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Access to Cancer Services for Rural Colorectal Cancer Patients

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Abstract

Context—Cancer care requires specialty surgical and medical resources that are less likely to be found in rural areas.

Purpose—To examine the travel patterns and distances of rural and urban colorectal cancer (CRC) patients to 3 types of specialty cancer care services—surgery, medical oncology consultation, and radiation oncology consultation.

Methods—Descriptive cross-sectional study using linked Surveillance, Epidemiology, and End Results (SEER) cancer registry and Medicare claims data for 27,143 individuals ages 66 and older diagnosed with stages I through III CRC between 1992 and 1996.

Findings—Over 90% of rural CRC patients lived within 30 miles of a surgical hospital offering CRC surgery, but less than 50% of CRC patients living in small and isolated small rural areas had a medical or radiation oncologist within 30 miles. Rural CRC patients who traveled outside their geographic areas for their cancer care often went great distances. The median distance traveled by rural cancer patients who traveled to urban cancer care providers was 47.8 miles or more. A substantial proportion (between 19.4% and 26.0%) of all rural patients bypassed their closest medical and radiation oncology services by at least 30 miles.

Conclusions—Rural CRC patients often travel long distances for their CRC care, with potential associated burdens of time, cost, and discomfort. Better understanding of whether this travel investment is paid off in improved quality of care would help rural cancer patients, most of whom are elderly, make informed decisions about how to use their resources during their cancer treatment.

Cancer care requires sophisticated surgical and medical resources, including medical, surgical, and radiation therapy specialists. These specialists are less likely to be found in rural areas, especially small and isolated small rural areas, as their work can require tertiary hospital settings, found primarily in urban areas and rural areas with sizeable populations.[1–4] Several studies have found that rural cancer patients are less likely to receive state-of-the-

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art cancer care such as adequate cancer staging or breast conserving therapy for early stage breast cancer.5–8 One reason may be that rural cancer patients have poorer geographic access to specialty care and diagnostic services.

This descriptive study examines the travel patterns and distances of elderly rural and urban CRC patients to 3 types of cancer care services—surgery, medical oncology consultation, and radiation oncology consultation, to determine whether rural elderly are disadvantaged by long distances to cancer care providers and to examine the degree to which rural elderly are bypassing local cancer care services. Having to travel long distances for care can be a burden for elderly cancer patients and has been associated with lower use of recommended services.9–12 Bypassing local services, on the other hand, may represent poor access to cancer care if the closest providers' practices are full, patient or referring provider preference (eg, for a provider offering clinical trials), or lack of confidence in the quality of local services.13 This study's results can provide insights into interventions that might improve cancer service access for rural populations, such as transportation, visiting oncology, or telemedicine services.

Methods

Data Sources

This study used Surveillance, Epidemiology, and End Results (SEER) cancer registry data from 5 states (Connecticut, Hawaii, Iowa, New Mexico/Arizona American Indians, and Utah) and 7 county-based areas (Atlanta, Detroit, rural Georgia, Los Angeles, San Francisco, San Jose, and Seattle/Puget Sound) in 4 other states linked with Medicare claims. SEER data include patient sociodemographics, the socioeconomic attainment in the patients' residence census tracts, and cancer type and stage. Medicare data include enrollment dates, HMO membership, and, for fee-for-service beneficiaries, billed claims with the timing, diagnoses, and procedures provided by hospitals, physician offices, and clinics both within and outside SEER registry areas.

We used unique physician identifiers from our study patients' Medicare claims data to link specialty from the American Medical Association (AMA) Masterfile, and to identify the practice ZIP code from which physicians billed their claims. Unique Medicare hospital numbers allowed ZIP codes to be linked to the CRC resection hospital from the 1993 and 2002 Provider of Service (POS) files.

Study Population

We identified 39,876 individuals ages 66 and older diagnosed with American Joint Committee on Cancer stages I through III CRC between January 1, 1992, and December 31, 1996. We sequentially excluded patients with non-adenomatous CRC (n = 675) and prior CRC (n = 997). To avoid underascertainment of surgical resection, we included only those patients who were fully enrolled during the 6 months following diagnosis, or fully enrolled until death during this time frame (excluded n = 8,471). We excluded 6 cases where the ZIP code was missing or in Puerto Rico. Last, to ensure that all study patients pursued standard CRC treatment, we excluded 2,584 patients without a Medicare surgical resection claim within 6 months of diagnosis. Our final sample included 27,143 patients.

For our analysis of travel to medical and radiation oncology consultants, we required our study population (1) to be alive and fully enrolled in fee-for-service Medicare during the 9 months following diagnosis, and (2) to not have simultaneous stage IV CRC. Because adjuvant chemotherapy is recommended only for stage III colon and stage II and III rectal cancer, we limited our study population to these 7,856 patients when examining travel to medical oncologists (MOs). We further limited our study population to the 1,982 stage II

and III rectal cancer patients when examining travel to radiation oncologists (ROs) since adjuvant radiation therapy is recommended only for these patients.

Study Variables

The study's primary variables included the geographic location of patients' residences, their actual cancer care providers, and the cancer care providers located closest to their residences, as well as the distance in miles between patients and their actual or closest providers. These variables allowed us to examine whether rural patients were bypassing local cancer care providers.

Identification of Cancer Care Providers—We used data from the 1991 through 1997 Medicare claims for the 39,876 original CRC patients in the SEER database to identify surgical hospitals, MOs, and ROs. Surgical hospitals were those hospitals with at least 1 CRC resection claim between 1991 and 1997. Cancer care physicians were identified using primary and secondary specialty data from the 1993 and 1997 AMA Masterfiles as well as specialty classification on the Medicare claims. Physicians in the Medicare claims data who listed medical oncology, hematology, hematology/oncology, or pediatric hematology/oncology in any of these sources were designated MOs. Physicians listing radiation oncology in any of these sources and radiologists who submitted at least one radiation therapy claim (CPT codes 77261–77499, 77750–77799; ICD-9-CM codes V58.0, V66.1, V67.1; ICD-9-Procedure codes 92.20–92.29; and revenue center codes 0330, 0333, 0339) were designated ROs.

Geographic Location of Patients and Providers—Patient residence location was defined as the most frequently listed ZIP code on the Medicare claims in the calendar month of the CRC diagnosis or the most proximate ZIP code if there was none in that month. Physician practice location was defined as the most frequently listed ZIP code on claims submitted by that physician in the 1991–1997 Medicare claims on behalf of CRC patients diagnosed between 1992 and 1996 and reported to the SEER program. The surgical resection hospital ZIP code was found on either the 1993 POS file or, if not available there, the 2002 POS file. ZIP codes were mapped to the version 1.11 Rural Urban Commuting Area (RUCA) codes.[14,15] RUCAs use Census Bureau information on urbanized areas and urban clusters combined with work commuting information to differentiate places based on their city/town size and functional relationships to larger cities and towns. The 30 RUCA designations were aggregated into 4 commonly used categories to represent patients living in or strongly associated with urban (RUCA codes 1.0, 1.1, 2.0, 2.1, 3.0, 4.1, 5.1, 7.1, 8.1, 10.1) and 3 types of rural location: large rural city/town (RUCA codes 4.0, 4.2, 5.0, 5.2, 6.0, 6.1), small rural town (RUCA codes 7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2), isolated small rural town (RUCA codes 10.0, 10.2, 10.3, 10.4, 10.5, 10.6). We chose these categories because they meaningfully distinguish themselves from one another by their population densities, are associated with travel distances from other, often larger population centers with medical resources, and are being used to make health policy decisions.

Travel distances were calculated within a 250-mile straight line buffer around each state's boundaries and were defined as the paved road mileage along the route with shortest travel time (segment distances × travel speed) between the ZIP code population centroid of CRC patients and either the ZIP code population centroid of the closest provider or the provider/facility actually used. Less than 1% of patients traveled beyond the 250-mile buffer to care (eg, patients who seasonally migrate, so were diagnosed in a SEER registry but received care elsewhere), and their distances were not calculated. A patient's actual surgical hospital was the facility where the initial CRC resection took place. A patient's actual consulting MO was the first MO who submitted a claim within 1 month before to 9 months after the

diagnosis month. Patients' actual ROs were defined in the same way. We chose the first MOs and ROs because these consulting physicians were likely to have had the greatest impact on the patients' decisions to initiate treatment. The closest cancer care providers were those whose ZIP code population centroids were the shortest travel distance from each patient's ZIP code, regardless of whether the patients received treatment. Distance to the closest surgical hospital was calculated for all study patients. Distance to the closest MO was calculated only for stage II and III rectal and stage III colon cancer patients, for whom chemotherapy is recommended. Distance to the closest RO was calculated only for stage II and III rectal cancer patients, for whom adjuvant radiation therapy is recommended.

Patient and Cancer Characteristics—SEER data provided patient age, sex, marital status, and race/ethnicity. Cancer stage (I, II, III) was defined using the American Joint Committee on Cancer staging system.16 Cancer type was defined with SEER site codes as colon (codes 180, 182–189, 199) and rectal (code 209).

Contextual Characteristics—SEER registry represented the cancer care region. Median income of race/age-matched individuals within each patient's census tract was a proxy for socioeconomic status.

Analysis

We first described the patient, contextual, and cancer characteristics of the urban and three types of rural patients in our CRC groups (stage I–III colorectal, stage III colon and stage II and III rectal only, and stage II and III rectal only) using overall chi-square tests. We then compared the proportion of patients in the 4 geographic areas that had cancer providers within 30 and 50 miles of their residence using overall chi-square tests. Next, we examined where patients from each geographic area traveled to receive their cancer care. We calculated the number of road miles between patients' residence ZIP codes and the ZIP codes of their actual providers, as well as between their residence ZIP codes and the ZIP codes of the closest provider of each type, stratified by cancer stage and type. Last, we examined the proportion of our study patients who bypassed their closest cancer care providers by 30 and 50 miles to go to their actual cancer care providers, and tested for significant differences in bypass rates between patients in different geographic areas using overall chi-square tests. Since a large proportion of the rural cancer cases were from Iowa, we repeated our basic analyses in rural Iowa versus other rural areas.

Results

Patient Characteristics

Table 1 presents the characteristics of the rural and urban patients in our study sample. The majority of patients in small and isolated small rural areas were from Iowa; the majority of patients in large rural areas were distributed across multiple SEER areas. The more rural a patient's residence, the lower the race/age-specific median household income in his/her census tract. Patients living in small and isolated small rural areas were most likely to be Caucasian, although over 90% of patients in all 3 rural area types were Caucasian. The patients in the combined stage III colon cancer and stage II and III rectal cancer group, as well as those in the stage II and III rectal cancer group appeared younger than the stage I–III CRC study group; other differences between the study groups were minor.

Proximity to Cancer Care Providers

The majority of CRC patients residing in all 3 rural locations had surgical services within 30 miles of their residence ZIP codes (Table 2). However, only 30.0% and 40.4% of CRC patients living in isolated small and small rural areas had medical oncology services within

30 miles; 67.5% and 73.7% had these services within 50 miles. Radiation oncology services were even more limited. About 28% of CRC patients living in isolated small and small rural areas had radiation oncology services within 30 miles; about 63% had these services within 50 miles. Though the majority of CRC patients living in larger rural areas had radiation and medical oncology services within 50 miles, a third did not have medical oncology and a quarter did not have radiation oncology services within 30 miles of their residence ZIP code.

Travel Patterns of Cancer Care Patients

Rural cancer patients, especially those in isolated small and small rural places, often left their areas for cancer care (Table 3). Travel for care paralleled proximity to cancer care providers. Rural cancer patients who were least likely to have cancer care providers near their homes (eg, those in isolated small and small rural areas) were most likely to travel to a larger rural or urban areas for care. For example, 86.9% in isolated small rural areas and 53.4% in small rural areas traveled to larger rural or urban areas for surgical resection, each compared to 17.2% in large rural areas ($P \leq .001$, chi-square tests). Those rural patients who traveled outside of their geographic area most frequently traveled to urban areas for care. Rural patients traveled to urban areas most frequently for medical and radiation oncology consultation, and least frequently for surgery.

Distances Traveled for Cancer Care

When rural patients traveled outside their areas for cancer care, they often went great distances. The median distance traveled by isolated small rural cancer patients to urban cancer care providers was between 47.8 and 67.0 miles (Table 4). Patients living in small rural places traveled comparable median distances to urban providers, between 50.3 and 56.6 miles. Patients in large rural places who traveled to urban cancer care providers traveled the longest median distances—between 62.1 and 70.0 miles.

Bypass of Local Providers

Table 5 illustrates the degree to which CRC patients bypassed their closest cancer care providers. Between 19.4% and 28.5% of all isolated small and small rural patients bypassed their closest surgical, medical oncology, and radiation oncology services by at least 30 miles. Comparable proportions of patients residing in large rural areas bypassed their closest ROs and MOs (21.5% and 26.1% respectively), while a smaller proportion bypassed their closest surgical hospitals (14.9%).

Discussion

Many rural CRC patients received their cancer care in locations other than their home communities, and traveled great distances to do so. Leaving one's community for care was most common among those from small and isolated small rural places. A less intuitive finding is that these patients traveled to urban areas for care, as many patients may have had a closer cancer care provider within a larger rural area. This raises important questions about why these rural patients travel to distant providers. Decisions about where to seek care for a condition like cancer are complex. Some patients may be seeking facilities or physicians with an affiliation that could indicate higher quality care (eg, American College of Surgeons cancer program certification). Others may travel due to concerns about the quality of their local providers.[13,17] Indeed, numerous studies have associated higher volume CRC surgical services with improved outcomes and preferred procedures such as anal sphincter-sparing surgery for rectal cancer.[18–21] These concerns put patients in the difficult position of weighing the possibility of receiving higher quality cancer care against the distance from home for frequent cancer care services.

Although patients may be seeking care from higher volume centers when they travel to urban areas, the majority of urban hospitals is not high volume centers, and a substantial amount of urban CRC care takes place in lower volume centers.22 In addition, we found no studies examining the quality of rural medical or radiation oncology services, or the volume-outcome relationship for these services. Further research on factors associated with cancer care quality will help rural cancer patients make the best decisions about how to use their resources during cancer treatment.

Other factors may be associated with rural patients' travel for cancer care. Patients may seek care near family members living in urban areas. Rural patients who must travel some distance for cancer specialty services may view additional travel time as a marginal increase, and choose a more distant urban setting offering a more complete spectrum of cancer services.

It is possible that cancer care specialists are limited in rural areas and may restrict new patients or certain types of patients (eg, Medicaid- or Medicare-insured),23 or be unable to accommodate the volume of cancer patients within their regions, leading to longer wait times for appointments. Indeed, the travel patterns of the CRC patients follow provider density in rural areas. Simple tabulations of physician-to-population ratios using the 2001 AMA Masterfile and the estimated 2001 US population demonstrate a surgeon-to-population ratio of 9.1:100,000 in small and isolated small rural areas, compared to 1.2:100,000 for MOs and 0.3:100,000 for ROs. These figures match the finding that rural CRC patients were least likely to travel for surgical care.

Last, rural primary care providers or surgeons may have established referral relationships with cancer centers or cancer specialists that determine their patients' travel patterns. If more of these relationships are established with urban specialists, this also could help explain the high rate of travel to urban centers.

Medical and radiation oncology services were the least available cancer services to rural patients. These findings are supported by a related study demonstrating that the median travel distance for Medicare beneficiaries' visits for cancer far exceeded that for other common diagnoses such as cerebrovascular disease, ischemic heart disease, and fractures.24 Radiation oncology services are tied to a physical facility where therapy is planned and administered. Strategies for increasing geographic access to these facilities require transportation. Transportation is most likely to be a challenge for the elderly, who comprise the majority of cancer patients. Medical oncology services, on the other hand, are not tied to specific physical facilities, offering more flexibility in provision of these services to rural populations. Patients can receive an initial consultation with a more distant MO, but receive ongoing chemotherapy with a local physician. Visiting oncology clinics or telemedicine consultation could both increase geographic access. Telemedicine services have been developed for cancer patients.25–28

This study has several limitations. It examines care for CRC patients only. The results should be generalizable to other cancer patients, however, since rural cancer care providers generally care for all cancer types. This study identified the surgical hospitals, MOs, and ROs using Medicare claims submitted on behalf of this study's original 39,876 patients only, not the entire population of CRC patients. This ensures that all identified cancer care specialists cared for CRC patients, but it also may have underestimated the number of these providers in different locations. We included providers listed in all study years, however, decreasing the likelihood of this underascertainment. We reviewed our ascertainment strategy in Iowa, and felt reassured after finding that our study methods identified all but one

radiation oncology center that the American Society for Therapeutic Radiology and Oncology (ASTRO) listed as open in Iowa during the years of our study.

Additional limitations relate to the measurement of travel distances. First, the SEER-Medicare data include a 5-digit ZIP code for providers and patients rather than the street address, which would be more accurate. Second, some clinical systems with multiple locations may bill from a single site that may not represent the clinic where the service occurred. Similarly, we may have underidentified visiting cancer care services in rural areas if the visiting physician billed from his/her base practice rather than from the itinerant clinic. Telemedicine visits also may have been missed because they are generally billed from the specialist's base clinic site, although there will have been few at the time of this study. Third, we could have overestimated or underestimated travel distances for patients who temporarily moved outside their area for care, depending on whether they changed their residence address in the Medicare system. We used median travel distances to minimize the influence of outlier values from such temporary moves. Last, these data, which were the most current available at the start of this study, may not represent current travel patterns for cancer care. However, over the past decade, the medical oncology workforce has not changed substantially in size, and the general surgical and radiation oncology workforce sizes have declined substantially.[29–31] With a population that is increasing in size and aging, the issues identified in this research are clearly relevant today.

Our sample is not representative of rural patients throughout the United States. Almost three quarters of the patients from isolated small rural areas and nearly 70% from small rural areas were from Iowa. We stratified our sample into Iowans and non-Iowans, and found variation by area, although our basic conclusions about the availability of cancer care providers, cancer patients' travel patterns, and the distances traveled did not change. The differences highlight the importance of developing local strategies to address access problems, depending on the existing health care systems, however.

Rural patients are traveling great distances to receive their CRC care. Many have no choice because of the regionalization of specialists, particularly MOs and ROs. Others are bypassing closer, local providers to seek care from more distant providers. The reasons for this are unclear. Though some studies have suggested rural/urban differences in quality of cancer care, the investigators' prior work suggests that rural and urban colon cancer patients are equally likely to receive adjuvant chemotherapy.[32] This may relate to the fact that rural patients can travel for their initial medical oncology consultation, then receive their more frequent treatments from local physicians. Radiation therapy is limited to regionalized facilities, and is frequently a daily treatment, making it a greater burden in time, cost, and discomfort for those who must travel long distances to these centers. Further work to examine the influence of distance from radiation therapy on the receipt of this treatment is needed. Research with both rural providers and rural cancer patients would also help elucidate whether travel to more distant providers is by choice or because of limitations in availability or perceived quality. It could also examine how closely the existing system of cancer care physicians matches a system that optimally locates such specialty services for rural patients. Another important area for future research is in using strategies such as spatial pattern analysis to examine the relationship of demographic and clinical characteristics (eg, stage) and outcomes of rural patients with travel distances to and bypassing of cancer care providers.[33] This body of research would inform providers, health systems, and policy makers as they work to ensure geographic access to optimal cancer care services for rural populations via strategies such as transportation systems, telemedicine services, and cancer center location planning. Improving access to optimal cancer care services in turn affords the opportunity for all patients to receive the treatments that can improve their survival.

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Table 1

Characteristics of Rural and Urban CRC Patients in the 3 Study Samples

	Stages I–III CRC Patients†				Stage III Colon Cancer, Stage II–III Rectal Cancer Patients‡				Stage II–III Rectal Cancer Patients§			
	Rural				Rural				Rural			
	Isolated Small (N = 1,506)	Small (N = 1,575)	Large (N = 1,696)	Urban (N = 22,366)	Isolated Small (N = 434)	Small (N = 463)	Large (N = 486)	Urban (N = 6,473)	Isolated Small (N = 121)	Small (N = 127)	Large (N = 127)	Urban (N = 1,607)
Sociodemographic characteristics (%)												
Age												
66–70	18.3	18.9	19.8	20.2	19.1	23.3	22.6	23.4	20.7	25.2	26.8	26.7
71–75	25.5	23.3	25.7	24.3	30.0	22.5	27.6	26.4	36.4	21.3	27.6	27.8
76–80	23.0	24.0	22.5	24.1	22.6	22.3	21.8	24.1	23.1	22.1	18.9	22.7
81+	33.2	33.8	32.0	31.5	28.3	32.0	28.0	26.1	19.8	31.5	26.8	22.8
Gender												
Female	51.2**	55.3	52.1	54.8	49.5	57.0	51.0	53.1	35.5**	51.2	37.0	47.2
Race												
White	95.2***	94.7	90.2	84.8	93.3***	95.5	90.3	83.1	93.4**	92.9	89.0	84.9
African American	1.1	1.8	0.7	7.5	1.4	1.3	0.4	7.8	0.8	1.6	0.0	5.1
Hispanic	1.5	2.2	4.2	3.5	1.6	2.2	5.0	3.9	0.8	4.7	6.3	4.9
Asian/Pacific Islander	1.3	0.9	4.6	4.1	2.5	0.9	4.3	5.0	4.1	0.8	4.7	5.0
Native American	0.9	0.3	0.2	0.1	1.2	0.2	0.0	0.1	0.8	0.0	0.0	0.1
Marital status												
Married	58.2***	55.6	56.2	52.0	59.8**	56.3	58.7	54.4	69.8*	59.1	65.9	56.4
Single/separated/divorced	7.4	8.5	9.0	12.6	7.5	8.7	9.1	12.7	7.6	9.5	11.1	12.9
Widowed	34.4	35.9	34.9	35.5	32.7	35.0	32.2	32.9	22.7	31.5	23.0	30.8
Contextual characteristics (%)												
Race/age-specific annual median household income												
≤$20,000	54.0***	54.1	43.5	28.0	50.7***	52.1	41.0	26.8	40.6***	56.0	32.7	25.2
$20,001–$25,000	29.7	30.3	27.9	19.0	32.6	30.4	30.9	18.4	42.5	29.4	35.5	18.8

	Stages I–III CRC Patients†				Stage III Colon Cancer, Stage II–III Rectal Cancer Patients‡				Stage II–III Rectal Cancer Patients§			
	Rural				Rural				Rural			
	Isolated Small (N = 1,506)	Small (N = 1,575)	Large (N = 1,696)	Urban (N = 22,366)	Isolated Small (N = 434)	Small (N = 463)	Large (N = 486)	Urban (N = 6,473)	Isolated Small (N = 121)	Small (N = 127)	Large (N = 127)	Urban (N = 1,607)
$25,001–$30,000	9.1	10.2	13.3	17.9	9.8	11.6	12.4	18.1	10.4	6.4	18.2	17.9
$30,001+	7.1	5.5	15.3	35.1	6.9	6.0	15.7	36.8	6.6	8.3	13.6	38.1
Registry												
Connecticut	6.8***	5.1	8.7	17.1	6.7***	5.4	9.1	17.2	6.6***	3.9	7.9	17.4
Atlanta/rural Georgia	3.4	3.6	0.4	6.0	3.7	2.8	0.4	6.2	4.1***	3.9	0.8	5.5
Hawaii	2.0	1.5	6.1	1.9	3.0	1.7	6.4	2.2	4.1***	0.8	7.1	1.6
Iowa	74.9	68.8	43.4	7.0	74.9	70.4	42.2	6.5	69.4	70.1	41.7	6.9
Los Angeles	0.3	0.3	0.4	17.6	0.2	0.2	0.2	17.0	0.0	0.0	0.0	13.4
Michigan	0.5	0.3	0.5	19.2	0.9	0.2	0.2	19.6	2.5***	0.0	0.0	19.7
New Mexico/Arizona American Indians	3.8	5.4	19.4	2.0	3.7	3.7	21.4	1.9	2.5***	5.5	19.7	2.5
San Francisco/San Jose	0.2	0.3	2.4	15.7	0.2	0.7	2.7	16.1	0.8	0.0	3.2	17.7
Seattle/Puget Sound	4.2	9.9	13.3	10.0	3.0	9.1	11.1	9.6	5.0***	7.9***	11.8	10.5
Utah	4.0	4.8	5.5	3.4	3.7	5.8	6.4	3.8	5.0***	7.9***	7.9	4.7
Cancer characteristics (%)												
Cancer type/stage												
Colon1	20.7	19.6	21.0	20.3								
Colon2	37.1	38.8	37.7	38.5								
Colon3	25.0	26.4	24.9	26.6	72.1	72.6	73.9	75.2				
Rectum1	8.0	6.5	7.5	6.4								
Rectum2	5.0	4.3	5.3	4.4	15.0	13.2	16.5	13.3	53.7	48.0	63.0	53.5
Rectum3	4.2	4.4	3.7	3.8	12.9	14.3	9.7	11.6	46.3	52.0	3.0	46.6

Overall chi-square tests were used to test for statistically significant differences.

*$P \leq .05$.

**$P \leq .01$.

***$P \leq .001$.

†Missing values for race: urban 187, large rural 5, small rural 2, isolated small rural 1; marital status: urban 445, large rural 23, small rural 22, isolated small rural 25; race/age-specific annual median household income: urban 1,781, large rural 217, small rural 181, isolated small rural 160.

‡Missing values for race: urban 56, large rural 1, small rural 1; marital status: urban 113, large rural 4, small rural 3, isolated small rural 6; race/age-specific annual median household income: urban 547, large rural 52, small rural 48, isolated small rural 57.

§Missing values for race: urban 13; marital status: urban 21, large rural 1, isolated small rural 2; race/age-specific annual median household income: urban 129, large rural 17, small rural 18, isolated small rural 15.

Table 2

Proximity of CRC Patients to 3 Types of Cancer Care Providers by Geographic Area of Residence

	Surgical Hospitals (Stages I–III CRC Patients)				MOs (Stage III Colon Cancer, Stage II–III Rectal Cancer Patients)				ROs (Stage II–III Rectal Cancer Patients)			
	Rural				Rural				Rural			
%With Service Available:	Isolated Small (N = 1,502)	Small (N = 1,571)	Large (N = 1,695)	Urban (N = 22,358)	Isolated Small (N = 424)	Small (N = 456)	Large (N = 468)	Urban (N = 6,471)	Isolated Small (N = 117)	Small (N = 126)	Large (N = 120)	Urban (N = 1,607)
Within 30 miles	90.8***	96.3	97.7	99.6	30.0***	40.4	76.5	99.6	27.4***	27.8	65.0	98.4
Within 50 miles	96.6***	97.7	98.9	99.8	67.5***	73.7	86.3	99.9	62.4***	62.7	70.0	99.4

Overall chi-square tests were used to test for statistically significant differences between patients living in the 4 different geographic areas (eg, comparing proportions of stage I–III CRC patients living in urban, large rural, small rural, and isolated small rural areas who lived within 30 miles of a surgical hospital.

* $P \leq .05$.

** $P \leq .01$.

*** $P \leq .001$.

Missing values for surgical hospitals 17, ROs 12, MOs 37.

Table 3

Travel Patterns of CRC Patients to their Cancer Care Providers by Geographic Area of Residence and Geographic Area of Care

	Surgical Hospitals (Stages I–III CRC Patients)				MOs (Stage III Colon Cancer, Stage II–III Rectal Cancer Patients)				ROs (Stage II–III Rectal Cancer Patients)			
	Rural				Rural				Rural			
% Receiving Care in:	Isolated Small (N = 1,491)	Small (N = 1,553)	Large (N = 1,665)	Urban (N = 22,051)	Isolated Small (N = 317)	Small (N = 336)	Large (N = 328)	Urban (N = 4,609)	Isolated Small (N = 69)	Small (N = 78)	Large (N = 76)	Urban (N = 949)
Isolated small rural	13.2	0.6	0.5	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Small rural	20.5	46.0	1.0	0.2	3.2	7.1	2.7	0.3	5.8	7.7	6.6	0.1
Large rural	20.5	15.3	81.3	0.4	20.5	16.1	49.7	0.4	29.0	14.1	44.7	0.4
Urban	45.9	38.1	17.2	99.3	75.1	76.8	47.6	99.3	65.2	78.2	48.7	99.5

N for each set of travel patterns represents cancer patients who received the cancer service (ie, surgical resection, medical oncology consultation, radiation oncology consultation) and had valid residence and provider ZIP codes available.

Table 4

Median Distance in Road Miles Traveled by CRC Patients to their Cancer Care Providers by Geographic Area of Residence and Geographic Area of Care

	Surgical Hospitals (Stages I–III CRC Patients)				MOs (Stage III Colon Cancer, Stage II–III Rectal Cancer Patients)				ROs (Stage II–III Rectal Cancer Patients)			
	Rural				Rural				Rural			
Median Distance to Actual Care Providers in:	**Isolated Small (N = 1,468)**	**Small (N = 1,517)**	**Large (N = 1,610)**	**Urban (N = 21,861)**	**Isolated Small (N = 281)**	**Small (N = 324)**	**Large (N = 298)**	**Urban (N = 4,485)**	**Isolated Small (N = 60)**	**Small (N = 68)**	**Large (N = 60)**	**Urban (N = 897)**
Isolated small rural	6.2											
Small rural	17.8	0.0	19.5	19.8		5.0						
Large rural	27.1	23.4	0.0	13.7	39.7	40.1	0.0	15.2	34.9	40.1	7.0	
Urban	47.8	50.3	70.0	5.5	60.2	56.6	62.1	6.4	67.0	54.8	64.1	7.5

N for each set of distances represents cancer patients who received the cancer service (ie, surgical resection, medical oncology consultation, radiation oncology consultation), had valid residence and provider ZIP codes available, and had distance data available. Categories with less than 10 patients were excluded.

Table 5

Proportion of CRC Patients Bypassing Closest Cancer Care Providers by Geographic Area of Residence

	Surgical Hospitals (Stages I–III CRC Patients)				MOs (Stage III Colon Cancer, Stage II–III Rectal Cancer Patients)				ROs (Stage II–III Rectal Cancer Patients)			
	Rural				Rural				Rural			
% Bypassing by More than:	Isolated Small (N = 1,467)	Small (N = 1,526)	Large (N = 1,618)	Urban (N = 21,863)	Isolated Small (N = 294)	Small (N = 324)	Large (N = 307)	Urban (N = 4,493)	Isolated Small (N = 63)	Small (N = 73)	Large (N = 65)	Urban (N = 901)
30 miles	27.1***	28.5	14.9	1.9	19.4***	21.0	26.1	2.7	25.4***	26.0	21.5	2.3
50 miles	17.9***	20.6	11.1	1.0	11.6***	10.5	18.6	0.7	17.5***	13.7	10.8	1.4

Overall chi-square tests were used to test for statistically significant differences between patients living in the 4 different geographic areas (e.g., comparing proportions of stage I–III CRC patients living in urban, large rural, small rural, and isolated small rural areas who bypassed their closest cancer care providers by more than 30 miles).

*$P \leq .05$.

**$P \leq .01$.

***$P \leq .001$.