

# Rural Disparities in Treatment-Related Financial Hardship and Adherence to Surveillance Colonoscopy in Diverse Colorectal Cancer Survivors



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## Abstract

**Background:** Cancer survivors increasingly report financial hardship as a consequence of the high cost of cancer care, yet the financial experience of rural cancer survivors remains largely unstudied. The purpose of this study was to investigate potential rural disparities in the likelihood of financial hardship and nonadherence to surveillance colonoscopy.

**Methods:** Individuals diagnosed with localized or regional colorectal cancer between 2004 and 2012 were ascertained by the population-based New Mexico Tumor Registry. Participants completed a mailed questionnaire or telephone survey about their colorectal cancer survivorship experience, including treatment-related financial hardship and receipt of surveillance colonoscopy. Multivariable logistic regression was used to estimate adjusted odds ratios (ORs) and 95% confidence intervals (CIs).

**Results:** Compared with urban colorectal cancer survivors ( $n = 168$ ), rural colorectal cancer survivors ( $n = 109$ ) were

slightly older; more likely to be married (65% vs. 59%) and have an annual income <\$30,000 (37% vs. 27%); and less likely to be employed (35% vs. 41%), have a college degree (28% vs. 38%), or a high level of health literacy (39% vs. 51%). Rural survivors were twice as likely as urban survivors to report treatment-related financial hardship (OR, 1.86; 95% CI, 1.06–3.28) and nonadherence to surveillance colonoscopy guidelines (OR, 2.28; 95% CI, 1.07–4.85). In addition, financial hardship was independently associated with nonadherence to surveillance colonoscopy (OR, 2.17; 95% CI, 1.01–4.85).

**Conclusions:** Substantial rural disparities in the likelihood of financial hardship and nonadherence to surveillance colonoscopy exist.

**Impact:** Treatment-related financial hardship among rural colorectal cancer survivors may negatively affect adherence to guideline-recommended follow-up care. *Cancer Epidemiol Biomarkers Prev*; 27(11); 1275–82. ©2018 AACR.

## Introduction

Treatment-related financial hardship is increasingly understood as a negative consequence of the high cost of cancer care. Colorectal cancer survivors may be at particularly high risk of financial hardship. In a population-based study of individuals receiving adjuvant chemotherapy for colorectal cancer, Shankaran and colleagues found that 38% of patients reported at least one financial hardship. That is approximately double the overall prevalence of financial hardship estimated from a national survey of cancer survivors reported by Yabroff and colleagues (1).

Rural cancer survivors may also be disproportionately burdened by treatment-related costs given their geographic isolation,

socioeconomic disparities, and limited access to care. In qualitative studies, financial hardship is a common theme among rural cancer survivors (2–5). In addition, Pisu and colleagues found that, among rural breast cancer survivors, out-of-pocket (OOP) costs represented approximately 10% of available income, with substantially higher OOP cost to income burdens observed for rural, low-income survivors (6).

Documenting the prevalence of and identifying risk factors for treatment-related financial hardship is important because of the potential negative clinical impacts among cancer survivors. Numerous studies have demonstrated associations between financial hardship and suboptimal treatment adherence, forgoing medical care, and increased mortality (7–19). Cancer survivors who report financial problems may be less likely to follow surveillance for recurrence and screening for second primary cancers (10, 20). The National Comprehensive Cancer Network (NCCN) guidelines recommend that colorectal cancer survivors undergo surveillance colonoscopy 1 year after diagnosis and every 3 to 5 years thereafter (21, 22). While individuals with lower incomes have been identified as being less likely to receive surveillance colonoscopy (23), the long-term relationship between financial hardship and nonadherence to surveillance colonoscopy is unknown. Understanding this relationship among rural colorectal cancer survivors is of particular public health importance given the recently observed 15.6% higher

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colorectal cancer mortality rate in rural versus metropolitan counties (24). The objective of this study was to investigate rural disparities in financial hardship and its association with nonadherence to surveillance colonoscopy among a population-based ethnically and geographically diverse sample of colorectal cancer survivors.

## Materials and Methods

### Study design and source of participants

We conducted a population-based, cross-sectional survey to assess colorectal cancer survivorship issues for cancer survivors in New Mexico. Participants were identified through the New Mexico Tumor Registry (NMTR), a member of the National Cancer Institute's (NCI) Surveillance Epidemiology and End Results (SEER) program of cancer registries. This study was conducted in accordance with the Belmont Report and all research was performed after approval by the Institutional Review Board of the University of New Mexico Health Sciences Center.

### Study population

Males and females ages 30 to 74 years diagnosed between 2004 and 2012 in New Mexico with localized or regional cancer of the colon or rectum were eligible for participation in this study. Individuals diagnosed with a heritable colon cancer syndrome, who did not live in the United States, were mentally incompetent, or incarcerated, and those who had died prior to the mailing of the surveys in early 2015 were excluded from this study. Exclusion criteria were ascertained through NMTR records and explained in the informed consent forms. Hispanic and rural cancer survivors were oversampled from NMTR with the goal of achieving approximately equal numbers of potentially eligible subjects. Rural–Urban Commuting Area (RUCA) codes were used to classify rural residence, based on the county of residence at the time of diagnosis (25).

### Survey procedures and measures

Potential study participants were mailed a self-administered questionnaire and a \$2 bill as an incentive to participate. The questionnaire aimed to comprehensively assess the experience of colorectal cancer survivors in New Mexico. For patients who had not returned the questionnaire, a reminder card was sent 2 weeks later and a member of the study staff attempted to call the participant 3 weeks following the initial mailing. Eligible participants who returned the completed questionnaires were sent an additional \$25 gift card. These sequential attempts at contact and financial incentives are based on evidence-based survey methods (26).

The primary outcomes in these analyses were cancer treatment-related financial hardship and nonadherence to NCCN guidelines for surveillance colonoscopy for colorectal cancer survivors (21, 22). The questionnaire used the same measures as the Medical Expenditure Panel Survey (MEPS) Experiences with Cancer Supplement to ascertain material financial hardship (27). Participants responding "yes" to any of the four material financial hardship questions (Have you, or has anyone in your family, had to borrow money or go into debt because of your cancer, its treatment, or the lasting effects of that treatment?; Did you or your family ever file for bankruptcy because of your cancer, its treatment, or the lasting effects of that treatment?; Have you or your family had to make any other kinds of financial sacrifices because of your cancer, its

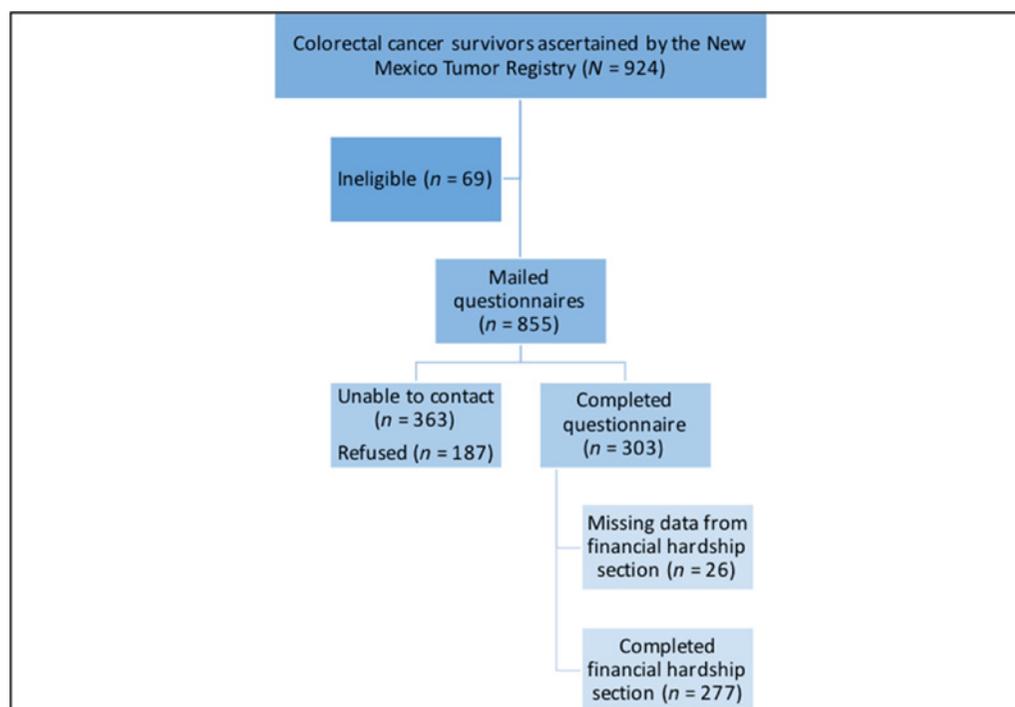
treatment, or the lasting effects of that treatment?; Please think about medical visits for cancer, its treatment, or the lasting effects of that treatment. Have you ever been unable to cover your share of the cost of those visits?) were classified as having experienced financial hardship. Nonadherence to the NCCN guidelines for surveillance colonoscopy was ascertained through a series of questions on whether a participant had received colonoscopies since their diagnosis and the dates of all colonoscopies. Estimated according to the time between the date of diagnosis and the date the questionnaire was completed, participants who had not received all recommended colonoscopies within the NCCN guidelines at 1, 3, 5, and 10 years after diagnosis (i.e., depending on their year of diagnosis) were classified as nonadherent.

Demographic data on race, ethnicity, primary language spoken, marital status, education, income, and employment status were self-reported based on participants' responses to the mailed questionnaire. Data on race, ethnicity, and primary language spoken was combined into a single variable to characterize participants as non-Hispanic white (NHW), English-speaking Hispanic, Spanish-speaking Hispanic, and individuals who self-identified as neither white nor Hispanic or did not report their race or ethnicity. Health literacy was assessed using a single validated measure described by Chew and colleagues that asked patients "How confident are you filling out forms yourself?" using a 5-item response scale (28, 29). Responses were then categorized into low (not at all/a little bit), medium (somewhat, quite a bit), and high (extremely) health literacy.

Additional demographic data on age, sex, and county of residence at the time of cancer diagnosis were ascertained from the NMTR records, as were clinical data on the date of diagnosis, tumor stage, and the first course of treatment. The date of diagnosis was subtracted from the date of the survey completion to obtain a variable for the time since diagnosis.

### Statistical analysis

Descriptive statistics were calculated for demographic and clinical characteristics as well as for the primary outcomes of financial hardship and nonadherence to surveillance colonoscopy. Differences in the demographic and clinical characteristics between rural and urban colorectal cancer survivors were compared using Student *t* tests for continuous variables and Pearson  $\chi^2$  tests for categorical variables. Statistical significance was assessed at the  $P < 0.05$  level. Logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the unadjusted association between sociodemographic and clinical characteristics of interest and financial burden and nonadherence to surveillance colonoscopy. To avoid collinearity of variables, the pairwise Spearman rank-correlation coefficients between sociodemographic factors were estimated. Demographic and clinical characteristics that were significant at the  $P < 0.2$  level in bivariate analysis and had a correlation of  $< 0.7$  were then entered into a multivariable model. The goodness of fit of the final multivariable models was assessed by testing the contribution and parameterization of each sociodemographic and clinical variable in the models using a likelihood ratio (LR) test. In addition, we assessed the extent to which the associations between rural residence and financial hardship varied based on our classification of the study population by ethnicity and language (NHW, English-speaking Hispanic, and Spanish-speaking Hispanic) by fitting a regression model with categorical interaction terms. The interaction model was compared with the model without



**Figure 1.**  
Study participation.

interaction terms using an LR test. All statistical analyses were conducted using STATA. SE Version 14.2.

## Results

We identified 924 men and women from the statewide NCI SEER NMTR, of which 855 were considered eligible for participation in this study. We were unable to contact 363 patients, and 187 contacted patients refused to participate. In addition, 26 individuals returned the survey but did not respond to the section on financial hardship and were thus excluded from this analysis. A total of 277 participants were available for this analysis, yielding a cooperation rate of 56% (calculated as the total number of participants divided by the number of individuals we were able to contact) and a response rate of 32% (calculated as the total number of participants divided by all eligible participants identified from the NMTR; Fig. 1). Compared with nonrespondents, individuals who completed the questionnaire were less likely to be classified in SEER as rural Hispanics (15% vs. 22%) and were more likely to be non-Hispanic urban residents at the time of diagnosis (34% vs. 24%).

Of the 277 colorectal cancer survivors in the study population, 40% ( $n = 109$ ) lived in rural areas at the time of their cancer diagnosis (Table 1). Compared with urban participants, rural colorectal cancer survivors were significantly older (mean age at diagnosis of 58 vs. 56,  $P = 0.019$ ). Although differences were not statistically significant, rural participants were more likely to be married (65% vs. 59%) and have an annual income  $< \$30,000$  (37% vs. 27%). In addition, rural colorectal cancer survivors were less likely to be employed (35% vs. 41%), have a college degree (28% vs. 38%), or have a high level of health

literacy (39% vs. 51%). Overall, 40% ( $n = 111$ ) of participants identified as Hispanic (24% primarily English-speaking and 16% primarily Spanish-speaking). The vast majority (96%) of participants reported having surgery as part of their primary treatment, while radiation and chemotherapy were reported by 23% and 43% of the study population, respectively. No differences in the primary colorectal cancer treatment received were observed between rural and urban participants.

### Treatment-related financial hardship

Treatment-related financial hardship was reported by 48% of rural participants and 41% of urban participants (Fig. 2). Twenty-six percent of rural participants and 22% of urban participants reported borrowing money or went into debt, with  $>50\%$  of those individuals borrowing or accumulating debt of  $\geq \$10,000$ . Four percent of rural participants and 3% of urban participants reported that they filed for bankruptcy; 25% of rural and 26% of urban participants were unable to cover the cost of medical visits; and 27% of both rural and urban participants made other financial sacrifices because of their cancer, its treatment, or the lasting effects of that treatment.

In the multivariable adjusted model, rural colorectal cancer survivors were nearly twice as likely (OR, 1.86; 95% CI, 1.06–3.28) as urban survivors to report treatment-related financial hardship (Table 2). In addition, age at diagnosis, health literacy, race/ethnicity, and marital status were all independently associated with financial hardship. We did not observe evidence of a statistically significant interaction between rural residence and race/ethnicity. For every 1-year increase in the age of colorectal cancer diagnosis, a 9% decrease in the likelihood of financial hardship (OR, 0.91; 95% CI, 0.88–0.95) was observed. Compared

**Table 1.** Demographic characteristics for a cohort of colorectal cancer survivors, *N* = 277

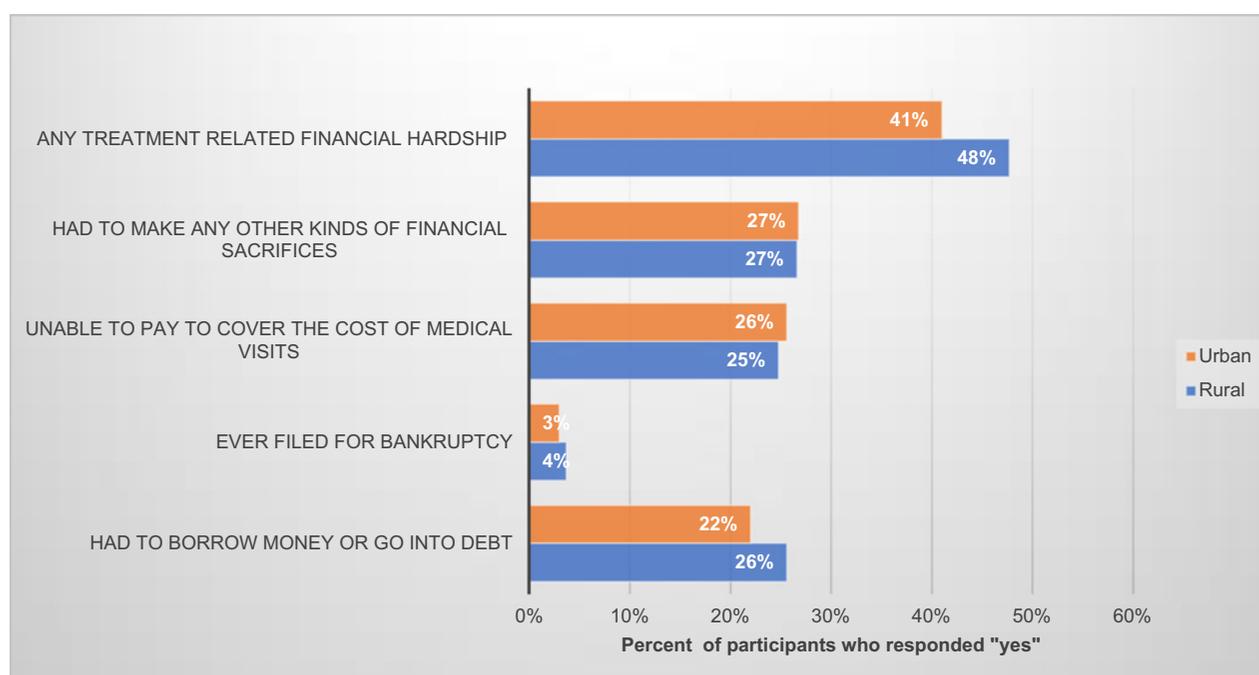
Characteristic	Rural ( <i>n</i> = 109) <i>n</i> (%)	Urban ( <i>n</i> = 168) <i>n</i> (%)	Total ( <i>N</i> = 277) <i>n</i> (%)	<i>P</i>
Age at diagnosis, years				
Mean (standard deviation)	58 (7)	56 (8)	57 (8)	0.019
≤50	16 (15%)	48 (29%)	64 (23%)	
51–64	75 (69%)	95 (57%)	170 (61%)	
≥65	18 (17%)	25 (15%)	43 (16%)	0.027
Sex				
Male	56 (51%)	91 (54%)	147 (53%)	
Female	53 (49%)	77 (46%)	130 (47%)	0.649
Race/ethnicity				
Non-Hispanic white	62 (57%)	87 (52%)	149 (54%)	
English-speaking Hispanic	24 (22%)	43 (26%)	67 (24%)	
Spanish-speaking Hispanic	16 (15%)	28 (17%)	44 (16%)	
Other	3 (3%)	7 (4%)	10 (4%)	
Missing	4 (4%)	3 (2%)	7 (3%)	0.758
Marital status				
Married	71 (65%)	99 (59%)	170 (61%)	
Divorced, separated, single	28 (26%)	54 (32%)	82 (30%)	
Widowed	9 (8%)	15 (9%)	24 (9%)	
Missing	1 (1%)	0 (0%)	1 (<1%)	0.502
Years from diagnosis				
Mean	6 (2)	6 (3)	6 (3)	0.255
1–5	56 (51%)	75 (45%)	131 (47%)	
≥6	53 (49%)	93 (55%)	146 (53%)	0.273
Highest level of education				
≤High school graduate or GED	34 (31%)	46 (27%)	80 (29%)	
Some college, vocational/technical/associates degree	44 (40%)	57 (34%)	101 (36%)	
≥College degree	31 (28%)	64 (38%)	95 (34%)	
Missing	0 (0%)	1 (1%)	1 (<1%)	0.808
Health literacy				
Low	8 (7%)	9 (5%)	17 (6%)	
Medium	57 (52%)	74 (44%)	131 (47%)	
High	43 (39%)	85 (51%)	128 (46%)	
Missing	1 (1%)	0 (0%)	1 (<1%)	0.207
Annual income				
<\$30,000	40 (37%)	45 (27%)	85 (31%)	
\$30,000–\$69,999	41 (38%)	66 (39%)	107 (39%)	
≥\$70,000	24 (22%)	47 (28%)	71 (26%)	
Missing	4 (4%)	10 (6%)	14 (5%)	0.220
Primary employment status				
Employed	38 (35%)	69 (41%)	107 (39%)	
Unemployed/unable to work	25 (23%)	30 (18%)	55 (20%)	
Retired	46 (42%)	69 (41%)	115 (42%)	0.463
Stage at diagnosis				
Localized	59 (54%)	87 (52%)	146 (53%)	
Regional	50 (46%)	81 (48%)	131 (47%)	0.703
Primary treatment				
Surgery	103 (95%)	159 (95%)	262 (96%)	0.683
Radiation	25 (23%)	39 (23%)	64 (23%)	0.926
Chemotherapy	48 (44%)	71 (42%)	119 (43%)	0.991

with survivors with high health literacy, those with low health literacy were 5.4 times as likely to report financial hardship (OR, 5.41; 95% CI, 1.45–20.1). Spanish-speaking Hispanic individuals were >3 times as likely to report financial burden as NHWs (OR, 3.09; 95% CI, 1.39–6.87), while no difference in the likelihood of financial burden was observed comparing English-speaking Hispanics with NHW. In addition, those who were divorced, separated, or single (OR, 1.94; 95% CI, 1.06–3.54) were nearly twice as likely to report financial burden as married participants.

**Nonadherence to surveillance colonoscopy**

Overall, 16% (*n* = 43) of participants were nonadherent to surveillance colonoscopy guidelines. Nonadherence was highest among participants who completed the survey ≥10 years after

diagnosis, whereas all 7 participants diagnosed between 1 and 2 years prior to the survey reported receiving at least one surveillance colonoscopy (Table 3). In the multivariable adjusted analysis, participants who reported treatment-related financial hardship were two times as likely to be nonadherent as participants who did not report financial hardship (OR, 2.17; 95% CI, 1.01–4.67; Table 4). Rural residents were also two times as likely to be nonadherent as urban residents (OR, 2.28; 95% CI, 1.07–4.85). Lower levels of education were significantly associated with nonadherence, with individuals reporting a high school education or less being >3.5 times as likely to be nonadherent (OR, 3.67; 95% CI, 1.30–10.3), and individuals with some college, vocational, technical, or associates degree being nearly 3 times as likely to be nonadherent (OR, 2.93; 95% CI, 1.04–8.22) than those with



**Figure 2.**

Prevalence of treatment-related financial hardship.

a college degree or higher. Finally, participants whose colorectal cancer was diagnosed at a regional stage were 50% less likely (OR, 0.48; 95% CI, 0.22–1.05) to be nonadherent than individuals with localized disease.

## Discussion

In this population-based survey of diverse colorectal cancer survivors, we identified substantial rural disparities in treatment-related financial hardship and adherence to surveillance colonoscopy guidelines. The prevalence of treatment-related financial hardship among both rural (48%) and urban (41%) participants

in our study was substantially higher than that reported previously. Shankaran and colleagues reported a prevalence of treatment-related financial hardship of 38% among population-based colorectal cancer survivors from the Seattle-Puget Sound SEER registry who received adjuvant chemotherapy (15). In a national study of cancer survivors by Yabroff and colleagues, using the same MEPS measures of financial hardship as we used in our study, approximately 20% of cancer survivors report treatment-related financial hardship (1).

The higher prevalence of treatment-related financial hardship in our population is likely due to the sociodemographic characteristics of the study population. Unlike the study by Shankaran and colleagues, which reflected the more affluent and primarily non-Hispanic white population of the Seattle-Puget Sound region (15), our New Mexican population was 40% Hispanic, 30% of the participants had a high school education or less, >50% were of medium or low health literacy, 31% had an annual income <\$30,000 and 20% of participants were unemployed or unable to work.

Given our unique study population, we were able to identify several disparities in financial hardship and adherence to surveillance colonoscopy that have not been reported previously, including a higher likelihood of treatment-related financial hardship

**Table 2.** Patient factors associated with treatment related financial hardship

Variable	Final multivariable model OR <sup>a</sup> (95% CI <sup>b</sup> )
County of residence	
Rural	<b>1.86 (1.06–3.28)</b>
Urban	1.00 (reference)
Age at diagnosis, years	<b>0.91 (0.88–0.95)</b>
Health literacy	
Low	<b>5.41 (1.45–20.1)</b>
Medium	1.27 (0.71–2.26)
High	1.00 (reference)
Race/ethnicity	
Non-Hispanic white	1.00 (reference)
English-speaking Hispanic	0.83 (0.42–1.64)
Spanish-speaking Hispanic	<b>3.09 (1.39–6.87)</b>
Other	0.31 (0.05–1.91)
Marital Status	
Married	1.00 (reference)
Divorced, separated, single	<b>1.94 (1.06–3.54)</b>
Widowed	1.01 (0.33–3.02)

NOTE: Bold terms are those that were found to be significant at the  $P < 0.05$  level.

<sup>a</sup>Odds ratio adjusted for all variables in the table.

<sup>b</sup>Confidence interval.

**Table 3.** Descriptive table of adherence to surveillance colonoscopy by time since cancer diagnosis

Time since diagnosis (years)	Adherent n (%)	Nonadherent n (%)
1–2	7 (100%)	0 (0%)
3–4	80 (85%)	14 (15%)
5–9	126 (86%)	20 (14%)
≥10	21 (70%)	9 (30%)

NOTE: Pearson  $\chi^2$  (3 degrees of freedom) = 6.4798,  $P = 0.090$ .

**Table 4.** Relationship between treatment-related financial hardship and nonadherence to surveillance colonoscopy recommendations

	<b>Final multivariable model OR<sup>a</sup> 95% CI<sup>b</sup></b>
Treatment-related financial hardship	<b>2.17 (1.01–4.67)</b>
County of residence	
Rural	<b>2.28 (1.07–4.85)</b>
Urban	
Highest level of education	
≤High school graduate or GED	<b>3.67 (1.30–10.3)</b>
Some college, vocational/technical/associates degree	<b>2.93 (1.04–8.22)</b>
≥College degree	
Stage at diagnosis	
Localized	
Regional	0.48 (0.22–1.05)

NOTE: Bold terms are those that were found to be significant at the  $P < 0.05$  level.

<sup>a</sup>Odds ratio adjusted for time since diagnosis and primary treatment regimen in addition to all variables in the table.

<sup>b</sup>Confidence interval.

among Spanish-speaking Hispanics and individuals with low health literacy, as well as a strong association between education and nonadherence to surveillance colonoscopy guidelines. Cancer patients with lower health literacy often report unmet information needs (30, 31). In our study, individuals with low health literacy were 5.4 times as likely to report financial hardship than individuals reporting high health literacy. This suggests that targeted efforts to reduce OOP costs among patients with low health literacy may be warranted. Our finding that Spanish-speaking Hispanics, but not English-speaking Hispanics, have a higher likelihood of financial burden than NHWs highlights the importance of investigating the often-overlooked heterogeneity of racial and ethnic groups and should be interpreted in the historical and political context of the Southwest. Our results are in line with previous studies showing that lower income and younger age are consistent risk factors for financial burden (6, 15, 32, 33).

Our finding that rural colorectal cancer survivors are approximately twice as likely to report treatment-related financial hardship and to be nonadherent to surveillance colonoscopy guidelines is of particular importance given emerging evidence from other studies that financial hardship is associated with higher mortality (18, 19). While this cross-sectional survey should not be used to infer causation, these results support the hypothesis that financial hardship leads cancer survivors to forgo needed medical care. Nonadherence to surveillance colonoscopy was relatively uncommon among participants in this study (16%), compared with previously reported estimates ranging between 20% and 49% within 5 years of diagnosis (34–36). This may be due to selection bias if individuals who did not respond to the survey were more likely to be nonadherent to surveillance colonoscopy, leading to a lower prevalence of nonadherence in our study sample. Moreover, our results suggest that adherence to surveillance colonoscopy declines over time. Yet we observed a strong association between financial burden and nonadherence, in addition to independent associations between rural residence and education and nonadherence, controlling for time since diagnosis. Our results are consistent with Kent and colleagues who found that cancer survivors were significantly more likely to report delaying (18.3% vs. 7.4%) or forgoing overall medical care (13.8% vs. 5.0%) than those without financial problems (10). In addition, Weaver and colleagues reported that Hispanic and

black cancer survivors were more likely to forego care than white survivors (16). It is highly plausible that rural cancer survivors, especially those who experience treatment-related financial burden, face substantial barriers in accessing recommended surveillance colonoscopy and that this lack of follow-up care contributes to observed rural disparities in colorectal cancer mortality (24).

The disparities in treatment-related financial hardship and adherence to surveillance colonoscopy identified in this study underscore the economic inequalities that may lead to widening socioeconomic disparities in stage-specific colorectal cancer mortality. Despite evidence that low-income, working-age colorectal cancer patients experience considerable financial hardship, there is an unmet need to understand the unique economic experience of this population. Most studies of financial burden are conducted in higher-income, insured populations (2). Moreover, the current paradigm of financial toxicity is often focused on the impact of high deductibles, copayments and coinsurance (11), and may not fully explain financial hardship among individuals experiencing financial instability prior to their cancer diagnosis. Current strategies to reduce financial hardship, including improving cost transparency, promoting patient-provider cost communication, and reducing OOP costs (7), are based primarily on the experience of higher-income, insured patients and may not be responsive to the needs of rural patients, those from racial and ethnic minority groups, or individuals of low socioeconomic position. Our results provide preliminary evidence quantifying the prevalence of financial hardship among a socioeconomically and geographically diverse, population-based sample of colorectal cancer survivors. Intervention research to mitigate treatment-related financial hardship, particularly among rural patients, underserved racial and ethnic minority groups, and individuals of low socioeconomic position, could focus on incorporating financial counseling and resources into patient navigation. In addition, continued efforts to improve the care transition for posttreatment cancer survivors and provide locally available colonoscopy surveillance may lessen the financial burden of rural cancer survivors.

The results of this study should be interpreted in the context of several important limitations. Despite using survey methods to maximize response (26), only 56% of eligible and available study subjects completed the questionnaire. Respondents were less likely to be Hispanic or from rural areas than nonrespondents which may have resulted in an underestimate of the overall prevalence of financial hardship. On the other hand, length-biased sampling, whereby individuals living the longest and thus having more time to accumulate financial burden were more likely to be sampled, may have resulted in an overestimate of financial burden. The study's cross-sectional design also presents important limitations including an inability to estimate the incidence of financial hardship or to infer causation from these results. We also did not elicit information about insurance at the time of cancer diagnosis, loss of employment, or inability to work because of colorectal cancer diagnosis or treatment. In this study, receipt of surveillance colonoscopy is ascertained by participant self-report, which should be validated in future work by confirmation in medical records or insurance claims. Finally, many of the factors investigated in this study are likely to be highly correlated with income prior to a cancer diagnosis. In our study, we did not ask about income at the time of diagnosis, and felt that controlling for income reported at the time of the questionnaire was not appropriate, as it may be a consequence of the outcome. Despite these limitations, the identification of disparities in

financial hardship has the potential to advance the study of financial burden, even if they cannot be separated from the impact of income and insurance. Modifying income and insurance require complex, potentially policy driven solutions. Even if income and insurance are the root causes of the disparities identified in this study, interventions such as financial counseling, patient navigation, and colonoscopy outreach may be most effective if targeted to the literacy and language needs of the populations with the greatest likelihood of experiencing financial hardship.

The results of this study provide novel evidence of rural disparities in financial hardship and adherence to surveillance colonoscopy. Future longitudinal studies are warranted to advance knowledge of these disparities and their potential relationship to the high rural colorectal cancer mortality rate. Moreover, these findings may be of particular relevance to the development of interventions to reduce treatment-related financial hardship.

### Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

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# BLOOD CANCER DISCOVERY

## Rural Disparities in Treatment-Related Financial Hardship and Adherence to Surveillance Colonoscopy in Diverse Colorectal Cancer Survivors

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