study conducted between 2010 and 2019 utilized cancer registry data for the Johns Hopkins Sidney Kimmel CCC (SKCCC). Eligible participants included patients with cancer in the contiguous US who received treatment for cancer, a diagnosis of cancer, or both at SKCCC. Patients were geocoded to zip code tabulation areas (ZCTAs). Individual-level variables included sociodemographic characteristics, smoking and alcohol use, treatment type, cancer site, and insurance type. Data analysis was performed between March and July 2023.

EXPOSURES Distance between SKCCC and ZCTAs were computed to generate a catchment area of the closest 75% of patients and outer zones in 5% increments for comparison.

MAIN OUTCOMES AND MEASURES The primary outcome was cancer stage at diagnosis, defined as early-stage, late-stage, or unknown stage. Multinomial logistic regression was used to determine associations of catchment area with stage at diagnosis.

RESULTS This study had a total of 94 007 participants (46 009 male [48.94%] and 47 998 female [51.06%]; 30 195 aged 22-45 years [32.12%]; 4209 Asian [4.48%]; 2408 Hispanic [2.56%]; 16 004 non-Hispanic Black [17.02%]; 69 052 non-Hispanic White [73.45%]; and 2334 with other or unknown race or ethnicity [2.48%]), including 47 245 patients (50.26%) who received a diagnosis of early-stage cancer, 19 491 (20.73%) who received a diagnosis of late-stage cancer , and 27 271 (29.01%) with unknown stage. Living outside the main catchment area was associated with higher odds of late-stage cancers for those who received only a diagnosis (odds ratio [OR], 1.50; 95% CI, 1.10-2.05) or only treatment (OR, 1.44; 95% CI, 1.28-1.61) at SKCCC. Non-Hispanic Black patients (OR, 1.16; 95% CI, 1.10-1.23) and those with Medicaid (OR, 1.65; 95% CI, 1.46-1.86) and no insurance at time of treatment (OR, 2.12; 95% CI, 1.79-2.51) also had higher odds of receiving a late-stage cancer diagnosis.

Key Points

Question Are there disparities in cancer staging within and outside a comprehensive cancer center's catchment area?

Findings In this cross-sectional study of 94 007 patients at the Sidney Kimmel Comprehensive Care Center, statistically significant disparities in cancer staging were identified, including higher odds of late-stage cancers for non-Hispanic Black patients, those with Medicaid and no insurance, and patients residing outside the main catchment that either only received treatment or only received a diagnosis at the center.

Meaning These findings suggest that disadvantaged populations and those living outside of a comprehensive cancer center's main catchment area may face barriers to screening and treatment, resulting in higher odds of receiving a diagnosis of late-stage cancer.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

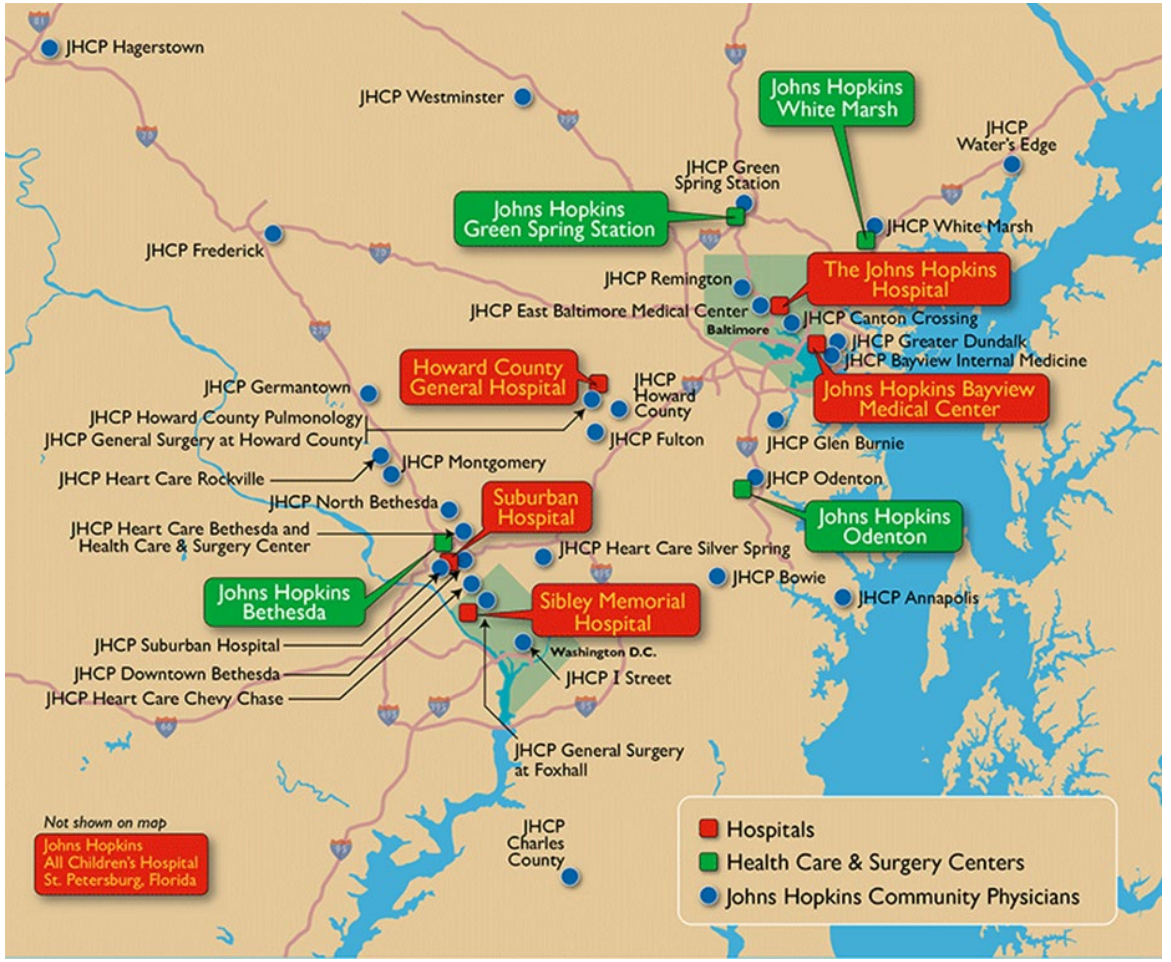
Desjardins, M. R., Kanarek, N. F., Nelson, W. G., Bachman, J., & Curriero, F. C. (2024). Disparities in Cancer Stage Outcomes by Catchment Areas for a Comprehensive Cancer Center. JAMA Network Open, 7(5), e249474-e249474.

What is a catchment area?

- Defined and justified by the cancer center(s)
- Based on geographic area it serves
- “They are expected to perform research relevant to their catchment area and engage the populations within their catchment area in the research they conduct and other Center activities” – NCI
- Important to examine cancer burden, risk factors, incidence, morbidity, mortality, and inequities

Sidney Kimmel Comprehensive Cancer Center (SKCCC)

- Founded in 1973 (51-year anniversary!)
- One of the first designated cancer centers in the country by the NCI
- 100 research laboratories
- Treating over two dozen types of cancers
- Tasked with defining and evaluating CAs between 2010-2019



https://www.hopkinsmedicine.org/kimmel_cancer_center/index.html

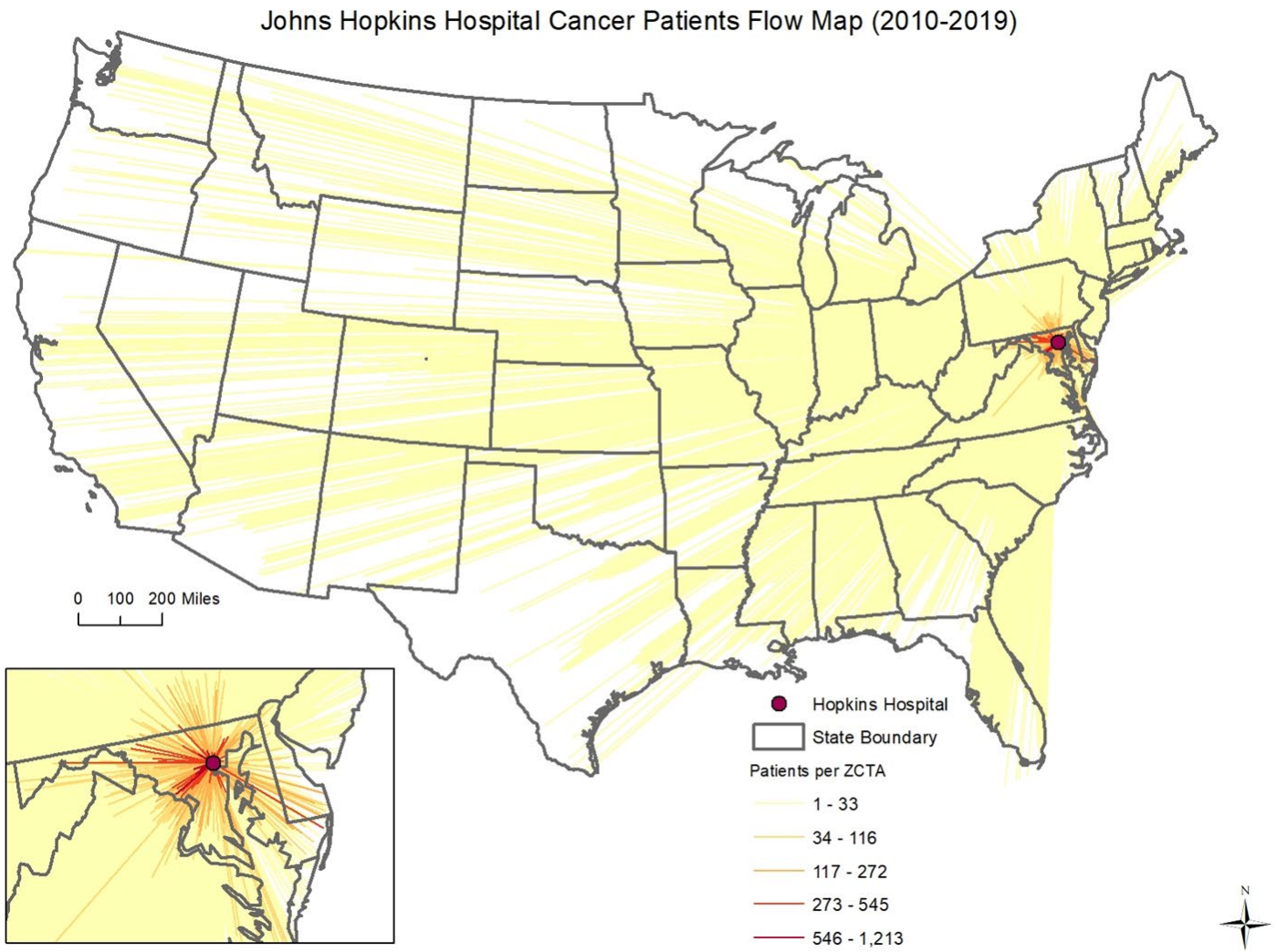
Research Questions and Objectives

- The National Cancer Institute comprehensive cancer centers (CCCs) lack spatial and temporal evaluation of their self-designated catchment areas.

- Current approaches do not account for travel distance to seek screening, diagnosis, and treatment; and do not capture the dynamics of smaller administrative boundaries (e.g., zip code tabulation areas [ZCTAs]) to capture within-county variations.

- Are there disparities in cancer staging within and outside a comprehensive cancer center's catchment area?
  - Across a 10-year period (2010-2019) using spatial and statistical analyses.

Data & Methods



- Final patient sample:
  - 94,007 contiguous U.S. patients were seen at SKCCC; 46,924 (49.7%) were diagnosed during 2010-14 and 47,525 (50.3%) during 2015-19.

Data & Methods

Variable	Type	Example
Sex at Birth	Binary	Female/Male
Age at Diagnosis	Categorical	>75 years old
Race/Ethnicity	Categorical	Non-Hispanic White
Insurance Type	Categorical	Medicaid
Cancer Type*	Categorical	Breast
Treatment Type	Binary	Chemo (Yes/No)
Class of Case	Categorical	Only Treated at SKCCC
Stage at Diagnosis	Early, Late, Unknown	-
Catchment Area/Zone	Categorical	<=75% of patients
Tobacco Use	Binary	Yes/No
Alcohol Use	Binary	Yes/No

*Chronic lymphocytic leukemia was staged using the Rai system, while all other leukemias were grouped under unknown stage.

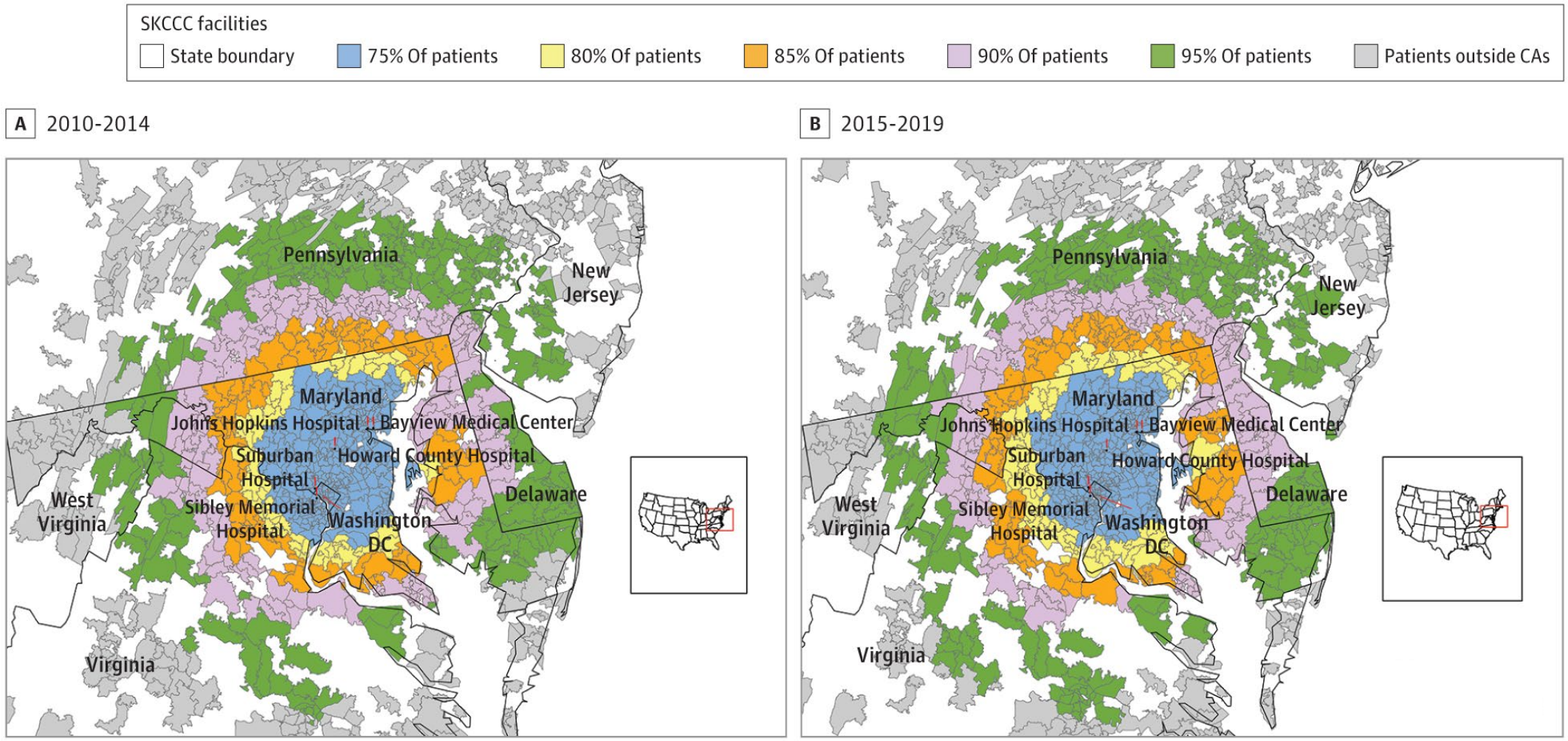
Data & Methods

- ZCTA at diagnosis was geocoded and road-network distance between population-weighted centroid and SKCCC facility was computed.
  - As a result, each patient was assigned a travel distance to SKCCC in miles.
  - Computed for 2010-2014 and 2015-2019 for comparison purposes.

- Main CA: Closest 75% of Patients
  - Outer zones in 5% increments; >95% as outside typical patient zones
  - For modeling purposes, we further grouped the categories by zone (75% CA, >75%-95%, and >95%).

- Multinomial logistic regressions and inclusion of interaction terms.
  - Outcome variable: Late-stage and unknown stage (reference = early stage)

Results



CA	75%	80%	85%	90%	95%	Outside	Total
ZCTAs, No.	296	357	465	640	900	1339	2239
Patients, No.	33357	35588	37758	40025	42202	3433	45635

CA	75%	80%	85%	90%	95%	Outside	Total
ZCTAs, No.	314	406	520	695	976	1263	2239
Patients, No.	31931	34058	36168	38315	40449	3382	45831

Results

Table 1. Sidney Kimmel Comprehensive Care Center Patient Characteristics Stratified by Catchment Area Between 2010 and 2019

Variable	Participants by percentage in catchment area, No. (%) (N = 94 007)			
	75% (n = 65 439)	>75%-95% (n = 17 168)	Outside 95% (n = 11 400)	Total
Cancer stage				
Early	31 796 (48.59)	8871 (51.67)	6577 (57.69)	47 244 (50.26)
Late	13 760 (21.03)	3634 (21.17)	2097 (18.39)	19 491 (20.73)
Unknown	19 883 (30.38)	4662 (27.16)	2726 (23.91)	27 271 (29.01)
Sex				
Male	32 199 (49.20)	8529 (49.68)	5281 (46.32)	46.009 (48.94)
Female	33 240 (50.80)	8639 (50.32)	6119 (53.68)	47.998 (51.06)
Age, y				
<22	748 (1.14)	217 (1.26)	86 (0.75)	1051 (1.12)
22-45	5026 (7.68)	1440 (8.39)	744 (6.53)	7210 (7.67)
46-65	20 811 (31.80)	5964 (34.74)	3420 (30.00)	30 195 (32.12)
66-75	18 676 (28.54)	5287 (30.80)	4062 (35.63)	28 025 (29.81)
>75	20 178 (30.83)	4260 (24.81)	3088 (27.09)	27 526 (29.28)
Race and ethnicity				
Asian	3572 (5.46)	369 (2.15)	268 (2.35)	4209 (4.48)
Hispanic	1991 (3.04)	237 (1.38)	180 (1.58)	2408 (2.56)
Native American	79 (0.12)	27 (0.16)	13 (0.11)	119 (0.13)
Non-Hispanic Black	14 098 (21.54)	1261 (7.35)	645 (5.66)	16 004 (17.02)
Non-Hispanic White	43 876 (67.05)	15 042 (87.62)	10 134 (88.89)	69 052 (73.45)
Other[a]	1189 (1.82)	167 (0.97)	121 (1.06)	1477 (1.57)
Unknown	634 (0.97)	65 (0.38)	39 (0.34)	738 (0.79)
Class of case				
Diagnosis and treatment	28 463 (38.05)	4783 (24.41)	2392 (18.32)	35 638 (33.17)
Diagnosis only	4295 (5.74)	530 (2.70)	343 (2.63)	5168 (4.81)
Treatment only	5430 (7.26)	1781 (9.09)	1346 (10.31)	8557 (7.96)
Nonanalytical	27 161 (36.31)	10 074 (51.41)	7319 (56.06)	44 554 (41.47)
No treatment	9446 (12.63)	2429 (12.39)	1656 (12.68)	13 531 (12.59)
Insurance				
Private	35 055 (55.04)	9846 (57.66)	6496 (57.31)	51 397 (55.80)
Medicaid	1866 (2.93)	255 (1.49)	65 (0.57)	2186 (2.37)
Medicare	22 903 (35.96)	5636 (33)	3896 (34.37)	32 435 (35.22)
Tricare	1266 (1.99)	532 (3.12)	228 (2.01)	2026 (2.20)
None	865 (1.36)	138 (0.81)	100 (0.88)	1103 (1.20)
Other	60 (0.09)	25 (0.15)	11 (0.10)	96 (0.10)
Unknown	1678 (2.63)	645 (3.78)	538 (4.75)	2861 (3.11)

Nonanalytical refers to those who only received consultation or follow-up care at the reporting facility

Results

- Decreased odds of late-stage cancers:
  - Patients residing in 95% zone (OR, 0.76; 95% CI, 0.71-0.80)
  - No alcohol use (OR, 0.94; 95% CI, 0.90-0.98)
  - Tricare insurance (OR, 0.83; 95% CI, 0.72-0.94)
  - Private insurance (OR, 0.92; 95% CI, 0.88-0.97)
  - Nonanalytical patients (OR, 0.52; 95% CI, 0.47-0.58)

- Increased odds of late-stage cancers:
  - Non-Hispanic Black patients (OR, 1.16; 95% CI, 1.10-1.23)
  - Medicaid (OR, 1.65; 95% CI, 1.46-1.86)
  - No insurance (OR, 2.12 95% CI, 1.79-2.51)
  - Dx in 2015-2019 (OR, 1.11; 95% CI, 1.07-1.16)
  - Only received treatment at SKCCC (OR, 1.13; 95% CI, 1.08-1.19)
  - Only received a diagnosis at SKCCC (OR, 1.26; 95% CI, 1.15-1.39)

Results

- Interaction term results:
  - **Asian patients residing outside the 95% zone** had higher odds of late-stage cancers (OR, 1.92; 95% CI, 1.36-2.73).
  - **Patients who received only a diagnosis at SKCCC and were residing in the greater than 75% to 95% zone** (OR, 1.34; 95% CI, 1.04-1.74) or **outside the 95% zone** (OR, 1.50; 95% CI, 1.10-2.05) had higher odds of late-stage cancers.
  - **Those who only received treatment at SKCCC and were residing in the greater than 75% to 95% zone** (OR, 1.44; 95% CI, 1.28-1.61) or **outside the 95% zone** (OR, 1.18; 95% CI, 1.02-1.36) also had higher odds of late-stage cancers.

Discussion

- Easily reproducible for other facilities evaluating patient utilization and outcomes to improve research programs and mitigate disparities in cancer outcomes and survivability.
- Geographic disparities were evident for those outside of the main catchment area who were only treated or only diagnosed at SKCCC.
  - The expert services sought may have been specific to SKCCC, given the distances involved.
- Patients with late-stage cancers were more likely to have received immunotherapy.
- Breast, male genital, skin, and urinary cancers were more likely to be early-stage at diagnosis.

Conclusion

- Accessibility is more complex than distance-to-care or screening facilities.
  - E.g., Non-Hispanic Black patients
  - Examine SDoH to reduce racial and ethnic health disparities.
- Can help identify individuals and areas that experience a high degree of care-sharing.
- Opportunity for all CCCs to collaborate on optimizing care-sharing models to improve screening and treatment outcomes.
- Centers should more actively consider their service areas in terms of health care needs, and geospatial analyses could facilitate the prioritization of improved services.

Acknowledgements

- Funded by:
  - Maryland Department of Health and Mental Hygiene (Cigarette Restitution Fund Program) 2024-2025, PI: Desjardins, M.R.
  - Maryland Department of Health and Mental Hygiene (Cigarette Restitution Fund Program) 2022-2023, PI: Desjardins, M.R.
  - Maryland Department of Health and Mental Hygiene (Cigarette Restitution Fund Program) 2022-2023, PI: Curriero, F.

- Co-authors:
  - Norma Kanarek, PhD – Associate Professor of Environmental Health and Engineering
  - Frank Curriero, PhD – Professor of Epidemiology
  - Jamie Bachman, Chief Administrative Officer of SKCCC
  - William (Bill) Nelson, MD, PhD – Director of SKCCC

- SKCCC Cancer Committee

- American College of Surgeons (ACS), Commission on Cancer (CoC)
  - Addressing barriers to care was one of three main strengths, along with oncology nursing credentials, and palliative care services.
    - Yay for geographers!

Thank you for your attention!

- Q&A and Discussion

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Press Release: https://www.hopkinsmedicine.org/news/newsroom/news-releases/2024/05/proximity-to-a-cancer-center-contributes-to-cancer-stage-at-diagnosis-study-finds