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Complexity of care needs and unstaged cancer in elders: a population-based study

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Abstract

BACKGROUND—Little is known about the contribution of older patients' complexity of care needs (COCN) to unstaged cancer, or incomplete evaluation of the extent of disease. We aimed at examining the association between the patients' COCN at baseline and unstaged cancer.

METHODS—The study used linked databases consisting of the Ohio Cancer Incidence Surveillance System (OCISS), Medicare and Medicaid enrollment files, the home health care Outcome and Assessment Information Set (OASIS), and the Long Term Care Minimum Data Set (MDS). The study population included patients 65 years of age or older diagnosed with incident breast (n=4,404), prostate (n=5,334), or colorectal cancer (n=4,822) in year 2000. The outcome of interest was unstaged cancer. Patients were identified with high COCN if they were admitted to a nursing home, with moderate COCN if they received home health services, and with low COCN if they were neither admitted to a nursing home nor received home health services, at baseline, or in the six months prior to cancer diagnosis. We employed logistic regression analyses to evaluate the independent association between COCN and unstaged cancer after adjusting for patient demographics and socioeconomic attributes.

RESULTS—The proportion of unstaged cases increased significantly with older age, by Medicaid status, and by COCN at baseline. Compared with patients with low COCN, those with higher complexity were 4 to 5 times as likely to have unstaged cancer.

CONCLUSION—The occurrence of unstaged cancer follows a systematic pattern of increase by age, Medicaid status, and COCN at baseline.

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Disclaimer Cancer incidence data were obtained from the Ohio Cancer Incidence Surveillance System (OCISS), Ohio Department of Health. Use of these data does not imply that the Ohio Department of Health either agrees or disagrees with any presentation, analyses, interpretations, or conclusions. Information about the OCISS may be obtained at odh.state.oh.us/ODHPrograms/CI_SURV/ci_surv1.htm".

Keywords

Unstaged Cancer; Long Term Care; Home Health Care; Complexity of Care

BACKGROUND

Unstaged or unknown stage cancer cases, hereafter referred to as “unstaged cancer”, present in relatively small numbers in population-based databases. As defined in the glossary of statistical terms by the Surveillance, Epidemiology, and End Results (SEER) program, unstaged cancer is “cancer for which there is not enough information to indicate a stage” [1], suggesting that patients with unstaged cancer have not received full diagnostic evaluation [2]. For the period 1998-2002, the percent of unstaged cases reported in SEER was 2% for breast cancer [3], 4% for prostate cancer [4], and 5% for cancer of the colon and rectum [5]. These proportions can be higher in state-based registries and subgroups of the population, however, ranging from 7.5% in one source, to over 10% in another, depending on the source of data, and the subgroup of the population being examined [6,7,8].

Cancer stage is key diagnostic information for disease management and for examining outcomes of care. When using registry data, different strategies have been employed to address unstaged cases in the analyses. Some studies have entirely excluded them from the analysis, while others have included them in the group with distant metastases. Using a more conservative approach, other studies have analyzed unstaged cases separately. The better we understand what types of patients are in the unstaged group, the better we will be able to understand the potential bias created by each of the above analytic strategies.

The reasons for any individual to be in the unstaged group are likely multifactorial. Prior research has demonstrated numerous demographic characteristics, likely associated with access to care, as being important. These studies have demonstrated that unstaged cases are disproportionately represented among patients who are older [6,9,10,11,12]; of minority descent [6,10]; with lower education [10] or history of Medicaid enrollment [6]; and those residing in Appalachian or rural areas [2]. In addition, there is variation by cancer site [10]. Other associations that are less well described include personal unwillingness to undergo staging and comorbid illness and disability that make a more conservative diagnostic and therapeutic approach warranted [14,15].

The presence of comorbidity (e.g., cardiovascular disease, diabetes, hypertension), disability, and/or geriatric syndromes (e.g., dementia), observed frequently in elders with cancer [13], implies a greater level of complexity in their care needs, and in managing their cancer [14]. A person’s use of home health care and nursing home care may be an appropriate surrogate for an individual’s complexity of care needs (COCN).

Because use of home health and nursing home care is not available in cancer registries, we used a unique database, the Cancer-Aging Linked Database (or the CALD, described below in detail) combining data from the Ohio Cancer Incidence Surveillance System (OCISS), Medicare and Medicaid claims and enrollment files, the home health care Outcome Assessment Information Set (OASIS), and the long term care Minimum Data Set (MDS). Thus, we were able to characterize COCN in cancer patients relative to a gradient, respectively from high to low, based on whether they received nursing home care, home health care, or neither.

In this study, we examined the association between COCN at baseline and unstaged cancer. We hypothesized that, independently of age, race, socioeconomic status, and patients’

residence in different geographic locations, higher COCN would be associated with greater likelihood of having unstaged cancer.

METHODS

This is a cross-sectional, population-based study, including all individuals 65 years of age or older residing in Ohio, and diagnosed with incident female breast, prostate, and colorectal cancer during the year 2000.

The study uses the Cancer-Aging Linked Databases (CALD), which, by linking data from the OCISS, Medicare and Ohio Medicaid enrollment and claims files, the OASIS, and the MDS, makes it possible to identify patients diagnosed with incident cancer, ascertain their enrollment in Medicare and Medicaid programs, and determine their receipt of home health services, and/or their residence in a nursing home. In the CALD, a patient from the OCISS would be successfully identified in the Medicare and/or Medicaid files if s/he was enrolled in the Medicare and/or Medicaid programs. Similarly, a patient from the OCISS would be successfully identified in the OASIS and/or the MDS files if s/he received home health care and/or nursing home care. Hence, depending on their enrollment in one or two of the Medicare and Medicaid programs, and based on their receipt of home health and/or nursing home care, a patient's record would be duplicated across the different databases. As noted below, however, a patient's successful identification in the various datasets was used to derive, *at the individual level*, a measure on the complexity of care needs, the key independent variable in this analysis.

The study was approved by the Institutional Review Board of the Ohio Department of Health and University Hospitals of Cleveland, as well as the Center for Medicare and Medicaid Services (CMS) and the Ohio Department of Job and Family Services, which administer the Medicare and Ohio Medicaid programs, respectively.

Data Sources

1. The Ohio Cancer Incidence Surveillance System (OCISS)—The OCISS requires the reporting of all incident cases of cancer, with the exception of in situ cervical cancer, and basal/squamous cell carcinoma of the skin. The OCISS records include patient demographics, cancer-specific data, including tumor site; date of cancer diagnosis; and Surveillance, Epidemiology, and End Results (SEER) summary stage. Patient identifiers in the OCISS records include social security number (SSN), date of birth, and patient first and last names, as well as residence address and zip code. The latter variables were used in this study to geocode residence addresses and to extract U.S. Census data at the block group level on income and educational attainment. Records not carrying the street-level address, approximately 3% for each of the cancer sites, were geocoded at the zipcode centroid level. Addresses for only 5 of 14,697 patients could not be geocoded. Records with missing census or other relevant data were excluded from the analysis, leaving the study population at 14,560.

2. Medicare and Ohio Medicaid enrollment files—Social security numbers were used by the CMS to retrieve Medicare enrollment and claims data for the patient population. Over 96% of OCISS patients were successfully identified in the Medicare files.

The linkage of the OCISS and Ohio Medicaid files used a deterministic, multistep algorithm [16], involving the use of SSN, date of birth, sex, as well as patients' first and last names. Between 8 and 10% of patients identified successfully through the OCISS and Medicaid enrollment files linked through a set of criteria based on first name, last name, and date of birth, omitting SSN. We used this strategy because some older women may not qualify for Medicare, and thus they fall in the Medicaid-only group. In any given year, the omission of SSN from the linking algorithm yields the identification of an additional 20 to 50 individuals as Medicaid

beneficiaries, or 7-9% of all Medicaid beneficiaries grouped as such based on the algorithm described above.

3. The Home Health Outcome and Assessment Information Set (OASIS)—The OASIS is a repository of health assessment forms for all patients receiving home health services that are reimbursed for by Medicare and/or Medicaid. OASIS assessment forms are completed upon admission, discharge, and every 60 days if the patient continues to receive home health services. The OASIS record carries patient identifiers, variables on the patient's clinical presentation, as well as the date at which the assessment had been completed.

4. The Long Term Care Minimum Data Set (MDS)—The MDS contains assessment forms for all patients residing in Medicare-certified nursing home. Similar to the OASIS, the MDS record includes patient identifiers, the date at which the assessment was completed, as well as variables that enable the evaluation of the patient's clinical presentation.

Both the MDS and OASIS files were linked with the OCISS using SSN and sex. Identification of a patient in the OCISS and either the OASIS or the MDS indicates that the patient received home health services and/or nursing home care, respectively.

Variables of interest

1. Dependent variable—The dependent variable was unstaged cancer, or cancer of unknown stage, as reported through the SEER summary stage variable. Coded as 0/1 (no/yes), this variable was retrieved from the OCISS.

2. Independent variables

Complexity of care needs (COCN): Using the data sources described above, we determined -- in a mutually exclusive fashion -- whether a) a patient resided in a nursing home in the six months preceding initial date of cancer diagnosis (high complexity); b) received home health services in the six months prior to being diagnosed with cancer (moderate complexity); or c) was neither a nursing home resident, nor a home health services recipient in the same time period (low complexity). Patients residing in a nursing home *and* receiving home health care during that time period were categorized as high complexity. Among the 650 cancer patients receiving home health care in the six months preceding cancer diagnosis, 147 (22.6%) were also nursing home residents during that period. It is likely that these patients may have experienced transfers from home health to nursing home care during that time period, reflecting an even more complex clinical presentation.

Medicaid status: A patient was identified as a Medicaid beneficiary if his/her record was found in both the OCISS and Medicaid enrollment files in the year of diagnosis.

Demographics: Demographic variables were retrieved from the OCISS. Age at the time of cancer diagnosis was categorized in 5-year increments, 65-69; 70-74; 75-79; 80-84; and 85+. We accounted for race as African-American and All Others, grouping the smaller number of individuals of other ethnic/racial descent with Caucasians. Sex was included in the bivariate comparisons and multivariable regression models only when analyzing the outcome of interest for colorectal cancer patients.

Residence at the time of cancer diagnosis: Consistent with a previous study analyzing the use of screening mammography by Ohio Medicaid beneficiaries [17], we used the county of residence at the time of cancer diagnosis, as documented in the OCISS file, to identify patients in each of the following groups of counties: Appalachian/Rural, Rural, Suburban, and Metro.

Socioeconomic attributes at the census block group level: The residence address at the time of cancer diagnosis, as documented in the OCISS file, was geocoded and used to retrieve the median income, and the proportion of adults 25 years of age or older with high school diploma from the U.S. Census data. Median income was categorized as high (top quartile), low (lowest quartile), and average (defined as the interquartile range). Educational attainment was specified as high or low, depending on whether the patient resided in a census block group with a proportion of adults with high school diploma above or below the 10^{th} percentile level for the state.

Analysis

All analyses were specific to the anatomic site of the cancer. The significance of bivariate associations between unstaged cancer and each of the independent variables was assessed using chi-square test. We developed multivariable logistic regression models to test the associations between COCN and unstaged cancer after adjusting for demographic and socioeconomic attributes, as well as for the county of residence. We tested for interactions between Medicaid status and COCN to examine the associations between complexity of care needs and unstaged cancer separately for Medicaid and non-Medicaid patients. Our final multivariable models included all variables deemed as potential confounders in our study design, even if they were not found to be statistically significant. We used SAS software version 9.0, and considered the level of significance to be at $p < 0.05$.

RESULTS

The study population consisted of 4,404 breast cancer patients, 5,334 prostate cancer patients, and 4,822 colorectal cancer patients. Their distribution by various characteristics is presented in Table 1. We note a greater representation of the individuals 85 years of age or older among colorectal cancer patients (18.39%, compared with 14.19% in breast cancer patients, and nearly 9% in prostate cancer patients); and a considerably lower representation of Medicaid beneficiaries among prostate cancer patients (less than 5%, compared with approximately 11% in colorectal cancer patients, and 9.42% in breast cancer patients). This is expected, given the more favorable socioeconomic status of older men, compared to older women, resulting in a greater representation of women in the Medicaid program. The distribution of patients by COCN was comparable across cancer sites.

Table 2 presents the proportion of unstaged cases by patient characteristics, as well as the unadjusted odds ratios. Overall, the proportion of unstaged cases was 7.6%, 16.9%, and 13.8%, respectively among breast, prostate, and colorectal cancer patients. Consistently across all cancer sites, we note a highly significant increase in the proportion of unstaged cases in older age groups and in Medicaid beneficiaries, compared with their younger and non-Medicaid counterparts, respectively. Additionally, there is significant variation in the proportion of unstaged cases by county of residence. In prostate cancer patients, the occurrence of unstaged cases was highest for residents of Suburban counties, whereas in colorectal cancer patients, the highest proportion of unstaged was observed among residents of Appalachian/Rural counties. Relative to the COCN categories, we observe a clear gradient in the proportion of unstaged cases, as well as the unadjusted odds ratios, with the lowest proportion of unstaged cases and unadjusted odds ratios observed in low complexity patients, and the highest proportion noted in high complexity patients. With regards to race, income, and education, the proportion of unstaged cases was significantly higher in African Americans and those with lower education in the case of breast cancer patients, and higher in lower income groups in each of breast and colorectal cancer patients.

The results of the multivariable logistic regression analysis presented in Table 3 are mostly consistent with the bivariate analyses presented in Table 2. In particular, we note that compared

with patients with low COCN, patients with moderate and high COCN were nearly 2 to 5 times as likely to have unstaged cancer. Additionally, while Medicaid status remained significantly associated with unstaged cancer after adjusting for other covariates in both breast and colorectal cancer patients, neither income nor education was significantly predictive of unstaged cancer. Interaction terms of Medicaid status by nursing home or by home health care were not shown to be statistically significant. The area under the Receiver Operating Curve, or C-statistic was 0.73, 0.68, and 0.66, respectively for breast, prostate and colorectal cancer models.

DISCUSSION

This study analyzed the occurrence of unstaged cancers in elders with incident breast, prostate, or colorectal cancer, by demographics, socioeconomic attributes, county of residence, Medicaid status, as well as COCN at baseline. The findings indicate that unstaged cancers follow a systematic pattern, whereby older patients, those enrolled in Medicaid, and ones with more complex care needs are least likely to have their cancers fully evaluated. The presence of a gradient for the COCN relative to unstaged cancer was clearly evident in all cancer sites, with the increasing proportions of unstaged cases in patients with higher COCN, and the unadjusted odds ratios (Table 2). In multivariable models, however, such a gradient was evident only in prostate cancer patients (Table 3).

As noted above, the documentation of unstaged cancer implies that there is missing information on the extent of disease. One study including breast cancer patients [11] showed that inability to assign cancer stage was due to insufficient data on lymph nodes, as well as on the primary and/or metastatic tumor status. As previously speculated [14], possible scenarios include: 1) competing priorities in health care do not favor the consideration of cancer as a condition of foremost concern; 2) staging will not add to the knowledge used in prescribing a course of cancer treatment, especially in the presence of apparent signs of distant metastases; 3) the patient and/or the family *choose(s)* not to pursue further investigations; and/or 4) the patient is unable to give an informed consent to undergo a full diagnostic evaluation. Clearly, the absence of such important factors as patient choice and/or elements driving medical decision making from our multivariable logistic models may explain the less than optimal values for the areas under the Receiver Operating Curve. Future studies are warranted to assess the contribution of each of these factors to the occurrence of incomplete diagnostic evaluation of an incident cancer, which implies poor cancer management, therefore poor prognosis. Additionally, the higher likelihood of having unstaged cancer associated with old age and/or Medicaid status *independently* of complex care needs raises serious concerns, as it indicates a clear pattern of disparities in the access to and use of cancer care. Relative to other attributes, future studies should also investigate the association between residence in suburban counties and higher likelihood of being diagnosed with unstaged cancer among prostate cancer patients, which was an unexpected finding. To better understand variations in cancer stage by county of residence, the availability of relevant health services in various geographic areas of the state should be evaluated.

The development of the COCN variable and its use in this study deserves some discussion. To our knowledge, this is the first study to account for the setting in which patients received care prior to cancer diagnosis, and used that variable to characterize the complexity of their care needs in relation to unstaged cancer. Compared with methods accounting for comorbid conditions, COCN likely captures the patient's clinical presentation in a more encompassing fashion. For example, because patients must be "homebound" or present functional limitations in order to qualify for Medicare-reimbursed home health services, moderate COCN reflects not only the presence of comorbidities, but also captures a level of dependence resulting from various conditions, including comorbidities. Other conditions contributing to dependence may include geriatric syndromes, and/or disabilities. Further, by also accounting for patients

admitted to long term care, we created a gradient reflecting increased degree of dependence, thus a greater level of COCN. Future studies should compare the ability of COCN to predict cancer treatment and survival with that of traditional measures of comorbidity, such as the Charlson index, used commonly in cancer-related health services research.

The findings from this study bear significant methodological implications. As noted earlier, the review of the literature points to a lack of consistency among researchers relative to whether to exclude unstaged cases from the analysis [18,19,20], to group unstaged cases with late-staged cancers [21,22], or even to analyze unstaged cases in a separate stage category [11,14, 23,24]. SEER reports survival rates for unstaged cases that are somewhat more favorable than for those with distant stage cancer, but less favorable than for those with regional stage cancer [3,4,5], and a previous study has documented differences in survival patterns among unstaged cases when analysis was performed in age-specific strata [11]. Further analyses are therefore needed to understand the associations between unstaged cancer and cancer-related outcomes in order to gain a better understanding on the biases associated with the different analytic approaches.

Our categorization of age in 5-year increments, used to highlight age-related gradients in unstaged cancers, should also be noted. Previous studies have compared cancer-related outcomes [25,26] and shown differences between young-old (60-74) and the old-old (75-90) cancer patients [27]. The analysis of the data with the latter grouping did not change our conclusion that older patients were more likely to have unstaged cancer.

A number of limitations should be taken into account in interpreting the study findings. First, this study is limited to Ohio, and given our use of the OCISS, the findings may not be generalizable to older cancer patients elsewhere in the country. Additionally, the findings might vary across regions of Ohio, and/or providers.

Second, our measure of COCN is less than a perfect summary measure of comorbidity, disability, and geriatric syndromes, as well as the social support available to a patient to address his/her care needs. There are likely patients in each COCN who are similar clinically, and whose use of nursing home care is related to social support, not clinical differences. Social support may not only affect the representation of patients in COCN categories, but may influence the decision to undergo full evaluation of their cancer [28]. Our inability to measure social support across all patients in this analysis constitutes an important limitation of our study [29].

Third, the proportion of unstaged cases may be subject to idiosyncrasies of documentation and data quality. For example, a more established cancer surveillance program, such as the SEER, contains lower proportions of such cases, as it receives better support in its data collection activities.

Fourth, we note that our measures of income and education at the census block group level were approximated to the individual level. Despite limitations in this approach, the use of such measures at the census tract [24,30] -- or even at the zip code level [31] -- has been widely adopted in studies using data sources with no relevant individual-level measures [32].

Fifth, we recognize the likely presence of unknown primary cancer site among unstaged cases. We note, however, that because these cases were documented as primary cancers of female breast, prostate, or the colon/rectum in the OCISS, the number of such cases may not be very large.

Finally, we note that patients whose OCISS records did not carry the complete/accurate SSN were not identified in the moderate or high complexity levels, potentially causing a

misclassification of moderate/high COCN patients in the lowest COCN category. From the data obtained by matching the SSNs from OCISS and Medicare enrollment and claims files, we estimate this proportion to be less than 2.5%. This potential bias is therefore unlikely to affect our results.

In closing, findings from this study clearly point to the presence of systematic patterns in the occurrence of unstaged cancer. Therefore, special consideration should be given to the methodological implications in studies of cancer-related outcomes using population-based data. That older age and Medicaid status are each significantly and associated with unstaged cancer *independently* of COCN reveals a troubling pattern of disparities in the access and use of cancer care in vulnerable subgroups of the elderly population.

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References

1. SEER: Glossary of Statistical Terms. [accessed November 23, 2005]. http://seer.cancer.gov/cgi-bin/glossary/glossary.pl#27
2. Lengerich EJ, Tucker TC, Powell RK, Colsher P, Lehman E, Ward AJ, et al. Cancer incidence in Kentucky, Pennsylvania, and West Virginia: disparities in Appalachia. J Rural Health 2005;21(1):39–47. [PubMed: 15667008]
3. SEER Stat Fact Sheets – Cancer of the Breast. [Accessed November 23, 2005]. http://seer.cancer.gov/statfacts/html/breast.html
4. SEER Stat Fact Sheets – Cancer of the Prostate. [Accessed November 23, 2005]. http://seer.cancer.gov/statfacts/html/prost.html
5. SEER Stat Fact Sheets – Cancer of the Colon and the Rectum. [Accessed November 23, 2005]. http://seer.cancer.gov/statfacts/html/colorect.html
6. Koroukian SM. Assessing the effectiveness of Medicaid in breast and cervical cancer prevention. J Public Health Manag Pract 2003;9(4):306–314. [PubMed: 12836513]
7. Dennis TD. Cancer stage at diagnosis, treatment, and survival among American Indians and Non-American Indians in Montana. Cancer 2000;89:181–6. [PubMed: 10897016]
8. McDavid K, Schymura MJ, Armstrong L, Santilli L, Schmidt B, Byers T, et al. Rationale and design of the National Program of Cancer Registries' breast, colon, and prostate cancer patterns of care. Cancer Causes Control 2004;15:1057–1066. [PubMed: 15801489]
9. Hillner BE, McDonald MK, Desch CE, Smith TJ, Penberthy LT, Retchin SM. A comparison of patterns of care of nonsmall cell lung carcinoma patients in a younger and Medigap commercially insured cohort. Cancer 1998;83:1930–7. [PubMed: 9806651]
10. Roetzheim RG, Pal N, Tennant C, Voti L, Ayanian JZ, Schwabe A, et al. Effects of health insurance on early detection of cancer. J Natl Cancer Inst 1999;91(16):1409–15. [PubMed: 10451447]
11. Yancik R, Wesley MN, Ries LA, Havlik RJ, Edwards BK, Yates JW, et al. Effect of age and comorbidity in postmenopausal breast cancer patients aged 55 years and older. JAMA 2001;285:885–892. [PubMed: 11180731]

12. Havlik RJ, Yancik R, Long S, Ries L, Edwards B. The National Institute on Aging and the National Cancer Institute SEER Collaborative study on comorbidity and early diagnosis of cancer in the elderly. Cancer 1994;74:2101–2106. [PubMed: 8087777]
13. Koroukian SM, Murray P, Madigan E. Comorbidity, disability, and geriatric syndromes in elderly patients with cancer receiving home health services. J Clin Oncology 2006 May 20;24(15):2304–10.
14. Yancik R, Wesley MN, Ries LA, Havlik RJ, Long S, Edwards BK, et al. Comorbidity and age as predictors of male and female colon carcinoma patients: a population-based study. Cancer 1998;82:2123–2134. [PubMed: 9610691]
15. West DW, Satariano WA, Ragland DR, Hiatt RA. Comorbidity and breast cancer survival: a comparison between black and white women. Ann Epidemiol 1996;6:413–419. [PubMed: 8915472]
16. Koroukian SM, Cooper GS, Rimm AA. Ability Of Medicaid claims data to identify incident cases Of breast cancer in the Ohio Medicaid population. Health Serv Res 2003;38(3):947–960. [PubMed: 12822920]
17. Koroukian SM. Screening mammography was used more, and more frequently, by longer than short term Medicaid enrollees. J Clin Epidemiol 2004;57(8):824–831. [PubMed: 15485735]
18. Bradley CJ, Gardiner J, Given CW, Roberts C. Cancer, Medicaid enrollment, and survival disparities. Cancer 2005;103:1712–1718. [PubMed: 15768435]
19. Elkin EB, Hudis C, Begg CB, Schrag D. The effect of changes in tumor size on breast carcinoma survival in the U.S.: 1975-1999. Cancer 2005;104:1149–1157. [PubMed: 16088887]
20. Harris DH, Bates JH, Cress R, Tabnak F, Wright WE. Stage of breast cancer diagnosis among medically underserved women in California receiving mammography through a state screening program. Cancer Causes Control 2004;15:721–729. [PubMed: 15280630]
21. Bradley CJ, Given CW, Roberts C. Late stage cancers in a Medicaid-insured population. Med Care 2003;41(6):722–728. [PubMed: 12773838]
22. Bradley CJ, Given CW, Roberts C. Race, socioeconomic status, and breast cancer treatment and survival. J Natl Cancer Inst 2002;94(7):490–496. [PubMed: 11929949]
23. Rogers SO, Ray WA, Smalley WE. A population-based study of survival among elderly persons with colorectal cancer: does race matter if all are insured? Cancer Causes Control 2004;15:193–199. [PubMed: 15017132]
24. Simon MS, Severson RK. Racial differences in survival of female breast cancer in the Detroit metropolitan area. Cancer 1996;77:308–314. [PubMed: 8625239]
25. Rose JH, O'Toole EE, Dawson NV, Lawrence R, Gurley D, Thomas C, et al. Perspectives, preferences, care practices and outcomes among older and middle-aged patients with late-stage cancer. J Clin Oncol 2004;22:4855–4865.
26. Rose JH, O'Toole EE, Dawson NV, Thomas C, Connors AF Jr, Wenger NS, et al. Age differences in care practices and outcomes for hospitalized patients with cancer. J Am Geriatr Soc 2000;48:S25–S32. [PubMed: 10809453]
27. Rose JH, Bowman KF, Deimling G, Stoller EP. Health maintenance activities and lay decision-making support: a comparison of young-old and old-old long-term cancer survivors. J Psychosoc Oncol 2004;22(3):21–44.
28. Rose JH. Social support and cancer: adult patients' desire for support from family, friends and health professionals. Am J Community Psychol 1990;3:439–464. [PubMed: 2264559]
29. Given BA, Given CW, Kozachik S. Family support in advanced care. CA Cancer J Clin 2001:213–231.
30. Liu L, Cozen W, Bernstein L, Ross RK, Deapen D. Changing relationship between socioeconomic status and prostate cancer incidence. J Natl Cancer Inst 2001;93(9):705–709. [PubMed: 11333293]
31. Merkin SS, Stevenson L, Powe N. Geographic socioeconomic status, race, and advanced-stage breast cancer in New York City. Am J Public Health 2002;92:64–70. [PubMed: 11772763]
32. Krieger N. Overcoming the absence of socioeconomic data in medical records: validation and application of a census-based methodology. Am J Public Health 1992;82(5):703–710. [PubMed: 1566949]

Table 1

Distribution of the study population by cancer site, demographics, socioeconomic attributes, county of residence, Medicaid status, and complexity of care needs

	Cancer Patients N (% of total)		
	Breast	**Prostate**	**Colorectal**
Demographic Variables			
Age:			
65-69	921 (20.91)	1,252 (23.48)[c]	813 (16.86)[c]
70-74	1,098 (24.93)	1,620 (30.40)	1,059 (22.01)
75-79	1,029 (23.37)	1,300 (24.37)	1,154 (23.93)
80-84	731 (16.60)	684 (12.83)	909 (18.85)
85+	625 (14.19)	478 (8.96)	887 (18.39)
Race:			
African-American	311 (7.06)[c]	551 (10.31)	385 (7.98)
All Other	4,093 (92.94)	4,795 (89.69)	4,437 (92.02)
Sex:			
Male	0 (0)[c]	5,334 (100)[c]	2,217 (45.98)[c]
Female	4,404(100)	0 (0)	2,605 (54.02)
Socioeconomic Attributes:			
Income:			
Quartile 1 (lowest)	1,077 (24.46)	1,229 (23.04)[c]	1,329 (27.56)[c]
Quartile 2-3 (IQR)	2,221 (50.43)	2,651 (49.70)	2,416 (50.10)
Quartile 4 (highest)	1,106 (25.11)	1,454 (27.26)	1,077 (22.34)
Education attainment:			
Low	391 (8.88)[b]	520 (9.75)	531 (11.01)[b]
High	4,013 (91.12)	4,814 (90.25)	4,291 (88.99)
County of Residence:			
Appalachian / Rural	1,085 (24.64)[c]	1,394 (26.13)	1,354 (28.08)[b]
Metro	2,646 (60.08)	3,055 (57.27)	2,715 (56.30)
Suburban	673 (15.28)	885 (16.59)	753 (15.56)
Medicaid Status:			
No	3,989 (90.58)[c]	5,084 (95.31)[c]	4,305 (89.28)[c]
Yes	415 (9.42)	250 (4.69)	517 (10.72)
Complexity of Clinical Presentation and Health Care Needs:			
Low	4,067 (92.35)	4,980 (93.36)[c]	4,359 (90.40)[c]
Moderate	162 (3.68)	139 (2.61)	202 (4.19)
High	175 (3.97)	215 (4.03)	261 (5.41)
Total Study Population	4,404 (100.00)	5,334 (100.00)	4,822 (100.00)

Level of statistical significance:

[a] $0.01 < p \leq 0.05$;

[b] $0.001 < p \leq 0.01$;

[c] $p \leq 0.001$

Table 2

Proportion of unstaged cases by cancer site, demographics, socioeconomic attributes, county of residence, Medicaid status, and complexity of care needs

	Cancer Patients					
	Breast		Prostate		Colorectal	
	% unstaged	Unadjusted OR (95%CI)*	% unstaged	Unadjusted OR (95%CI)*	% unstaged	Unadjusted OR (95%CI)*
Demographic Variables						
Age:						
65-69	3.69 [c]	1.0 *(Referent)*	9.27 [c]	1.0 *(Referent)*	10.70 [c]	1.0 *(Referent)*
70-74	4.46	1.22 (0.78, 1.90)	12.96	1.46 ((1.15, 1.85)	10.48	0.97 (0.73, 1.31)
75-79	6.32	1.76 (1.15, 2.69)	15.46	1.79 (1.40, 2.28)	11.61	1.10 (0.82, 1.46)
80-84	9.71	2.81 (1.84, 4.28)	26.32	3.50 (2.71, 4.52)	12.43	1.18 (0.88, 1.59)
85+	18.40	5.88 (3.95, 8.76)	40.38	6.63 (5.09, 8.64)	24.69	2.74 (2.09, 3.58)
Race:						
African-American	10.61[a]	1.50 (1.02, 2.19)	17.97	1.09 (0.86, 1.37)	15.06	1.12 (0.84, 1.50)
All Other	7.35	1.0 *(Referent)*	16.75	1.0 *(Referent)*	13.66	1.0 *(Referent)*
Sex:						
Male	0	N/A	16.87	N/A	12.27[b]	0.79 (0.67, 0.93)
Female	7.58		0		15.05	1.0 *(Referent)*
Socioeconomic Attributes:						
Income:						
Quartile 1 (lowest)	9.10 [a]	1.31 (1.09, 1.58)	18.14	1.19 (0.92, 1.55)	16.18 [b]	1.07 (0.90, 1.28)
Quartile 2-3 (IQR)	7.74	1.0 *(Referent)*	17.16	1.0 *(Referent)*	12.83	1.0 *(Referent)*
Quartile 4(highest)	5.79	0.73 (0.54, 0.98)	15.27	0.87 (0.73, 1.04)	12.91	1.01 (0.81, 1.25)
Education attainment:						
Low	10.74 [b]	1.0 *(Referent)*	18.85	1.0 *(Referent)*	16.38	1.0 *(Referent)*
High	7.28	0.65 (0.46, 0.92)	16.66	0.86 (0.68, 1.09)	13.45	0.79 (0.62, 1.01)
County of Residence:						
Appalachian / Rural	8.66	1.04 (0.88, 1.24)	16.57 [b]	1.29 (1.08, 1.55)	16.25 [b]	1.16 (0.90, 1.50)
Metro	7.56	1.0 *(Referent)*	15.97	1.0 *(Referent)*	13.04	1.0 *(Referent)*
Suburban	5.94	1.35 (1.12, 1.64)	20.45	0.91 (0.71, 1.16)	11.95	0.77 (0.54, 1.10)
Medicaid Status:						
Yes	18.31 [c]	3.24 (2.45, 4.29)	35.20 [c]	2.86 (2.18, 3.74)	29.40 [c]	3.09 (2.50, 3.81)
No	6.47	1.0 *(Referent)*	15.97	1.0 *(Referent)*	11.89	1.0 *(Referent)*
Complexity of Clinical Presentation and Health Care Needs:						
Low	5.93 [c]	1.0 *(Referent)*	14.60 [c]	1.0 *(Referent)*	11.81 [c]	1.0 *(Referent)*
Moderate	23.46	4.87 (3.31, 7.16)	33.81	2.99 (2.08, 4.28)	18.32	1.67 (1.16, 2.42)
High	31.43	7.28 (5.15, 10.27)	58.60	82.28 (6.24, 10.99)	42.91	5.61 (4.32, 7.29)
Total Study Population	7.58		16.87		13.77	

Level of statistical significance:

[a] $0.01 < p \leq 0.05$;

[b] $0.001 < p \leq 0.01$;

[c] $p \leq 0.001$;

all other statistics not significant at $p < 0.05$

OR=Odds Ratio; CI=Confidence Interval

Table 3

Results of the multivariable logistic regression analysis predicting unstaged cancer, by cancer site

	Cancer Patients Odds ratio (95% Confidence Interval)		
	Breast	**Prostate**	**Colorectal**
Demographic Variables			
Age:			
65-69 *(ref)*	1.0 *(Referent)*	1.0 *(Referent)*	1.0 *(Referent)*
70-74	1.24 (0.79, 1.95)	1.44 [b] (1.13, 1.83)	0.96 (0.71, 1.30)
75-79	1.68 [a] (1.09, 2.59)	1.71 [c] (1.34, 2.19)	1.04 (0.78, 1.39)
80-84	2.41 [c] (1.57, 3.71)	3.11 [c] (2.40, 4.05)	1.05 (0.77, 1.42)
85+	4.39 [c] (2.91, 6.62)	4.61 [c] (3.48, 6.10)	2.15 [c] (1.62, 2.85)
Race:			
African-American	1.33 (0.86, 2.05)	1.12 (0.85, 1.48)	0.93 (0.66, 1.30)
All Other *(ref)*	1.0 *(Referent)*	1.0 *(Referent)*	1.0 *(Referent)*
Sex:			
Male	N/A	N/A	0.96 (0.80, 1.14)
Female (*ref)*			1.0 *(Referent)*
Socioeconomic Attributes:			
Income:			
Quartile 1 (lowest)	0.96 (0.71, 1.29)	1.00 (0.81, 1.23)	1.14 (0.92, 1.41)
Quartile 2-3 (IQR**) (*ref*)	1.0 *(Referent)*	1.0 *(Referent)*	1.0 *(Referent)*
Quartile 4 (highest)	0.84 (0.62, 1.15)	0.97 (0.81, 1.17)	1.09 (0.87, 1.37)
Education attainment:			
Low *(ref)*	1.0 *(Referent)*	1.0 *(Referent)*	1.0 *(Referent)*
High	0.88 (0.58, 1.33)	0.92 (0.69, 1.21)	0.97 (0.73, 1.30)
County of Residence:			
Appalachian / Rural	1.15 (0.87, 1.51)	1.12 (0.93, 1.35)	1.31 [b] (1.08, 1.60)
Metro *(ref)*	1.0 *(Referent)*	1.0 *(Referent)*	1.0 *(Referent)*
Suburban	0.87 (0.60, 1.25)	1.54 [c] (1.26, 1.89)	0.94 (0.73, 1.22)
Medicaid Status:			
Yes	1.75 [c] (1.25, 2.44)	1.27 (0.91, 1.77)	1.93 [c] (1.51, 2.46)
No *(ref)*	1.0 *(Referent)*	1.0 *(Referent)*	1.0 *(Referent)*
Complexity of Clinical Presentation and Health Care Needs:			
Low *(ref)*	1.0 *(Referent)*	1.0 *(Referent)*	1.0 *(Referent)*
Moderate	3.77 [c] (2.53, 5.61)	2.13 [c] (1.46, 3.10)	1.34 (0.92, 1.96)
High	3.54 [c] (2.37, 5.28)	4.68 [c] (3.40, 6.45)	3.47 [c] (2.59, 4.65)

Level of statistical significance:

[a] $0.01 < p \leq 0.05$;

[b] $0.001 < p \leq 0.01$;

[c] $p \leq 0.001$.

All other statistics not significant at $p < 0.05$

** IQR: Interquartile Range