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RESEARCH ARTICLE

Primary Care Physicians and Disparities in Colorectal Cancer Screening in the Elderly

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Objective. To examine whether having a primary care physician (PCP) is associated with reduced ethnic disparities for colorectal cancer (CRC) screening and whether clustering of minorities within PCPs contributes to the disparities.

Data Sources/Study Setting. Retrospective cohort study of Medicare beneficiaries age 66–75 in 2009 in Texas.

Study Design. The percentage of beneficiaries up to date in CRC screening in 2009 was stratified by race/ethnicity. Multilevel models were used to study the effect of having a PCP and PCP characteristics on the racial and ethnic disparities on CRC screening.

Data Collection/Extraction Methods. Medicare data from 2000 to 2009 were used to assess prior CRC screening.

Principal Findings. Odds of undergoing CRC screening were more than twice as high in patients with a PCP (OR = 2.05, 95 percent CI 2.03–2.07). After accounting for clustering and PCP characteristics, the black–white disparity in CRC screening rates almost disappears and the Hispanic–white disparity decreases substantially.

Conclusions. Ethnic disparities in CRC screening in the elderly are mostly explained by decreased access to PCPs and by clustering of minorities within PCPs less likely to screen any of their patients.

Key Words. Colorectal cancer, screening, primary care physician, disparities, Medicare

Colorectal cancer (CRC) is the third most common cancer diagnosis and second leading cause of cancer deaths in both men and women in the United States, with approximately 142,500 new cases and 51,000 deaths annually (American Cancer Society 2010; Jemal et al. 2010). Black patients tend to present at a more advanced stage and experience approximately 20 percent greater mortality compared with white patients (Soneji et al. 2010). Although

incidence and mortality rates are lower among Hispanics, CRC in Hispanics is diagnosed at a more advanced stage with poorer survival compared with non-Hispanic whites (Jemal et al. 2004; National Cancer Institute 2008).

Screening, most commonly with colonoscopy, has reduced both the incidence and mortality of CRC (Whitlock et al. 2008). Although screening rates are improving, only about 60 percent of eligible people (>50 years of age) are current on CRC screening (Richardson, Rim, and Plescia 2008; U.S. Preventive Services Task Force 2008). Further, blacks and Hispanics have lower rates of screening than do non-Hispanic whites. These racial disparities persist among those with health insurance coverage for screening colonoscopy (Meissner et al. 2006; Shih, Zhao, and Elting 2006; Fenton et al. 2008; Richardson, Rim, and Plescia 2008; Doubeni et al. 2010a, b), as in the case in people aged 65 and older.

Having a primary care physician (PCP) has been shown to be associated with receipt of cancer screening in general (Pham et al. 2005; O'Malley and Forrest 2006) and CRC screening in particular (O'Malley et al. 2005; Pham et al. 2005; Lloyd et al. 2007; Sewitch et al. 2007; Zarychanski et al. 2007; Doubeni et al. 2010a, b). Among physicians, screening rates for CRC were higher among PCPs practicing family medicine, those who were board certified, and those trained in the United States (Pham et al. 2005). However, data are lacking on the effect of PCP characteristics on racial disparities in CRC screening.

The goal was to determine racial disparities in CRC screening rates among the Medicare population in Texas aged 66–75 years. Specifically the study sought to (1) assess whether having a PCP was associated with higher screening rates for CRC; (2) determine whether having a PCP was associated with reduced racial/ethnic disparities in CRC screening; and (3) assess PCP characteristics associated with CRC screening rates. In particular, we were interested in whether any ethnic disparities in CRC screening were the result of minority patients being clustered within PCPs whose

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patients were less likely to receive screening, regardless of their race. Texas is a multiethnic state with no ethnic majority, and the 100 percent Medicare data used for the study allowed for a sufficient sample size clustered within each PCP.

METHODS

Source of Data

Claims from the years 2000 to 2009 for 100 percent of Texas Medicare beneficiaries were used, including Medicare beneficiary summary files, Medicare Provider Analysis and Review (MedPAR) files, Outpatient Standard Analytical Files (OutSAF), and Medicare Carrier files. Provider information was obtained from the American Medical Association (AMA) physician Masterfile. Year 2009 population estimates at zip code level were from "The Primary Care Service Area Project" by the Dartmouth Institute for Health Policy and Clinical Practice (http://pcsa.dartmouth.edu/pcsa_data.php).

Establishment of the Study Cohort

We used two cohorts of patients in this study. The first cohort included patients aged 66–75 in 2009, and the second cohort included patients aged 74 or 75 in 2009. The second cohort allowed us to do a full 10-year look back for colonoscopies in 2000–2009. For the first cohort, Medicare beneficiaries aged between 66 and 75 residing in Texas in 2009 were selected (n = 1,251,552). We excluded beneficiaries who were enrolled in health maintenance organizations (HMOs); did not have continuous Medicare Parts A and B coverage or died during 2000–2009 (n = 542,057); those at high risk for CRC (n = 33,517); those whose racial/ethnic code was not black, white, or Hispanic (n = 14,104); and those whose residential zip code information was not available from the 2009 population estimates (n = 1,566), leaving 660,308 beneficiaries in the study. Risk of colon cancer was estimated using ICD-9-CM codes obtained from claims in the first year of the study period. Beneficiaries with Crohn's disease (555), ulcerative colitis (556), noninfectious gastroenteritis and colitis (558.2, 558.9), personal history of colorectal cancer (V10.05) or rectal cancer (V10.06), or family history of gastrointestinal cancer (V16.0) were classified as high risk. The second cohort included those members of the first cohort who were age 74 or 75 in 2009.

Measures

We categorized beneficiaries by age, gender, and race/ethnicity using Medicare Part D beneficiary summary files. We used the Medicaid indicator in 2009 as a proxy of low socioeconomic status. To obtain information on neighborhood income and ethnic composition, data were linked to the 2009 population estimates based on zip code of residence. A comorbidity index was generated using the claims in the first year of the study period (Elixhauser et al. 1998).

We identified outpatient visits using American Medical Association-Current Procedural Terminology (CPT) evaluation and management (E&M) codes 99,201–99,205 (new patient encounters) and 99,211–99,215 (established patient encounters). Individual providers were differentiated by using their National Provider Identifier (NPI). Physician specialty was based on Part B claims in the Medicare Carrier files. Those with multiple specialty codes were assigned the specialty that appeared most often in their claims. A PCP was defined according to the algorithm of Shah et al. (2007), as a generalist physician (general practitioner, family physician, internist, or geriatrician) who saw the beneficiary on two or more occasions in an outpatient setting in 2008 (Shah et al. 2007).

Using this definition, 54.1 percent of patients had at least one identifiable PCP. In other analyses, we used a less stringent definition for PCP: a generalist physician who saw the patient on at least one occasion in an outpatient setting and who provided >50 percent of all visits to generalist physicians during the year. With this definition, 64.8 percent of patients had an identifiable PCP.

A third method to identify patients with a PCP was to identify those with a PCP in 2008, using the first method described above, and to further require that the same PCP had seen the patient in at least 4 years during the period 2000–2007.

Using the first definition, a patient could have more than one identified PCP. In analyses of the effect of PCP characteristics on the likelihood of having CRC testing, analyses were limited to beneficiaries with only one identified PCP, who could be linked to AMA files, were studied (264,066 beneficiaries and 8,637 PCPs). With the second definition, 413,439 beneficiaries and 11,448 PCPs were included. We categorized PCPs by age, years in practice, gender, and U.S.- versus foreign-trained using AMA files. For each PCP, the percentage of total Medicare patients in 2008 classified as white race was calculated based on E&M codes in the 2008 Carrier and Beneficiary

summary files and was categorized into quartiles based on the distribution at the PCP level.

Study Outcomes

The U.S. Preventive Services Task Force (2008) recommends yearly fecal occult blood test (FOBT), flexible sigmoidoscopy or double contrast barium enema (DCBE) every 5 years, or colonoscopy every 10 years for the early detection of CRC, beginning at age 50. Due to the various lengths of the study period depending on the beneficiary age, for the first cohort, the study outcome for those aged between 66 and 68 was having any FOBT in 2009, or any DCBE, sigmoidoscopy, or colonoscopy in the complete study period. For those aged 69 and above, the study outcome was having any FOBT in 2009, any DCBE or sigmoidoscopy in 2005–2009, or colonoscopy in the complete study period. The second cohort was a subset of the first cohort, consisting of those aged 74 or 75 in 2009 and for whom we had complete 10-year data on receipt of colonoscopy. We included all procedures, whether their indication was for screening or for evaluation of a specific problem. We did this because any of those tests should be an adequate screen for CRC regardless of the indication.

Statistical Analyses

The CRC test rates in 2009 were calculated, then stratified by race/ethnicity, other beneficiary characteristics, and whether the beneficiary had any PCP in 2008. Chi-square test was used to examine differences in CRC test rates by beneficiary characteristics. The Cochran–Armitage trend test was used to examine the trend of CRC test rates by income and ethnic composition. The racial disparities in CRC testing among beneficiaries with or without any PCP were estimated using logistic regression models. These models were stratified by whether the beneficiary had any PCP in 2008 with adjustment for beneficiary age, gender, comorbidity, zip code income, and ethnic composition.

For those beneficiaries with one identified PCP, CRC test rates were compared by PCP characteristics. Chi-square test was used to examine the difference in CRC test rates across levels of PCP characteristics. The Cochran–Armitage trend test was used to examine the trend in CRC test rates by racial composition of PCPs' patients. To examine how PCP characteristics impact the likelihood of having CRC testing, hierarchical generalized linear models

were used. These models accounted for the clustering of beneficiaries within PCPs. Race/ethnicity, other beneficiary characteristics, and PCP characteristics were entered into the models to estimate the extent to which they mediated racial disparity in CRC testing. All analyses were performed with *SAS* version 9.2 (*SAS* Inc., Cary, NC, USA).

RESULTS

A patient was considered up to date in CRC screening at the end of 2009 if he or she had undergone a FOBT in 2009, sigmoidoscopy examination or DCBE in 2005–2009, or colonoscopy examination in 2000–2009. Because the analyses were based on 2000–2009 Medicare data, true up-to-date rates were underestimated for those aged 66–73 in 2009, because the data on CRC screening only start at age 65. Thus, these results are presented not to estimate true up-to-date rates for CRC screening for the population but to assess the relative up-to-date rates for CRC screening based on race and PCP characteristics. In addition, we repeated the analyses in a cohort aged 74 or 75 in 2009, for whom there were 10 years of data on CRC screening.

In 2009, the overall percentage of 660,308 Medicare enrollees aged 66 through 75 who were up to date on CRC screening was 48.5 percent. Of these, 90.0 percent were screened with colonoscopy, 21.1 percent had FOBT, 3.8 percent had sigmoidoscopy, and 2.7 percent underwent DCBE. For those age 74 or 75 in 2009 and thus with 10 years of data, the up-to-date rate was 62.1 percent.

Table 1 presents the CRC screening rates stratified by race/ethnicity, age, sex, comorbidity, Medicaid eligibility, zip code ethnic composition and income, and having a PCP. The CRC screening rates were 51, 43, and 38 percent among whites, blacks, and Hispanics, respectively.

Among whites, screening rates were higher with a higher neighborhood income (Table 1). Among blacks and Hispanics, the association with income was weaker. Neighborhood ethnic composition had varying associations with screening rates. There was no clear association between the percentage of black patients in the zip code with screening rates for any ethnicity. Higher Hispanic density was associated with somewhat lower screening rates among all three ethnic groups. Patients with any identified PCP had higher screening rates than those without a PCP (57.9 percent vs 37.3 percent; $p < .001$). This effect of having any PCP on CRC screening rates was similar for whites, blacks, and Hispanics. Having any PCP was associated with a reduction in the

Table 1: Association of Characteristics of Texas Medicare Enrollees with Colorectal Cancer Screening Rates*

		Total		Non-Hispanic White		Black		Hispanic	
		N	Test Rate (%)	*N*	Test Rate (%)	*N*	Test Rate (%)	*N*	Test Rate (%)
Overall		660,308	48.5	511,322	51.1	47,173	43.3	101,813	37.8
Age†	66–67	167,501	30.2	126,951	31.6	13,314	27.8	27,236	24.4
	68–69	144,636	45.5	111,689	47.8	10,595	42.4	22,352	35.5
	70–71	136,510	54.8	106,594	57.5	9,311	50.3	20,605	42.6
	72–73	117,382	60.1	91,995	63.0	7,905	54.7	17,482	46.9
	74–75	94,279	62.1	74,093	65.3	6,048	53.8	14,138	48.7
Gender†	Male	302,091	45.2	234,279	48.5	20,357	37.1	47,455	32.4
	Female	358,217	51.3	277,043	53.3	26,816	48.1	54,358	42.4
Comorbidity†	No	330,879	43.3	263,984	46.9	18,703	32.1	48,192	28.4
	Yes	329,429	53.7	247,338	55.6	28,470	50.8	53,621	46.2
Medicaid eligibility†	No	587,378	49.7	487,350	51.8	35,986	44.4	64,042	37.1
	Yes	72,930	38.4	23,972	37.1	11,187	40.0	37,771	38.8
Percent black in zip code population	Q1	165,178	46.1	114,035	49.9	932	39.9	50,211	37.7
	Q2	166,142	50.2	141,106	52.1	3,835	43.3	21,201	39.1
	Q3	167,997	49.8	141,985	51.8	8,606	41.5	17,406	38.4
	Q4	160,991	47.7	114,196	50.2	33,800	43.9	12,995	35.0
Percent Hispanic in zip code population‡	Q1	165,381	52.0	153,080	52.6	9,035	44.8	3,266	43.5
	Q2	165,725	50.8	147,404	51.9	10,727	43.8	7,594	39.1
	Q3	163,492	48.1	129,481	50.1	16,951	42.9	17,060	37.4
	Q4	165,710	43.0	81,357	48.2	10,460	42.4	73,893	37.5
Median income in zip code§	Q1	163,907	43.0	86,852	46.7	20,809	43.0	56,246	37.2
	Q2	166,490	47.5	133,446	49.6	12,204	43.7	20,840	36.4
	Q3	164,920	49.8	143,122	51.3	8,051	42.0	13,747	38.8
	Q4	164,991	53.6	147,902	54.8	6,109	45.6	10,980	42.1
PCP in 2008†,¶	None	303,019	37.3	232,520	40.5	22,272	29.9	48,227	25.7
	Any	357,289	57.9	278,802	60.0	24,901	55.3	53,586	48.6

*CRC test rate is based on the data during 2000–2009. Note that beneficiaries aged <74 have incomplete data.
†There is a significant difference in CRC test rates between levels of the beneficiary characteristics (chi-square test, $p < .001$).
‡There is a trend of decreasing CRC test rate with increasing Hispanic population in the zip code (Cochran–Armitage trend test, $p < .001$).
§There is a trend of increasing CRC test rate with increasing income (Cochran–Armitage trend test, $p < .001$ for whites and Hispanics, $p = .018$ for blacks).
¶A PCP is a generalist who was visited at least twice in 2008.

absolute differences in black and white rates (10.6 percent to 4.7 percent) and Hispanic and white rates (14.8 percent to 11.4 percent) for CRC screening. We repeated the analyses of having any PCP on disparity in CRC screening and restricted it to the cohort of subjects who were 74 or 75 in 2009 and for whom there were 10 years of data on CRC screening. The pattern of results was similar (the absolute difference in black and white was reduced from 15.0 percent to 6.9 percent, and the difference in Hispanic and white was reduced from 18.8 percent to 14.8 percent.)

There were no major differences in mode of CRC screening by ethnicity. For example, 4.4 percent of whites, 4.3 percent of blacks, and 4.2 percent of Hispanic were up to date on CRC screening on the basis of FOBT screening.

In a multivariable analysis including age, gender, comorbidity, zip code income, and neighborhood ethnic composition, having a PCP increased the odds of CRC screening by twofold (odds ratio [OR] 2.05; 95 percent confidence interval [CI]: 2.03–2.07). In this analysis, there was a significant interaction ($p < .001$) between having a PCP and patient ethnicity. This is shown in Table 2, in which patients are stratified by whether they have a PCP.

We present analyses for the entire cohort and also for those aged 74–75, for whom there were complete 10 years of data on screening. For the entire cohort, the odds of being up to date in CRC screening for blacks versus whites was 0.65 (95 percent CI 0.63, 0.67) in patients without a PCP and 0.89 (95 percent CI 0.86, 0.91) in those with a PCP. For the patients aged 74–75 with 10 years of data, the odds of blacks versus whites receiving screening were 0.55 in those without a PCP, rising to 0.73 in those with a PCP. The effect of having a PCP was less but still significant in reducing Hispanic–white disparities in CRC screening for both cohorts.

We repeated the analyses in Table 2 using a less stringent definition of having a PCP (see Methods). This definition identified 64.8 percent of patients as having a PCP as opposed to 54.1 percent of the patients by the definition used in Table 2. Nevertheless, the pattern of results was very similar. For example, the black versus white odds of receiving CRC screening were 0.66 (0.64, 0.69) in those without a PCP and 0.88 (0.85, 0.90) in those with a PCP.

Table 3 shows the rates of CRC screening stratified by PCP characteristics, for patients with an identified PCP. Screening rates were higher if the PCP specialty was Internal Medicine or Geriatrics, and if the PCP graduated from a U.S. medical school. Patients with PCPs who were age 65 or older or who were

Table 2: The Association of Having a Primary Care Physician* on Black versus White and Hispanic versus White Odds of Being Up to Date in Colorectal Cancer Screening†

	Entire Cohort Aged 66–75		*Cohort Aged 74–75*	
Comparison	*Any PCP (n = 357,289)*	*No PCP (n = 303,019)*	*Any PCP (n = 54,674)*	*No PCP (n = 39,605)*
Black versus white	0.89 (0.86, 0.91)	0.65 (0.63, 0.67)	0.73 (0.67, 0.79)	0.55 (0.50, 0.59)
Hispanic versus white	0.70 (0.68, 0.71)	0.58 (0.56, 0.59)	0.57 (0.54, 0.61)	0.51 (0.48, 0.55)

*A PCP is a generalist who was visited at least twice in 2008.
†All models were adjusted with beneficiary age, gender, comorbidity,% black,% Hispanic, and median income of the zip code.

trained more than 40 years ago had somewhat lower rates of CRC screening. There was also a relationship between CRC screening rates and the ethnic composition of the PCP's panel of patients. PCPs with a higher percentage of white patients in their panels were more likely to have patients who were up to date in CRC screening, regardless of the patient's ethnicity (Table 3).

Table 4 presents the results of multilevel analyses examining the effect of patient and PCP characteristics on CRC screening, using two different methods to determine whether a patient had a PCP. In the null model, 9.0 percent of the variation in CRC screening was at the level of the PCP (intraclass correlation coefficient of 0.090). In the adjusted model, PCP gender, years in practice, and specialty were significantly associated with receipt of CRC screening, as were whether the PCP went to a U.S. medical school and the ethnic makeup of the PCP's patients. We repeated this analysis using a less stringent definition of PCP (see Methods) and obtained almost identical results.

In the adjusted model in Table 4, the odds of CRC screening for blacks versus whites or Hispanics versus whites are higher than those shown in Table 2 for patients with PCPs. After accounting for clustering of patients within PCPs, and also for PCP characteristics, the black–white disparity in CRC screening rates almost disappears (OR = 0.96 in Table 4 vs. OR = 0.89 in Table 2), whereas the Hispanic–white disparity is reduced after adjusting for clustering and with PCP characteristics in the model (OR = 0.79 in Table 4 vs. OR = 0.70 in Table 2). These differences between the results of Table 4 versus Table 2 imply that part of the ethnic disparity is secondary to clustering of minority patients within PCPs who are less likely to perform CRC screening in any of their patients.

Table 3: Effect of Primary Care Physician* Characteristics on Colorectal Cancer Test Rates

	Total		*Non-Hispanic White*		*Black*		*Hispanic*	
	N	*Rate (%)*	*N*	*Rate (%)*	*N*	*Rate (%)*	*N*	*Rate (%)*
Overall	264,066	57.1	208,180	59.1	18,177	54.6	37,709	46.8
PCP gender†								
Male	218,130	56.5	172,331	58.7	13,895	53.4	31,904	46.0
Female	45,936	59.7	35,849	61.3	4,282	58.5	5,805	51.2
U.S. trained‡								
No	61,912	53.3	39,174	56.5	5,264	53.0	17,474	46.2
Yes	202,154	58.2	169,006	59.8	12,913	55.2	20,235	47.3
Physician specialty†								
General practice	4,530	48.1	3,330	50.4	361	46.3	839	39.9
Family practice	132,103	53.3	104,068	55.2	8,205	51.1	19,830	44.3
Internal medicine	126,591	61.3	100,226	63.5	9,552	57.8	16,813	50.1
Geriatrics	842	57.2	556	60.6	59	57.6	227	48.9
PCP age§								
≤ 45	79,867	57.3	63,110	59.1	5,489	55.7	11,268	48.1
46–65	163,972	57.5	129,931	59.6	11,005	54.6	23,036	47.4
>65	20,193	52.2	15,109	55.3	1,681	51.2	3,403	38.8
Year in practice¶								
≤ 20	104,263	57.2	82,606	59.0	7,042	55.2	14,615	47.9
21–40	144,399	57.5	113,967	59.7	9,832	54.4	20,600	46.8
>40	15,404	52.0	11,607	54.5	1,303	52.3	2,494	40.3
Patient panel (% of white)**								
Q1 (0–55.6)	45,942	47.7	14,309	50.7	6,732	52.0	24,901	44.8
Q2 (55.6–83.3)	67,410	55.7	52,602	56.6	6,695	56.0	8,113	49.7
Q3 (83.3–95.2)	113,362	60.1	104,689	60.6	4,442	56.2	4,231	51.9
Q4 (95.2–100)	37,352	61.9	36,580	62.0	308	57.5	464	55.0

*Generalist who was the only PCP visited at least twice in 2008.
†There is a significant difference in CRC test rates across PCP genders and specialties (chi-square test, $p < .001$).
‡Beneficiaries who had a PCP trained in the United States has a higher CRC test rate (chi-square test, $p < .001$ for whites, $p = .006$ for blacks, and $p = .033$ for Hispanics).
§PCP age for 34 (0.01%) beneficiaries was not available. There is a significant difference in CRC test rates across PCP ages (chi-square test, $p < .001$ for whites and Hispanics, $p = .005$ for blacks).
¶For whites and Hispanics, there is a significant difference in CRC test rates across PCP practice years (chi-square test, $p < .001$), but not for blacks (chi-square test, $p = .140$).
**There is a trend of increasing CRC test rate with increasing ratio of whites in the PCP's patient panel (Cochran–Armitage trend test, $p < .001$).

This point is illustrated more directly in Table 5, which presents the adjusted rates of patients receiving CRC, stratified by ethnicity, for the entire

Table 4: Effect of Primary Care Physician Characteristics on the Racial Disparity in Colorectal Cancer Testing by Multilevel Analysis*

PCP Definition	*Generalist Physician Seen ≥ 2 Times in 2008*†	*Generalist Physician Seen ≥ 1 Times in 2008*†
Beneficiary number	264,066	413,439
PCP number	8,637	11,448
Characteristic	OR (95% CI)	
Beneficiary race (black vs. white)	0.96 (0.92, 0.99)	0.95 (0.92, 0.98)
Beneficiary race (Hispanic vs. white)	0.79 (0.77, 0.82)	0.80 (0.78, 0.82)
PCP gender (Female vs Male)	1.14 (1.09, 1.19)	1.12 (1.08, 1.16)
PCP U.S. trained (Yes vs. No)	1.13 (1.08, 1.17)	1.10 (1.06, 1.14)
PCP practice years		
21–40 versus ≤ 20	1.04 (1.01, 1.08)	1.04 (1.01, 1.08)
>40 versus ≤ 20	0.85 (0.80, 0.92)	0.85 (0.80, 0.91)
PCP specialty		
GP versus IM	0.63 (0.56, 0.70)	0.64 (0.59, 0.71)
FP versus IM	0.75 (0.72, 0.77)	0.74 (0.72, 0.76)
Geriatrics versus IM	0.87 (0.68, 1.11)	0.92 (0.75, 1.12)
% White patients in PCP panel (per 10% increase)	1.05 (1.04, 1.06)	1.05 (1.04, 1.06)

*All models were adjusted with beneficiary age, gender, comorbidity,% black,% Hispanic, and median income of the zip code.
†See Methods for the algorithms used to define PCP.

cohort, in the cohort with a PCP, and in those with a PCP with adjusting for clustering at the PCP level with a multilevel model.

Also shown is the absolute difference in the adjusted rates of blacks versus whites and Hispanics versus whites. The black–white difference for the entire cohort was 7.0 percent for the entire cohort. This decreased to 2.9 percent for those with a PCP, and further decreased to 1.0 percent after adjusting for clustering of patients within PCPs. The Hispanic–white difference for the entire cohort was 10.9 percent, decreasing to 8.9 percent for those with a PCP, and to 5.8 percent after adjusting for clustering.

All analyses presented thus far have determined whether a patient had a PCP by examining Medicare charge data for 2008. However, CRC screening took place over a longer period. For example, for patients aged 74 or 75 in 2008, we examined receipt of colonoscopy over 2000–2009, and sigmoidoscopy or barium enema from 2005–2009. To examine the impact of having a PCP over more extended time, we identified enrollees age 74 or 75 in 2009 who

Table 5: Adjusted Rates of Being Up To Date With Colorectal Cancer Screening, by Ethnicity, for the Entire Cohort, for Those with a Primary Care Physician, and for Those with a Primary Care Physician Adjusted for Clustering within Primary Care Physicians*

	Whole Cohort		*Those with a PCP† (Stratified Model)*		*Those with a PCP‡ (Multilevel Model)*	
Beneficiary number	660,308		357,289		264,066‡	
	Adjusted Rate (%, 95% CI)	Diff. from Whites	Adjusted Rate (%, 95% CI)	Diff. from Whites	Adjusted Rate (%, 95% CI)	Diff. from Whites
White	50.4 (50.2, 50.5)		59.9 (59.7, 60.1)		57.7 (57.3, 58.1)	
Black	43.4 (42.9, 43.9)	7.0	57.0 (56.3, 57.7)	2.9	56.7 (55.7, 57.6)	1.0
Hispanic	39.5 (39.1, 39.9)	10.9	51.0 (50.5, 51.5)	8.9	51.9 (51.1, 52.7)	5.8

*All models were adjusted with beneficiary age, gender, comorbidity,% black,% Hispanic, and median income of the zip code.
†PCP was a defined as a generalist physician who was seen ≥ 2 times in 2008.
‡In the multilevel model, we restricted the cohort to beneficiaries who had only one identifiable PCP in 2008.

had an identifiable PCP in 2008 and who had seen that same PCP in at least 4 years in the period 2000–2007. The analyses produced results almost identical to those using the definition of PCP care using just the 2008 data.

DISCUSSION

This study demonstrates that having a PCP is associated with higher screening rates for CRC in older patients. Patients with a PCP were more than twice as likely to have received CRC screening. Furthermore, having a PCP was associated with reduction in relative and absolute racial/ethnic disparities in receipt of CRC screening. Finally, among older patients with a PCP, adjusting for clustering of patients within PCPs and for PCP characteristics almost entirely eliminated black–white disparities and greatly diminished Hispanic–white disparities.

It is important to remember that the screening rates reported in Tables 1 and 3 are likely to be considerably lower than actual screening rates. That is because an individual with a colonoscopy in the prior 10 years is considered up to date in screening, but data were limited to fewer than 10 years for most of the subjects. For example, for individuals who were 67 in 2009, there are only 2 years of prior Medicare data to examine for a charge for colonoscopy or sigmoidoscopy or DCBE. Individuals who obtained their test at age 64, before Medicare coverage, would be labeled as not screened. Thus, screening rates in this study are lower than those found in studies with more complete data (Richardson, Rim, and Plescia 2008; Shavers, Jackson, and Sheppard 2010). The exception was subjects aged 74 and 75 in 2009, for whom 10 years of data were available. Because of the incomplete data on CRC screening for most subjects, this study emphasizes the relative differences in screening rates, not the absolute rates themselves. In particular, the focus here is on ethnic differences in screening rates, which should not be biased by having fewer than 10 years of data. Also, the ethnic differences persisted when we limited the analyses to the subjects aged 74 and 75 in 2009.

Ethnic and racial disparities in receipt of CRC screening and other preventive services have been well described (AMA Council on Ethical, Judicial Affairs 1990; Byrd 1990; Zuvekas and Taliaferro 2003; Meissner et al. 2006; Fenton et al. 2008; Atlas et al. 2009; Doubeni et al. 2010a, b; Henley et al. 2010). Prior studies have shown that having a PCP is associated with higher rates of mammography screening (Atlas et al. 2009). The effect of having a PCP on CRC screening has also been observed previously (O'Malley et al.

2005; Klabunde, Schenck, and Davis 2006; Zarychanski et al. 2007). Lack of physician recommendation was an important factor affecting CRC screening rates in a Medicare population (Klabunde, Schenck, and Davis 2006). The finding of higher CRC screening in Medicare patients with an identified PCP is consistent with these reports. Because black and Hispanic patients are less likely to have a PCP than whites (Gaskin et al. 2007), this accounts for a substantial portion of the ethnic disparities in CRC screening.

What the current study adds to these prior reports is a focus on characteristics of the PCP and the demonstration that racial disparities in CRC screening result in part from clustering of patients within PCPs. PCP characteristics influencing CRC screening rates were U.S. training, Internal Medicine or Geriatrics specialty, and the ethnic composition of the PCP panel. PCPs older than age 65 were associated with lower screening rates. The effect of PCP characteristics on CRC screening was investigated earlier by Pham et al. (2005). The authors analyzed the 2001 Medicare database to show that CRC screening rates were better for PCPs who were board certified and those practicing general internal medicine as compared with family medicine (Pham et al. 2005). There was no effect of physician's age, gender, and time in practice. Certain differences between the two studies could explain the difference in results. First, the sample size in this study was larger than that of the earlier study for both Medicare enrollees (264,066 vs. 24,581) and PCPs (8,637 vs. 3,661), and it was limited to Texas. Second, this study used the AMA physician Masterfile to determine the PCP characteristics, whereas Pham et al. used a telephone survey to obtain this information. The earlier study did not analyze the effect of PCPs and their characteristics on racial disparities in CRC screening, a recent focus of research (Bao, Fox, and Escarce 2007; Gaskin et al. 2007; Rodriguez et al. 2008).

Bao et al. examined what they termed "between versus within physician differences," that is, whether racial disparities exist (1) because individual physicians treat patients differently based on race or (2) because minorities were more likely to receive care from physicians whose patients were less likely to receive appropriate care regardless of their race (Bao, Fox, and Escarce 2007). In their analyses, and also in analyses in this current paper, the latter explanation appears to hold, that older minorities are clustered within PCPs who are less like to screen. In the analyses presented here, among patients with a PCP, black–white disparities were almost eliminated after controlling for type of PCP. Similar observations have been made by other investigators for preventive health services and routine health care (Bach et al. 2004; Fiscella and Franks 2006; Rodriguez et al. 2008; Galbraith et al. 2010).

The explanation for why patients who see minority-serving PCPs are less liked to be screened is presumably complex. Bach et al. showed that black patients were more likely to be clustered within PCPs who were less likely to be board certified (2004). Minority-serving PCPs may also have less access to appropriate subspecialty and facilities for colonoscopy. Racial disparity due to clustering of minority patients has also been documented at the level of hospital. Hospitals with patient populations comprised mainly of minorities provide lower quality care in treating various diseases compared with hospitals with more mixed populations (Skinner et al. 2005; Jha et al. 2007).

This study has several limitations. The lack of 10 years of data for the subjects aged 66–73 in order to fully establish CRC screening has been mentioned. In addition, this study is limited to Texas, and the results may not be generalizable to the rest of the United States. Furthermore, information on race/ethnicity may be inaccurate. Medicare data have just one racial designation, in contrast to the U.S. Census, where respondents can be identified as Hispanic or non-Hispanic and also by race (Arday et al. 2000). The claims data may be incomplete in documenting FOBT, which is not always reimbursed separately, and the results may not be applicable to patients under age 65, or for those in Medicare HMOs, who tend to have higher screening rates (Haas et al. 2002). Finally, any colonoscopy or sigmoidoscopy was used as evidence of being up to date in CRC screening, although the procedure may have been performed for screening or diagnostic purposes.

These results have implications for public policy. First, programs to increase the percentage of older patients with an identified PCP should raise overall CRC screening rates and lower ethnic disparities in those rates. The recent medical home initiatives are consistent with that goal (Martin et al. 2004; Fisher 2008). Second, specific initiatives may be needed for minority-serving PCPs to support better preventive care by those physicians. Initiatives could include encouraging these PCPs to network with other PCPs and physician groups and increasing patient–provider interactions (Mehrotra, Epstein, and Rosenthal 2006; Friedberg et al. 2007; Franks and Fiscella 2008).

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