## RACIAL DISPARITIES AND TRENDS IN USE OF COLORECTAL PROCEDURES AMONG TENNESSEE ELDERLY (1996–2000)

**Background:** Blacks are more likely to be diagnosed at a later stage of colorectal cancer (CRC), and have poorer survival than Whites. Colorectal cancer (CRC) is usually curable when diagnosed at an early stage.

**Objectives:** We compare the use of CRC tests for screening between Whites and Blacks and compare the use of CRC tests for either screening or diagnosis and further check the test results for a diagnosis of CRC.

**Data:** The data we use are from physician claims files provided by the Centers for Medicare and Medicaid Services (CMS) (1996–2000) for a closed cohort of all Tennesseans eligible for Medicare in 1996, age  $\geq 6$ .

Results: Half as many Blacks as Whites were screened with fecal occult blood testing (FOBT), sigmoidoscopy, and colonoscopy. Significantly fewer Blacks had any colorectal procedures, sigmoidoscopy, colonoscopy, and/ or barium enema, for screening or diagnosis; however, the test results show that more Blacks were diagnosed with CRC than Whites. The use of CRC tests is low regardless of race. Only 24% of beneficiaries used at least one of the four procedures during the five years. During the five years, FOBT and barium enema use decreased significantly for both Blacks and Whites, while colonoscopy use increased significantly. Sigmoidoscopy use was highest in 1998, which corresponds to the change of Medicare coverage policy in 1998.

**Conclusions:** Removal of financial barriers to screening alone has failed to substantially improve the use of colorectal procedures. Lack of vigilance and lack of access to good quality of care contribute to the fact that Blacks are more likely to be diagnosed at a late stage of CRC than Whites. (*Ethn Dis.* 2006;16:412–420)

**Key Words:** Colorectal Cancer, Medicare, Racial Disparities

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## INTRODUCTION

Blacks are more likely to be diagnosed at a later stage of colorectal cancer (CRC)<sup>1,2</sup> and to have poorer survival than Whites.<sup>2,3</sup> Colorectal cancer (CRC) survival is closely related to the stage of cancer at diagnosis and is usually curable when diagnosed at an early stage. Studies have been done to try to find the reasons that are related to the late diagnosis, and factors such as patient's age, sex, race, insurance coverage, socioeconomic status, residence (urban/rural), and the use of CRC screening tests have been reported.<sup>4–14</sup>

Colorectal cancer (CRC) screening tests were not covered for Medicare beneficiaries until 1998. Before January 1, 1998, Medicare covered fecal occult blood testing (FOBT), sigmoidoscopy, colonoscopy, and double-contrast barium enema for diagnosis of CRC for people who have signs or symptoms. Effective January 1, 1998, Medicare added selected coverage for screening. Specifically, for beneficiaries aged 50 and older, Medicare paid for: 1) a screening FOBT every year; 2) a screening sigmoidoscopy every four years; and 3) a screening colonoscopy for high-risk individuals every two years. Medicare also permitted substitution of a double-contrast barium enema for the latter two tests as per physician judgment.<sup>15</sup> Effective July 1, 2001, Medicare started to cover screening colon-

Address correspondence and reprint requests to Bojuan B. Zhao, PhD; Meharry Medical College; Department of Surgery; 1005 DB Todd Blvd; Nashville, TN 37208; 615-327-5692; 615-327-5579 (fax); bzhao@ mmc.edu Specifically, for beneficiaries aged 50 and older, Medicare paid for: 1) a screening FOBT every year; 2) a screening sigmoidoscopy every four years; and 3) a screening colonoscopy for high-risk individuals every two years.

oscopy for normal- and low-risk individuals once every 10 years. As a result of the policy change, new Healthcare Common Procedure Coding System (HCPCS) codes have been established for these services.<sup>15</sup> Ko et al<sup>16</sup> investigated the effect of the policy change on the use of colorectal tests, and found that the insurance coverage for these tests did not substantially affect the utilization rates for Washington state Medicare beneficiaries in 1994, 1995, and 1998.

In this paper, to explore the reasons for more late diagnoses for Blacks than Whites, we not only compared the use of CRC tests for screening between Whites and Blacks, noting the difficulty in distinguishing screening and diagnosis procedures, but we also compared the use of CRC tests for either screening or diagnosis and further checked the test results for a diagnosis of CRC. Fewer tests but more diagnosed CRC for Blacks is consistent with late-stage diagnoses for Blacks. The data we used are from physician claims files provided by Centers for Medicare and Medicaid

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Services (CMS) (1996–2000) for a closed cohort that includes all Tennesseans who were eligible for Medicare in 1996 with an age  $\geq 65$ . Trends in utilization of CRC procedures over five years are also presented, and the results reflect the policy change in 1998 and also a shift in physicians' use of CRC detection procedures.

#### **METHODS**

# Study Population and Data Sources

All Tennessee residents  $\geq$ 65 years of age and eligible for Medicare in 1996 are included in the study cohort. The data are mainly from physician claims files provided by CMS (1996– 2000). Available information included patients' race, sex, county (rural/urban), zip code, birthday, death date, months of part B coverage, ICD-9-CM (International Classification of Diseases, Ninth and Tenth Revisions, Clinical Modification) codes, CPT-4 (Current Procedural Terminology) codes, and HCPCS codes.

Medicare has two parts: Part A (hospital insurance) and Part B (medical insurance). Medicare Part A covers inpatient, hospice, and some home health care. Most people do not have to pay for Part A as long as they or a spouse paid Medicare taxes while they were working. Medicare Part B covers doctors' services, outpatient hospital care, and some of the services that Part A does not cover. Medicare Part B covers services and supplies when they are medically necessary including some preventive services (eg, cancer screenings). Beneficiaries pay a monthly fee ( $\approx$ \$50 in 2000) for Part B coverage.

The 1996 baseline cohort consisted of 691,018 people. Sixty percent were female, and 40% were male; 89% were White, and 11% were Black; 39% resided in rural counties, and 61% resided in urban counties; 29% were 65–69 years old, 26% were 70–74, 20% were 75–79, and 26% were  $\geq$ 80. Part B coverage is considered to be a possible confounding factor in this paper. Among all Tennesseans who are eligible for Medicare,  $\approx$ 97% have Part B coverage. Among those who have Part B coverage,  $\approx$ 3% have only a few months of Part B coverage (not including those who died). Since we did not have Part B coverage data for everyone in 1996, it is excluded in the analysis for that year.

#### Codes for Identifying Colorectal Cancer Tests (Diagnostic and Screening)

Four colorectal procedures, FOBT, sigmoidoscopy, colonoscopy, and barium enema, were identified by the codes listed in HCPCS or CPT-4. Fecal occult blood testing (FOBT) was identified by CPT-4 codes 82270 and 82273 for diagnosis of bleeding and HCPCS code G0170 for screening; sigmoidoscopy was identified by CPT-4 codes 45300-45345 for diagnosis of tumor and HCPCS code G0104 for screening; colonoscopy was identified by CPT-4 codes 45355-45387 for diagnosis of tumor and HCPCS codes G0105 and G0121 for screening; barium enema was identified by CPT-4 codes 74270 and 74280 for diagnosis of tumor and HCPCS codes G0106, G0120, and G0122 for screening. Note that the codes used for identifying the procedures vary in different reports.<sup>4,5,17,18</sup> Some ICD-9-CM codes in form HCFA-1450 (UB-92) filed by institutional and other selected providers (outpatient files) are also included in the procedure identifications,<sup>4,17</sup> but these codes are not available in our data.

#### Codes for Identifying Diagnosed Colorectal Cancer

Codes for identifying CRC differ slightly among published papers.<sup>19–23</sup> We used ICD-9-CM codes 153.0– 154.8, which is based on the CRC definition from *Healthy People 2000*  and *Healthy People 2010.*<sup>24</sup> According to National Cancer Institute standards, CRC is defined by ICD-9 codes 153.0–154.1 and 159.0. The difference in definition is unlikely to affect interpretation of this study because some of the codes that are included by one definition and excluded by another are not used often.

In our data, to eliminate possible errors in coding, we regarded a patient as having newly diagnosed CRC in a year when ICD-9-CM codes 153.0– 154.8 appeared for the first time, so long as: 1) it was at least one year after the 1996 baseline; and 2) the code appeared at least twice within that year, unless the only time a diagnosis occurred was in the year the beneficiary died, in which case only one appearance was needed.

#### Outcomes of Interest

We have four outcomes of interest:

- 1. Racial disparities and trends in the use of each of the CRC procedures for screening or diagnosis:
- a. Fecal occult blood testing (FOBT) (screening or diagnosis of bleeding)
- b. Sigmoidoscopy (screening or diagnosis of tumor)
- c. Colonoscopy (screening or diagnosis of tumor)
- d. Barium enema (screening or diagnosis of tumor)
- 2. Racial disparities and trends in the use of any of the three major diagnostic procedures: sigmoidos-copy, colonoscopy, and/or barium enema.
- 3. Racial disparities and trends in rates of newly diagnosed CRC; rates of newly diagnosed CRC in each year are calculated among those who had at least one of the three major procedures, sigmoidoscopy, colonoscopy and/or barium enema and were diagnosed as having CRC but had no indication of CRC in baseline (1996) from the ICD-9-CM codes.

4. Racial disparities and trends in the use of screening procedures only (ie, excludes diagnostic codes).

## Statistical Analysis

Descriptive statistics, odds ratios, and 95% confidence intervals (CIs) are presented to assess associations between each of the outcomes and each of the following factors: age (65-74 years vs  $\geq$ 75 years in 1996), race (Black vs White), gender (female vs male), residence (urban vs rural), and part B coverage (whole vs partial year) in which a CRC procedure was used. Logistic regression was used to calculate adjusted odds ratios with 95% CIs after adjusting for confounding factors of age, sex, rural/urban residence, 12 months Part B coverage in the year the test was done, and their interactions. The Cochran-Armitage (CA) trend test was used to test the trends of percentages over time.

## RESULTS

### Racial Disparities and Trends in the Use of CRC Procedures for Screening or Diagnosis

#### Fecal Occult Blood Testing

Significantly fewer Blacks used FOBT each year than Whites (Table 1), and the percentages of FOBT use decreased significantly over the five years (1996–2000) for both Blacks and Whites (p<0.0001 from CA trend test, see Figure 1a). There were 8.0%, 7.4%, 6.7%, 6.7%, and 6.9% of Blacks, and 11.8%, 11.2%, 10.1%, 9.9%, and 9.6% of Whites who had either diagnosis or screening FOBT in 1996, 1997, 1998, 1999, and 2000, respectively. The numbers were 4897, 4348, 3556, 3296, and 3175 for Blacks, and 64,632, 58,792, 47,050, 44,081, and 45,081 for Whites, respectively.

Race, age, sex, rural/urban residence, and 12 months Part B coverage during the year of the FOBT test were significantly associated with using FOBT. Specifically, Blacks, males, rural county residents, those age  $\geq$ 75 years in 1996, or those who had <12 months Part B coverage during the year were less likely to use FOBT. The differences between urban and rural in using FOBT decreased over the five years. After adjusting for the confounding factors, the racial differences in using FOBT were still significant (see the crude and adjusted odds ratios and 95% CIs in the FOBT section in Table 1).

#### Sigmoidoscopy

Significantly fewer Blacks used sigmoidoscopy each year than Whites (Table 1), and the percentage using sigmoidoscopy was highest in 1998, which is consistent with the policy change in 1998 (see Figure 1b). There were 1.6%, 1.6%, 1.7%, 1.6%, and 1.5% of Blacks, and 2.3%, 2.2%, 2.4%, 2.3%, and 2.1% of Whites who had either diagnostic or screening sigmoidoscopy in year 1996, 1997, 1998, 1999, and 2000, respectively. The numbers were 986, 942, 893, 769, and 692 for Blacks, and 12,408, 11,482, 11,022, 10,166, and 8684 for Whites, respectively.

Race, age, sex, rural/urban residence, and 12 months Part B coverage during the year of sigmoidoscopy test were significantly associated with using sigmoidoscopy. Specifically, Blacks, those age  $\geq$ 75 years in 1996, females, rural residents, and those who did not have 12 months Part B coverage during the year were less likely to use sigmoidoscopy than their corresponding groups. After adjusting for confounding factors, racial differences in using sigmoidoscopy were still significant (see the crude and adjusted odds ratios in the sigmoidoscopy section in Table 1).

#### Colonoscopy

Significantly fewer Blacks used colonoscopy each year than Whites (Table 1), and the percentages of using colonoscopy increased significantly over the five years for both Blacks and Whites (P<.0001 from CA trend test, see Figure 1c). There were 4.7%, 5.1%, 5.7%, 5.7%, and 6.4% of Blacks and 5.2%, 5.3%, 6.0%, 6.3%, and 6.9% of Whites who had either diagnostic or screening colonoscopy in year 1996, 1997, 1998, 1999, and 2000, respectively. The numbers were 2878, 2972, 3004, 2821, and 2954 for Blacks and 28,099, 27,744, 27,804, 27,989, and 29,192 for Whites, respectively.

Race, age, sex, and 12 months Part B coverage were significantly associated with using colonoscopy. Specifically, Blacks, those age  $\geq$ 75 years in 1996, females, and those who did not have 12 months Part B coverage during that year were less likely to use colonoscopy than their corresponding groups. After adjusting for the confounding factors, the racial differences in using colonoscopy were still significant (see crude and adjusted odds ratios and 95% CIs shown in Table 1).

#### Barium Enema

Significantly more Blacks used barium enema each year than Whites (Table 1), which was opposite to racial differences in the use of FOBT, sigmoidoscopy, or colonoscopy, where Whites were more likely to use the tests, and the percentages of using barium enema decreased significantly over the five years for both Blacks and Whites (P<.0001 from CA trend test, see Figure 1d). There were 2.8%, 2.6%, 2.5%, 2.2%, and 2.0% of Blacks, and 2.2%, 2.0%, 1.9%, 1.7%, and 1.6% of Whites who used either diagnostic or screening barium enema in 1996, 1997, 1998, 1999, and 2000, respectively. The numbers were 1681, 1494, 1319, 1101, and 918 for Blacks, and 11,935, 10,386, 8896, 7729, and 6535 for Whites, respectively.

Significantly more females used barium enema than males each year. Age, residence, and presence of 12 months Part B coverage during the year of the barium enema test was done were not consistently associated with using barium enema. After adjusting for the confounding factors, the racial differences in using barium enema

FOBT         Black vs White       .65 (.6367)       .64 (.6266)       .64 (.6266)       .65 (.6367)       .70 (.6772)         Male vs female       .83 (.8285)       .83 (.8285)       .80 (.7882)       .81 (.7982)       .82 (.8083)         Urban vs rural       1.62 (1.60-1.65)       1.58 (1.55-1.61)       1.52 (1.49-1.55)       1.50 (1.47-1.53)       1.45 (1.42-1.48)         12 months Part B       NA       1.73 (1.48-2.02)       2.07 (1.64-2.62)       1.71 (1.34-2.20)       1.93 (1.44-2.58) $\geq 75$ vs <75 (1996)       .76 (.7477)       .71 (.6972)       .68 (.6770)       .65 (.6467)       .64 (.6267)         Black/White (adj)*       .59 (.5761)       .58 (.5660)       .58 (.5660)       .60 (.5762)       .64 (.6267)         Sigmoidoscopy       Black vs White       .71 (.6676)       .73 (.6978)       .71 (.6676)       .68 (.6373)       .73 (.6779)         Male vs female       1.08 (1.05-1.12)       1.08 (1.04-1.12)       1.06 (1.02-1.10)       1.09 (1.05-1.13)       1.13 (1.09-1.18)         Urban vs rural       1.50 (1.44-1.56)       1.48 (1.42-1.54)       1.40 (1.34-1.45)       1.41 (1.35-1.46)       1.45 (1.39-1.52)         12 months Part B       NA       1.40 (1.021.92)       1.73 (1.10-2.71)       1.61 (.97-2.69)	CI)
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12 months Part B NA 1.67 (1.40–2.01) 1.72 (1.36–2.16) 1.69 (1.30–2.19) 2.81 (1.97–4.00)	))
≥75 vs <75 (1996) .92 (.9093) .87 (.8589) .79 (.7881) .76 (.7477) .71 (.7073)	
Black/White (adj)* .93 (.91–.96) .92 (.89–.95) .92 (.89–.95) .92 (.89–.95) .90 (.87–.93)	
Newly diagnosed CRC	
Black vs White         1.22 (1.05–1.41)         1.31 (1.12–1.53)         1.35 (1.15–1.58)         1.25 (1.06–1.48)	5)
Male vs Female         1.35 (1.23–1.48)         1.29 (1.16–1.42)         1.30 (1.18–1.45)         1.20 (1.08–1.33)	;)
Urban vs rural.99 (.89–1.09)1.08 (.97–1.20)1.00 (.90–1.11).94 (.85–1.05)	
12 months Part B         .42 (.2279)         .75 (.24-2.39)         .59 (.19-1.90)         .95 (.13-6.93)	
≥75 vs <75 (1996) 1.67 (1.52–1.84) 1.50 (1.36–1.66) 1.58 (1.43–1.76) 1.76 (1.59–1.96)	j)
Black/White (adj)* 1.19 (1.03–1.38) 1.30 (1.11–1.52) 1.32 (1.12–1.55) 1.22 (1.03–1.44)	.)

Table 1. Crude and adjusted odds ratios for using FOBT, sigmoidoscopy, colonoscopy, barium enema, and at least one of the three procedures (sigmoidoscopy, colonoscopy, and/or barium enema)

\* After adjusting for age, sex, rural/urban residence, 12 months part B coverage in the year the test was done, and their interactions. FOBT=fecal occult blood testing.

remain significant (see the crude and adjusted odds ratios in the barium enema section in Table 1).

### At Least One of the Three Tests for Screening or Diagnosis

Fecal occult blood testing (FOBT) procedures can only be used for screening or diagnosis of bleeding. To detect a tumor, at least one of the three tests, colonoscopy, sigmoidoscopy, and/or barium enema, has to be used. Significantly fewer Blacks used at least one of the three tests than Whites each year (Table 1). The percentages of using at least one of the three tests

increased over the five years (P<.0001 from CA trend), and the increase in 1998 was highest (see Figure 1e). There were 7.8%, 7.8%, 8.5%, 8.2%, and 8.7% of Blacks, and 8.2%, 8.1%, 8.9%, 9.1%, and 9.3% of Whites who used at least one of the three procedures in 1996, 1997, 1998, 1999, and



Fig 1. Racial differences and trends in using screening and diagnostic colorectal procedures

2000, respectively. The numbers were 4723, 4538, 4477, 4021, and 3984 for Blacks, and 44,687, 42,521, 41,385, 40,233, and 39,462 for Whites, respectively.

Race, age, sex, rural/urban residence, and 12 months Part B coverage during the year of the CRC test(s) were significantly associated with using any of the three major diagnostic procedures. Blacks, those age  $\geq$ 75 years in 1996, females, rural residents, and beneficiaries without 12 months Part B coverage were less likely to use any of the three procedures than their corresponding groups. After adjusting for the confounding factors, the racial differences in using any of the three tests were still significant (see the crude and adjusted odds ratios in the "any of the three" section in Table 1).

#### Racial Disparity in Diagnosed Colorectal Cancer

Among those who had at least one of the three procedures (sigmoidoscopy, colonoscopy, and/or barium enema) but no diagnosis of CRC before the test, the test results show that significantly more Blacks were subsequently diagnosed with CRC than Whites (Figure 1f). The percentages of diagnosed CRC were 4.8%, 4.5%, 4.6%, and 4.3% for Blacks, and 4.0%, 3.4%, 3.5%, and 3.4% for Whites in 1997, 1998, 1999, and 2000, respectively. The numbers were 210, 188, 160, and 177 for Blacks, and 1622, 1343, 1314, and 1263 for Whites. Odds ratios and 95% CIs for 1997–2000 were 1.22 (1.05–1.41), 1.31 (1.12–1.53), 1.35 (1.15–1.58), and 1.25 (1.06–1.48), respectively.

Combining the results from the last section, we conclude that Blacks were less likely to use any of the three tests and they are more likely to be diagnosed with CRC once the tests were taken. People aged  $\geq$ 75 years in 1996 and males were more likely to be diagnosed with CRC than their corresponding groups (eg, aged  $\geq$ 75 vs aged <75, and males vs. females). After adjusting for the confounding factors, racial differences in the diagnosed CRC persisted.

# Racial Disparities and Trends in the Use of Screening Procedures

Medicare started to cover CRC screening in 1998, and new HCPCS codes have been established for screening services to distinguish the procedures used for diagnosis. The use of CRC screening test shows people's vigilance, which is important in detecting CRC at an earlier stage.

In using each of the screening tests, FOBT, sigmoidoscopy, and colonoscopy, each year from 1998 to 2000 only half as many Blacks as Whites used the tests, and the differences are statistically significant. The percentages for using screening FOBT were 2.6%, 3.0%, and 3.4% for Blacks, and 4.4%, 5.5%, and 6.0% for Whites (1355, 1495, and 1565 for Blacks and 20,601, 24,239, and 25,244 for Whites); the percentages in using screening sigmoidoscopy were .1%, .1%, and .2% for Blacks and .2%, .3%, and .3% for Whites (49, 72, and 78 for Blacks and 1049, 1341, and 1331 for Whites); the percentages in using screening colonoscopy were .08%, .09%, and .11% for Blacks and .16%, .19%, and .22% for Whites (40, 45, and 52 for Blacks, and 722, 862, and 933 for Whites). Since few people were billed for screening barium enema in Tennessee (5 out of 10,215 in 1998, 10 out of 8830 in



Fig 2. Racial differences and trends in using screening colorectal procedures

1999, and 9 out of 7453 in 2000), this procedure is not considered for racial comparison in this section. Over the three years, the percentages of using screening FOBT, screening sigmoidoscopy, and screening colonoscopy increased for both Blacks and Whites (see Figure 2).

Race, age, sex, and rural/urban residence were significantly associated with the use of screening FOBT and screening sigmoidoscopy. Older people  $(\geq 75$  years in 1996) were less likely to use any of the screening tests. Females were more likely to use FOBT, and males were more likely to use sigmoidoscopy. Sex was not significantly associated with using screening colonoscopy. People living in urban counties were more likely to use screening FOBT and screening sigmoidoscopy than those living in rural counties. However, the use of screening colonoscopy was not associated with residence. People with 12 months of Part B coverage were more likely to use screening FOBT, but 12 months Part B coverage was not significantly associated with screening sigmoidoscopy or colonoscopy.

Note the wide confidence intervals, like 2.08 (.29–14.8) for 12 months Part

Table 2. Crude and adjusted odds ratios (with 95% confidence intervals) for using screening FOBT, screening sigmoidoscopy, and screening colonoscopy

		1998 (N=517,769)	1999 (N=493,738)	2000 (N=468,458)
FOBT	Blacks vs Whites	.57 (.5460)	.54 (.51–.57)	.55 (.5358)
	Male vs female	.77 (.75–.79)	.75 (.73–.77)	.77 (.7579)
	Urban vs rural	1.88 (1.83-1.94)	1.69 (1.64–1.74)	1.49 (1.45–1.53)
	≥75 vs <75 (1996)	.65 (.63–.67)	.62 (.60–.64)	.60 (.5861)
	12 months Part B	1.54 (1.12-2.11)	1.67 (1.19-2.33)	2.00 (1.36-2.92)
	Blacks/Whites (adj)	.50 (.47–.53)	.49 (.4652)	.51 (.49–.54)
Sigmoidoscopy	Blacks vs Whites	.41 (.31–.55)	.48 (.38–.61)	.54 (.4368)
	Male vs female	1.31 (1.17-1.48)	1.31 (1.18–1.46)	1.38 (1.24–1.53)
	Urban vs rural	1.25 (1.11-1.42)	1.15 (1.03-1.28)	1.55 (1.38-1.74)
	≥75 vs <75 (1996)	.41 (.36–.47)	.37 (.3342)	.33 (.29–.38)
	12 months Part B	1.52 (.38-6.09)	1.58 (.39-6.32)	NA
	Blacks/Whites (adj)	.41 (.31–.55)	.50 (.39–.63)	.50 (.4064)
Colonoscopy	Blacks vs Whites	.49 (.35–.67)	.47 (.3563)	.51 (.39–.68)
	Male vs female	.94 (.81–1.09)	.96 (.84–1.10)	.94 (.82–1.07)
	Urban vs rural	1.05 (.91-1.22)	1.25 (1.09–1.43)	1.12 (.98-1.27)
	≥75 vs <75 (1996)	.55 (.4764)	.49 (.4357)	.45 (.39–.52)
	12 months Part B	2.08 (.29-14.8)	1.01 (.25-4.03)	NA
	Blacks/Whites (adj)	.48 (.35–.67)	.46 (.34–.63)	.52 (.3969)

B coverage, meaning that few people without 12 months Part B coverage used screening sigmoidoscopy or colonoscopy, and "NA" means that all people who had screening sigmoidoscopy or colonoscopy in 2000 had 12 months Part B coverage in the data. After adjusting for confounding factors, racial disparities in the use of screening FOBT, screening sigmoidoscopy, and screening colonoscopy remained (Table 2).

## DISCUSSION

The strength of the data is that they come from five years of billing files, which contain the use of the CRC procedures before and after the Medicare policy change in 1998. We analyzed the trend and checked the effect of the policy change in 1998 on the use of each of the CRC procedures.

The data have two limitations. First, we only have physician claim files and do not have the billing files for those that were hospitalized or for outpatients billed through hospitals. Therefore, the rates of using CRC procedures are probably a little lower than the actual values. Because of this limitation, the rates of the use of the CRC tests in this study are lower than those in Cooper's paper,<sup>4</sup> where both physician and hospital claims were used in nationwide data (1999). In the use of FOBT, the rates are only 9.9% for Whites and 6.7% for Blacks in 1999 from our data, while the rates are 16.52% for White men, 19.4% for White women, 10.11% for Black men, and 12.85% for Black women from Cooper's paper (national level). In the use of sigmoidoscopy, the rates are 2.3% for Whites and 1.6% for Blacks in this data, while the rates in the national level are 3.37% for White men, 2.28% for White women, 2.09% for Black men, and 2.19% for Black women. In the use of colonoscopy, our rates are 6.3% for Whites and 5.7% for Blacks, while the rates in the national level are 8.00% for White men, 6.95% for White women, 6.97% for Black men, and 6.85% for Black women. In the use of barium enema, the rates are 1.7% for Whites and 2.2% for Blacks, while rates at the national level are 1.68% for White men, 2.01% for White women, 2.09% for Black men, and 2.36% for Black women.

Secondly, though the study population is a closed cohort, we do not have many repeated observations at this stage because of the limited billing history (1998-2000) and the required frequencies of the tests. Medicare reimburses FOBT once a year, sigmoidoscopy once in four years, and colonoscopy once in 10 years for CRC screening, but the data we have are only for three years. Though annual FOBT is recommended, once someone used sigmoidoscopy, colonoscopy, or barium enema, there is no need for this person to undergo any colorectal tests for several years, and the recommended annual FOBT test does not need to be performed. Therefore, repeated use of FOBT tests were not included as part of our analysis.

Healthcare Common Procedure Coding System (HCPCS) codes for CRC screening became available in 1998. Less than 6% used screening FOBT; <.3% used screening sigmoidoscopy; <.2% used screening colonoscopy, and <.003% used barium enema. The corresponding rates on the national level are about 11% for FOBT, 2% for sigmoidoscopy, 4% for colonoscopy, and .6% for barium enema. Furthermore, in checking the ratios of percentage of screening to the percentage of diagnosis for each of CRC procedures, in our data the ratios are 1.2 for FOBT, .15 for sigmoidoscopy, .03 for colonoscopy, and .001 for barium enema, which are distinctly lower than the national level, where the ratios are two for FOBT, two for sigmoidoscopy, one for colonoscopy, and .6 for barium enema. Thus, we conclude that Tennessee physicians have been slow to 1)

begin screening or 2) differentiate between screening and diagnostic testing in their Medicare billing. Despite the low report incidence of screening tests in our data, we consider the racial comparisons in the use of screening CRC tests between Whites and Blacks to be valid. Only half as many of Blacks as Whites used screening FOBT, screening sigmoidoscopy, and screening colonoscopy. The difference between Blacks and Whites was significant (P<.0001) in each year alone from crude and adjusted odds ratios. Note that in Medicare data, we classify diagnosis and screening procedures by the billing codes, which include no indication of whether a FOBT was office based or home based, though research shows that an effective screening FOBT test should be home based.<sup>25</sup>

Taking into consideration the difficulty in distinguishing the screening and diagnosis procedures, we compared the use of CRC tests for either screening or diagnosis and further checked the test results (the diagnosed CRC) between Whites and Blacks. Compared to Whites, significantly fewer Blacks used at least one of the three major procedures (sigmoidoscopy, colonoscopy, or barium enema) for screening or diagnosis, yet the test results show that they had a significantly higher rate of diagnosed CRC. The fact that compared to Whites, Blacks are less likely to use the CRC procedures but are more likely to be diagnosed with CRC once a procedure is done, is consistent with the finding that fewer Blacks use CRC procedures for screening, and they are both consistent with the late stage of diagnosed CRC for Blacks.<sup>1,2</sup> That is, Blacks are less vigilant of their health. We are aware that a higher rate of diagnosed CRC does not necessarily translate to a later stage of diagnosis. Since we do not have the stages of CRC at diagnosis, we will link the tumor registry data with Medicare billing records and check if more Blacks were diagnosed at later stages of CRC.

Compared to Whites, significantly fewer Blacks used at least one of the three major procedures (sigmoidoscopy, colonoscopy, or barium enema) for screening or diagnosis, yet the test results show that they had a significantly higher rate of diagnosed CRC.

Barium enema as a substitution for sigmoidoscopy or colonoscopy is usually recommended by physicians when no gastrointestinal specialist is available and is an indicator of poor access to highquality care. While significantly fewer Blacks used FOBT, sigmoidoscopy, and colonoscopy compared with Whites, they had a significantly higher use of barium enema, and the differences persist after adjusting for age, sex, rural/urban residence, and 12 months Part B coverage. This finding is consistent with those by Cooper et al,4 McMahon et al,<sup>9</sup> and Richards et al,<sup>14</sup> which have detailed discussions on the use of CRC procedures.

Sex, residence (rural/urban), age (<75 years vs  $\geq$ 75 years), and with/ without 12 months Part B coverage are also related to the use of the CRC procedures. Females are more likely to use FOBT and barium enema; males are more likely to use sigmoidoscopy and colonoscopy. This difference may be caused by the fact that females are significantly more embarrassed and fearful about sigmoidoscopy and colonoscopy than males.<sup>26</sup> People living in urban areas are more likely to use FOBT and sigmoidoscopy. People who are <75 years are more likely to use FOBT, sigmoidoscopy, and colonoscopy. People who have 12 months Part B coverage are more likely to use FOBT, sigmoidoscopy, colonoscopy, and barium enema than those with only a few months part B coverage.

In addition to the above results, we investigated the trends of the use of CRC tests over the five years. The use of FOBT, sigmoidoscopy, and barium enema decreased over the five years, except sigmoidoscopy in 1998, but the use of colonoscopy increased. This finding is consistent with the insurance policy change in 1998 and the increasing acceptance of colonoscopy as safe, the most accurate procedure, and highly recommended by physicians.<sup>27,28</sup> The percentages of using at least one of the three tests for diagnosis or screening for tumor (sigmoidoscopy, colonoscopy, or barium enema) increased over the five years ( $P \le .0001$ ), and the increase in 1998 was highest, which reflects the policy change in 1998. The policy change is also reflected in the high use of sigmoidoscopy in 1998.

In general, the use of CRC tests is low regardless of race. Only 24% of beneficiaries used at least one of the four procedures (FOBT, sigmoidoscopy, colonoscopy, or barium enema) during the five years of observation. Considering the policy change as of 1/1/98, we note that the removal of financial barriers to screening failed to substantially improve the use of colorectal procedures. Further use of these data in combination with other variables for behavioral models<sup>29</sup> of preventive service utilization would facilitate the identification of additional barriers to colorectal screening procedures. The barriers may result from patients' fear of discomfort or pain, embarrassment concerning colorectal procedures, lack of awareness, and the belief that screening is not necessary when no symptoms are present.<sup>30–33</sup> Primary care physicians may be failing to endorse screenings or communication between patients and physicians may be lacking.33-35 The identification of specific barriers among

elderly beneficiaries in Tennessee would allow for public health programs and policies to target these barriers.

#### ACKNOWLEDGMENTS

We thank Jared D. Elzey of Meharry Medical College for manuscript preparation. This research was funded by the Agency for Healthcare Research and Quality (AHRQ) 1R24 HS11640.

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