

Racial/Ethnic and Age Disparities in Chemotherapy Selection for Colorectal Cancer

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Studies¹⁻⁸ have evaluated racial/ethnic and age disparities in whether patients receive chemotherapy for nonmetastatic colorectal cancer (CRC) treatment and have found that patients of nonwhite race/ethnicity and older patients are less likely to receive chemotherapy. However, these studies did not evaluate specific types of chemotherapy agents used.

Management of metastatic (stage IV) CRC historically has involved 5-fluorouracil-leucovorin as the standard chemotherapy,⁹⁻¹¹ but the introduction of various novel add-on chemotherapies with improved efficacy has led to an increase in the chemotherapeutic options available to manage stage IV CRC.^{12,13} Irinotecan hydrochloride, approved in 1998 as a second-line agent for metastatic CRC treatment and approved in 2000 as a first-line agent for use with 5-fluorouracil-leucovorin,¹⁴ was the first of these novel agents to show improved efficacy relative to 5-fluorouracil-leucovorin alone.^{15,16} Irinotecan inhibits the enzyme necessary for the reversible breakage and relegation of DNA strands during DNA synthesis, leading to significant improvement in tumor progression slowing and median survival time (approximately 3 additional months relative to the 5-fluorouracil-leucovorin regimen).¹⁴ Its availability, as well as the subsequent availability of other novel agents such as oxaliplatin, bevacizumab, and cetuximab, has raised expectations for more efficacious regimens than 5-fluorouracil-leucovorin alone.¹⁷⁻²⁰ Nevertheless, these novel agents also place patients at higher risk of experiencing adverse effects as a result of their increased toxic effects.^{15,16,17-20}

Knowledge is scarce about racial/ethnic and age disparities in the receipt of newer chemotherapies. Addressing this gap by examining the first of the newer agents marketed for treatment of advanced CRC disease can provide an understanding of healthcare disparities among specific services for CRC management. In addition to knowing whether patients are receiving chemotherapy in real-world settings, it is important to know whether newer chemotherapies are being selectively utilized among chemotherapy users, particularly elderly patients in whom incidence of the disease is high.²¹

This study sought to determine whether racial/ethnic and age disparities existed in the selection of specific types of chemotherapy among elderly patients with stage IV CRC. Given that irinotecan was the first novel agent to be available at the start of the study period, newer therapy was designated as irinotecan-containing chemotherapy.

Objectives: To test the hypotheses that African American patients and older patients with stage IV colorectal cancer were less likely to receive newer chemotherapy agents.

Study Design: Retrospective cohort design.

Methods: Among 5068 Surveillance, Epidemiology, and End Results–Medicare patients diagnosed as having stage IV colorectal cancer between 2000 and 2002, a total of 2466 received chemotherapy and were included in the analysis. Irinotecan hydrochloride was the first of the “newer” chemotherapy agents and was marketed in 2000 as a first-line add-on agent. Descriptive statistics were generated, and a multivariable logistic regression was run to estimate the odds of receiving irinotecan among African American patients and older patients and within 2 months of chemotherapy initiation.

Results: African American patients had lower odds of initiating treatment with a newer chemotherapy than white patients (adjusted odds ratio, 0.641; 95% confidence interval, 0.453-0.907). An age disparity was also found, with all older age groups being significantly less likely to initiate treatment with a newer chemotherapy than the youngest age group: the adjusted odds of receiving newer chemotherapy agents (relative to patients aged 66-70 years) were lower and significant among patients aged 71 to 75, 76 to 80, and older than 80 years (odds ratios, 0.708, 0.527, and 0.213, respectively).

Conclusions: Disparities in chemotherapy selection exist among patients receiving chemotherapy for stage IV colorectal cancer. On initiating chemotherapy, African American patients and older patients were less likely to receive a newer agent.

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Take-Away Points

In a population-based study of older Medicare patients with stage IV colorectal cancer, racial/ethnic and age disparities were detected in the receipt of newer chemotherapy agents (using irinotecan hydrochloride as an example of a newer therapy) for first-line management of the disease. The following specific findings were observed:

- African American patients had lower odds of initiating treatment with a newer chemotherapy than white patients.
- Patients aged 71 to 75, 76 to 80, and older than 80 years had lower odds of initiating treatment with a newer chemotherapy agent than patients aged 66 to 70 years.

It was hypothesized that patients of African American race/ethnicity and older patients with stage IV CRC would have a lower likelihood of receipt of newer chemotherapy than white patients and younger patients.

METHODS

Data Source

The linked Surveillance, Epidemiology, and End Results (SEER)-Medicare database was used for this study.²² SEER data provided clinical and demographic information about patients with cancer from SEER registries across the following 16 geographic areas: Connecticut, Detroit (Michigan), Hawaii, Iowa, New Mexico, Seattle (Washington), Utah, Atlanta (Georgia), rural Georgia, Kentucky, Louisiana, New Jersey, greater California, and Los Angeles, San Jose, and San Francisco (California). Health utilization information for these patients was obtained from their Medicare Part A and Part B claims, which include hospital services, physician and other noninstitutional provider services, and outpatient institutional providers.²²

Study Population

A total of 112,345 patients with at least 1 diagnosis of non-appendiceal colon or rectal cancer occurring between 1998 and 2002 were initially identified from SEER. Patients diagnosed at death were excluded (n = 1104 patients), as were patients diagnosed as having nonadenocarcinomas or a stage of disease that did not require any chemotherapy treatment (n = 39,755). Patients younger than 66 years also were excluded to allow a complete year of data during the year before CRC diagnosis to identify prediagnosis comorbidities (n = 10,600).

Patients who were ineligible for Medicare fee for service were excluded, as were those with no utilization information because of death or loss of Medicare eligibility occurring during the same month of diagnosis (n = 22,140). To ensure that chemotherapy use was specifically for stage IV CRC, patients with a history of cancer dating 5 years or earlier before the current CRC diagnosis or patients with a concurrent cancer occurring in the same year as the CRC diagnosis were excluded (n = 3883). The final sample was further refined

to those eligible to receive first-line irinotecan-containing chemotherapy (ie, patients with stage IV disease diagnosed after 1999 [n = 5068]).

Outcome Variable

The main variable of interest was the receipt of newer chemotherapy (irinotecan vs all other chemotherapy) within 2 months of chemotherapy initiation. Chemotherapy administration was identified through specific chemotherapy-related medical codes in physician, outpatient facility, and durable medical equipment Medicare claims. Various resources and published studies^{3,7,23-26} that have measured chemotherapy through Medicare claims were used to identify the relevant codes that represented chemotherapy use. These codes are listed in **Table 1**.

Patients with any chemotherapy-related Medicare claim were identified as chemotherapy users, and the earliest chemotherapy-related claim on or after the first day of the diagnosis month was used to identify the chemotherapy start date. A 2-month window beginning on the chemotherapy start date was searched for any claims indicating irinotecan use (Healthcare Common Procedure Coding System code J9206). If no irinotecan claims were identified, the chemotherapy user was identified as having received “other” chemotherapy.

Explanatory and Control Variables

Clinical Variables. SEER-Medicare data were used to identify several clinical variables. Year of diagnosis was obtained from the SEER file. Other SEER clinical variables included a history of cancer that occurred at least 5 years before the cancer diagnosis under study. Furthermore, although all patients had stage IV disease, variability in tumor characteristics such as tumor site and lymph node involvement was observed, and these variables were included in the descriptive analysis.

The Charlson Comorbidity Index (CCI), a measure of disease burden, was used as a proxy for health status (prediagnosis). The index has been validated as a reliable tool for the prediction of morbidity in patients with cancer.²⁷⁻³⁰ Calculation of the index involved using physician and hospital claims in the year preceding cancer diagnosis to search medical codes that reflected the following: myocardial infarction, congestive heart failure, peripheral vascular disease, chronic obstructive pulmonary disease, dementia, paralysis, diabetes, chronic renal failure, liver disease, ulcers, rheumatoid arthritis, and AIDS.³¹ Because few patients had CCI scores exceeding 2, the final CCI obtained was used to categorize patients into the following 3 groups: 0 CCI, 1 CCI, or more than 1 CCI.

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Table 1. Medical Codes Used to Identify Cancer-Related Services

Cancer-Related Service	Codes
Chemotherapy	
Any chemotherapy drug	HCPCS codes beginning with J9, J0640, J8510, J8521, J8530-J8999
Irinotecan hydrochloride	HCPCS code J9206
5-Fluorouracil or derivative based	HCPCS codes J8520, J8521, J9190, J9200; NDC codes 00004110020, 00004110051, 00004110113, 00004110116, 00004110150
Leucovorin	HCPCS code J0640
General chemotherapy administration indicator	Any code for a chemotherapy drug or the following: HCPCS codes Q0083-Q0085; CPT codes 964xx, 965xx, 51720; RC codes 0331, 0332, 0335; ICD-9-CM procedural code 99.25; ICD-9-CM diagnosis codes V58.1, V66.2, V67.2
Surgery	
Major to colorectal region	ICD-9-CM procedural codes 45.7, 45.8, 48.4-48.6; CPT codes 44139-44160, 44204-44213, 45110-45126
Metastatic beyond colorectal region	ICD-9-CM procedural codes 32.3-32.6, 32.9, 50.2-50.4, 57.7, 68.8; CPT codes 32440, 32442, 32445, 32480, 32482, 32484, 32500, 32520, 47120-47130, 47300, 47380-47382, 51597, 58240
Radiation therapy	
	ICD-9-CM procedural codes 92.21-92.29; ICD-9-CM diagnosis codes V58.0, V66.1, V67.1; RC codes 0330, 0333, 0339; CPT codes 77401-77799; SEER codes 1-6

CPT indicates Current Procedural Terminology; HCPCS, Healthcare Common Procedure Coding System; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; NDC, National Drug Code; RC, Revenue Center; SEER, Surveillance, Epidemiology, and End Results.

Other cancer-related procedures occurring within the first 4 months of diagnosis were measured. Codes reflecting surgery to the colorectal region, surgery to metastatic sites (eg, liver, lung), and radiation therapy were identified from published resources (Table 1).^{8,26,32-36}

Demographic Variables. In addition to age at diagnosis and race/ethnicity, sex and marital status were obtained from the SEER-Medicare enrollment files. The following 4 age groups were created: 66 to 70, 71 to 75, 76 to 80, or older than 80 years. Race/ethnicity was categorized as white, African American, or other. A variable indicating whether the patient was married at the time of diagnosis was also available. Finally, SEER registry geographic information was available as a demographic variable.

Aggregate Socioeconomic Variables. Individual-level socioeconomic variables were unavailable. However, SEER data contained a group of aggregate zip code-level and census tract-level household income variables that were used to create a proxy variable for socioeconomic status.³⁷ A compound median household income proxy variable for socioeconomic status was generated using an algorithm previously applied to SEER-Medicare data.^{38,39} In order of priority, the algorithm used information from the census tract median household income by race/ethnicity, by age, and by income, as well as the zip code median income.^{38,39} Patients were then ranked into quintiles based on the final composite median income value.

Patient residence in a metropolitan (vs rural) area was also measured. This tested whether proximity to an urban area might influence the receipt of newer agents if adoption occurs earlier in urban environments.

Statistical Analysis

All analyses were conducted using commercially available software (SAS/STAT software version 9.1; SAS Institute Inc, Cary, NC). Bivariate descriptive statistics and likelihood ratio χ^2 tests of significance were generated to compare patients initiating newer chemotherapy versus patients initiating any other chemotherapy with respect to demographic, socioeconomic, and clinical variables. Variables significantly associated with initiation of newer chemotherapy at the bivariate level ($P < .05$) were included in a multivariable logistic regression model to test the association between race/ethnicity or age and the odds of initiating on newer chemotherapy, while controlling for clinical and demographic factors.

RESULTS

The final sample among 5068 patients with stage IV CRC receiving chemotherapy was 2466 patients. Approximately 32% of the chemotherapy users initiated their therapy using an irinotecan-containing regimen. Based on healthcare claims, the patient group using non-irinotecan-containing

chemotherapy primarily received (in approximately 93% of patients) 5-fluorouracil as the cytotoxic agent.

Results of the bivariate analysis comparing patients who initiated treatment with newer chemotherapy versus those who initiated treatment with other chemotherapy are given in **Table 2**. Race/ethnicity, sex, age, year of diagnosis, median household income, presence of comorbidities, marital status, surgery to the metastatic site, and radiation therapy were significantly associated with the receipt of newer chemotherapy agents ($P < .05$). Specifically, among patients initiating treatment with newer chemotherapy, there were higher proportions of white, male, and younger patients, as well as patients diagnosed in later years (2001 and 2002), patients in higher quintiles of median household income, patients with fewer comorbidities, and married patients, compared with patients not receiving irinotecan. With respect to clinical characteristics significantly associated with the receipt of newer chemotherapy agents, fewer patients who received radiation therapy or surgery to the metastatic site (within 4 months of diagnosis) received newer chemotherapeutic agents.

Results of the final model developed for the multivariable logistic regression analysis are given in **Table 3**. After simultaneously controlling for demographic and clinical variables significant at the bivariate level, African American race/ethnicity and older age remained significantly ($P < .05$) negatively associated with the receipt of newer chemotherapy agents in the logistic regression analysis. Specifically, African American patients were 35.9% less likely to initially receive newer chemotherapy than white patients (odds ratio, 0.641; 95% confidence interval, 0.453-0.907). Patients aged 71 to 75, 76 to 80, and older than 80 years were 29.2%, 47.3%, and 78.7%, respectively, less likely to initiate treatment with newer chemotherapy than patients aged 66 to 70 years ($P < .05$). Male patients remained significantly more likely to receive newer chemotherapy.

DISCUSSION

This study reveals important findings with regard to the receipt of general chemotherapy and specific chemotherapeutic agent use among a Medicare sample of older patients with stage IV CRC. Approximately 49% of the final patient sample received any chemotherapy. This estimate is not directly comparable to other SEER-Medicare data because of differences in staging, disease site (colon vs rectal), and period of study, but evidence nevertheless indicates that a substantial proportion of Medicare patients with CRC do not receive chemotherapy: studies^{23,40} of SEER-Medicare older patients with stage III CRC (among whom chemotherapy benefits are widely acknowledged) indicate that the receipt of chemotherapy ranges from only 54% to 70%.

Our study results also indicate that, among chemotherapy-receiving patients with stage IV CRC, African American patients and older patients were significantly less likely to initiate their chemotherapy with a newer agent such as irinotecan compared with white patients and younger patients. The direction of results is generally consistent with published studies^{1-3,5-8,23,25,40-43} that have evaluated racial/ethnic and age disparities among patients receiving treatment for locally advanced CRC.

Disparities in the receipt of chemotherapy among patients with stage IV CRC have not been as widely researched as disparities among patients with earlier stages of CRC. However, McKibbin et al⁴⁴ evaluated the receipt of irinotecan, oxaliplatin, or bevacizumab in patients with advanced CRC from 10 cancer centers and detected a significant association between younger age (<65 years) and increased receipt of newer chemotherapeutic agents. Furthermore, compared with patients younger than 65 years, the receipt of newer agents decreased among older patients (ie, >70 and >75 years).⁴⁴ In addition, the direction of racial/ethnic and age disparities observed in the present study was consistent with that in other observational studies^{32,33} addressing surgical management of patients with stage IV CRC.

The existence of racial/ethnic and age differences in the receipt of newer chemotherapeutic agents among patients receiving chemotherapy indicates a persisting disparity even after selection into chemotherapy treatment. Because irinotecan was likely perceived during the study period to be a new agent with improved benefits (but with a more toxic profile), disparities in its use during that time warrant consideration. Arguably, the observed disparities may have been due to justifiable clinical or patient preference-related reasons. Conversely, these disparities may have been the result of access issues (eg, African American patients or older patients may be less able to afford a newer medication such as irinotecan) or other unmeasured factors.

With regard to the racial/ethnic disparity observed, identifying factors driving the observed difference is challenging. There is evidence to suggest that African American patients are more likely to receive care from less trained primary care physicians who have fewer resources to offer patients.⁴⁵ It is unknown if this finding extends to medical oncologists providing cancer care. Baldwin et al⁴⁰ evaluated various patient, physician, hospital, and environmental characteristics in an attempt to identify why African American patients with stage III colon cancer were less likely to receive chemotherapy than white patients and found “no single or simple explanation.” Although African American patients and white patients were equally likely to see a medical oncologist, the authors noted that African American patients who saw a medical oncologist were less likely to receive chemo-

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Table 2. Bivariate Descriptive Analysis Comparing Patients Having Stage IV Colorectal Cancer Who Initiated Chemotherapy With Irinotecan Hydrochloride Versus Other Chemotherapy

Variable	No. (%)		Total (N = 2466)
	Irinotecan-Based Chemotherapy (n = 791)	All Other Chemotherapy (n = 1675)	
Age, y^a			
66-70	263 (33.2)	352 (21.0)	615 (24.9)
71-75	263 (33.2)	463 (27.6)	726 (29.4)
76-80	191 (24.1)	449 (26.8)	640 (26.0)
>80	74 (9.4)	411 (24.5)	485 (19.7)
Race/ethnicity^a			
White	694 (87.7)	1390 (83.0)	2084 (84.5)
African American	59 (7.5)	174 (10.4)	233 (9.4)
Other	38 (4.8)	111 (6.6)	149 (6.0)
Male sex^a	441 (55.8)	817 (48.8)	1258 (51.0)
Married^a	497 (62.8)	932 (55.6)	1429 (57.9)
Metropolitan vs rural	658 (83.2)	1404 (83.8)	2062 (83.6)
Year of diagnosis^a			
2000	218 (27.6)	583 (34.8)	801 (32.5)
2001	282 (35.7)	560 (33.4)	842 (34.1)
2002	291 (36.8)	532 (31.8)	823 (33.4)
Median household income quintile^a			
1, Low	122 (15.4)	372 (22.2)	494 (20.0)
2	153 (19.3)	341 (20.4)	494 (20.0)
3	167 (21.1)	328 (19.6)	495 (20.1)
4	171 (21.6)	324 (19.3)	495 (20.1)
5, High	178 (22.5)	310 (18.5)	488 (19.8)
Registry^a			
California	169 (21.4)	337 (20.1)	506 (20.5)
Connecticut	28 (3.5)	40 (2.4)	68 (2.8)
Detroit, Michigan	51 (6.4)	123 (7.3)	174 (7.1)
Hawaii	46 (5.8)	143 (8.5)	189 (7.7)
Iowa	14 (1.8)	34 (2.0)	48 (1.9)
New Mexico	56 (7.1)	144 (8.6)	200 (8.1)
Seattle, Washington	18 (2.3)	36 (2.1)	54 (2.2)
Utah	45 (5.7)	73 (4.4)	118 (4.8)
Kentucky	54 (6.8)	159 (9.5)	213 (8.6)
Atlanta and rural Georgia	17 (2.1)	23 (1.4)	40 (1.6)
Louisiana	63 (8.0)	101 (6.0)	164 (6.7)
New Jersey	230 (29.1)	462 (27.6)	692 (28.1)
No. of comorbidities^a			
0	566 (71.6)	1106 (66.0)	1672 (67.8)
1	153 (19.3)	378 (22.6)	531 (21.5)
>1	72 (9.1)	191 (11.4)	263 (10.7)
History of cancer	35 (4.4)	92 (5.5)	127 (5.2)
Colon site of cancer	604 (76.4)	1269 (75.8)	1873 (76.0)
Received			
Surgery to the colorectal area	564 (71.3)	1165 (69.6)	1729 (70.1)
Surgery to the metastatic site ^a	34 (4.3)	106 (6.3)	140 (5.7)
Radiation therapy ^a	56 (7.1)	240 (14.3)	296 (12.0)
Tumor size, mm			
≤45	279 (35.3)	545 (32.5)	824 (33.4)
>45	298 (37.7)	655 (39.1)	953 (38.6)
Unknown	214 (27.1)	475 (28.4)	689 (27.9)
No. of positive nodes			
0	128 (16.2)	263 (15.7)	391 (15.9)
1-3	191 (24.1)	434 (25.9)	625 (25.3)
≥4	256 (32.4)	518 (30.9)	774 (31.4)
None examined	216 (27.3)	460 (27.5)	676 (27.4)
Tumor grade			
Low	498 (63.0)	1022 (61.0)	1520 (61.6)
High	205 (25.9)	451 (26.9)	656 (26.6)
Unknown	88 (11.1)	202 (12.1)	290 (11.8)

^aSignificant χ^2 statistic ($P < .05$) was obtained when testing for differences in the distribution of the explanatory variable between who initiated chemotherapy with irinotecan versus other chemotherapy.

■ **Table 3.** Multivariable Logistic Regression Analysis Results for Receipt of Irinotecan Hydrochloride Within 2 Months of Chemotherapy Initiation Among Patients With Stage IV Colorectal Cancer

Variable	Adjusted Odds Ratio (95% Confidence Interval)
Age, y	
66-70	1 [Reference]
71-75	0.708 (0.563-0.891)
76-80	0.527 (0.413-0.673)
>80	0.213 (0.157-0.289)
Race/ethnicity	
White	1 [Reference]
African American	0.641 (0.453-0.907)
Other	0.694 (0.446-1.081)
Male sex	1.274 (1.056-1.537)
Married	1.081 (0.890-1.313)
Median household income quintile	
1, Low	1 [Reference]
2	1.221 (0.908-1.643)
3	1.334 (0.991-1.794)
4	1.294 (0.960-1.743)
5, High	1.348 (0.997-1.822)
Year of diagnosis	
2000	1 [Reference]
2001	1.415 (1.133-1.767)
2002	1.598 (1.279-1.996)
No. of comorbidities	
0	1 [Reference]
1	0.819 (0.655-1.025)
>1	0.732 (0.541-0.992)
Received	
Radiation therapy	0.392 (0.286-0.538)
Surgery to the metastatic site	0.539 (0.356-0.817)
Registry	
California	1 [Reference]
Connecticut	0.800 (0.546-1.173)
Detroit, Michigan	0.636 (0.433-0.936)
Hawaii	0.849 (0.413-1.744)
Iowa	0.628 (0.436-0.905)
New Mexico	0.824 (0.445-1.526)
Seattle, Washington	1.049 (0.687-1.603)
Utah	1.350 (0.687-2.654)
Kentucky	0.543 (0.377-0.783)
Atlanta and rural Georgia	1.183 (0.808-1.732)
Louisiana	0.952 (0.735-1.232)
New Jersey	1.357 (0.791-2.331)

therapy. In their analyses, although oncologist characteristics such as years in practice and volume of consultations influenced the receipt of chemotherapy, disparities persisted even after accounting for these characteristics (as well as patient characteristics such as age, sex, and comorbidities).⁴⁰ Almost half of the variation in the observed receipt of chemotherapy could not be accounted for. The authors suggest that other unmeasured factors such as supplemental insurance and affordability of care, as well as patient perceptions, may have a role in selection of patients into chemotherapy.⁴⁰ Similar conclusions have been drawn in other analyses of the receipt of chemotherapy among patients with rectal cancer.⁴⁶ It is unclear whether similar observations can be made with regard to disparities in specific types of chemotherapy selected among users, particularly patients with stage IV CRC.

The age disparity observed may be the result of a misconception that older patients are too frail to receive chemotherapy and should not be placed on a newer and more toxic regimen.⁴⁷ Evidence suggests that chemotherapy treatment recommendations in older patients can be influenced by physician characteristics such as age (with younger physicians being more likely to recommend chemotherapy) and whether he or she practiced in a teaching hospital.⁴⁸ Furthermore, older patients may have difficulty than their younger counterparts in accessing more intensive healthcare services. The age disparity warrants further study, particularly in older patients who are healthy enough to tolerate aggressive therapy, among whom data demonstrate derivation of clinical benefits similar to those of younger patients.⁴⁹ Like racial/ethnic disparities, age disparities are likely multifaceted and driven by patient, physician, and health system characteristics.

Male patients were more likely to initiate treatment with newer chemotherapy than female patients. Evidence indicates that women experience more adverse effects with chemotherapy than men, a factor that may have lessened the use of the more toxic therapy in women.⁵⁰ Our analysis also indicates that the receipt of newer chemotherapy was less likely to occur if the patient underwent surgery.

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This relationship was observed in unadjusted and adjusted analyses.

This study has some limitations. Although the analysis involved a large cohort of SEER-Medicare patients, the exclusion criteria resulted in a considerable loss of patients, particularly patients enrolled in health maintenance organizations. Therefore, the patients in this study may not be representative of all patients with stage IV CRC. Nevertheless, given that CRC is primarily a disease of older patients,²¹ the information obtained with regard to drug use in the selected group of Medicare patients with stage IV disease is important to learn more about how management of the disease in this group of Medicare enrollees is evolving.

In addition, as a result of relying on limited clinical information from SEER-Medicare data, certain variables were unavailable that may have contributed to variation in the receipt of newer chemotherapy. These include patient preferences, performance status, patient-level socioeconomic measures, and physician and hospital characteristics. Therefore, bias may exist as a result of unmeasured variables. It is difficult to state with certainty that the type of chemotherapy selected is the result of a real disparity or rather is the effect of an unobserved factor systematically distributed between racial/ethnic or age groups. Nevertheless, unobservable bias may be less pronounced between subgroups among patients who have been selected into chemotherapy. In other words, given selection into chemotherapy treatment, subgroups within chemotherapy-receiving patients are likely to be more homogeneous than broader groups of treated and untreated patients with CRC, among whom the receipt of any chemotherapy has been previously evaluated.¹⁻⁸

Despite these limitations, this study is important in providing information about a topic (disparities in the use of novel chemotherapies) and a stage of disease (stage IV CRC) that have not been widely researched through population-based studies. Furthermore, although the study focus is on the receipt of irinotecan, information with regard to racial/ethnic and age disparities in irinotecan use is likely to be relevant to the use of newer agents with similar profiles (improved clinical efficacy but higher toxic effects, as well as costs) marketed after irinotecan.

In conclusion, our results support the existence of racial/ethnic and age disparities in the use of irinotecan, an agent representative of a newer trend in chemotherapy treatment for patients with stage IV CRC. The results are consistent with the literature, namely, lower health services utilization in patients of African American race/ethnicity and in older patients. This utilization trend, coupled with the association of minority races/ethnicities with lower survival outcomes,^{51,52} provides further rationale for continuing to investigate the cause and extent of disparities in cancer-related health ser-

vices across all stages of CRC. Additional population-based research on disparities in the use of newer agents marketed after irinotecan (eg, oxaliplatin, bevacizumab) is recommended, particularly as advances in chemotherapy regimens are taking place that lead to the questions not only of “should chemotherapy be administered” but also of “what chemotherapy should be used given the decision to treat.” Medicare Demonstration Projects & Evaluation Reports provide an excellent example of how such investigations may be studied, as do large prospective observational studies such as the Cancer Care Outcomes Research & Surveillance Consortium.^{53,54}

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