Underuse of Colorectal Cancer Screening in a Cohort of Medicare Beneficiaries

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BACKGROUND. To the authors' knowledge, few population-based studies to date have considered the serial use of colorectal cancer screening tests, which are usually recommended at specific intervals.

METHODS. The study included a cohort of cancer-free Medicare beneficiaries aged ≥70 years who were identified in 1998. Inpatient, physician, and outpatient Medicare claims for colorectal screening procedures from 1991 through 1997 and 1998 through 2004 were used to categorize patients as receiving previous and subsequent complete screening, respectively. Codes were also used to identify patients at increased neoplasia risk. Cox proportional hazards models were used to measure time to receipt of complete screening in follow-up.

RESULTS. The cohort consisted of 153,469 Medicare beneficiaries. Previous complete screening was performed in 29.2% of the cohort, including 76.7% of the increased risk group and 22.9% of other patients ($P < .001$). In the entire study cohort, the criteria for complete screening during the follow-up period were met in only 25.4% of patients, and included colonoscopy (17.6%), flexible sigmoidoscopy (2.9%), yearly fecal occult blood testing (0.8%), barium enema (0.1%), and >1 method (4.1%). Subsequent screening was strongly associated with receipt of previous screening (35.7% vs 21.2% of others; $P < .001$), and was also more frequent in younger and white patients. The differences were maintained in multivariate analysis.

CONCLUSIONS. In a population-based cohort of Medicare beneficiaries, despite insurance reimbursement, there is significant underuse of colorectal testing. Given the ability of screening tests to reduce cancer incidence and mortality, continued efforts to promote screening are clearly warranted. ***Cancer* 2008;112:293–9.** © *2007 American Cancer Society.*

KEYWORDS: colorectal neoplasms, screening, colonoscopy, sigmoidoscopy, fecal occult blood testing, barium enema, Medicare.

Population-based screening for colorectal cancer, the second most fatal neoplasm in the U.S.,[1] is currently recommended for adults aged ≥50 years by all professional societies.[2–5] Despite evidence regarding the efficacy of screening in reducing cancer mortality and the reimbursement for screening by most insurers, including Medicare,[6,7] the use of these procedures in the general population is likely below target rates (unpublished data and Reference 8). The most widely reported measures of screening are derived from the Behavioral Risk Factor Surveillance System (BRFSS), a random digit-dialed telephone survey of health practices and beliefs. The BRFSS instrument asks questions regarding the receipt of fecal occult blood testing (FOBT) within the past year and lower gastrointestinal endoscopy (sigmoidoscopy or colonoscopy) within the past 10 years. During the most recent published survey, the reported rates from

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2004 were 18.7% and 50.6%, respectively, and varied according to racial group and state of residence.[9]

Although the BRFSS and other surveys such as the National Health Interview Survey[10] provide important data, there are some notable limitations to this approach. First, guidelines typically specify frequent intervals (eg, yearly) for less sensitive screening procedures such as FOBT. Conversely, longer intervals (eg, every 5 years) between examinations are recommended for procedures such as sigmoidoscopy.[2–5] Thus, the intervals chosen in the cross-sectional survey items may not accurately measure serial screening. Also, the surveys do not differentiate responses according to colorectal cancer risk, with more intense screening recommended in patients with risk factors such as a history of polyps.[2,3,5,11] Finally, it is unknown whether individuals who have already been screened are more likely to receive subsequent screening. From a public health perspective, the subgroup of patients who have never received screening represent the highest priority for targeted efforts.

We therefore conducted the present study in a cohort of Medicare beneficiaries to determine the prevalence of colorectal screening, including the association of previous with future screening. Medicare data provide a unique opportunity to capture the different screening modalities as well as provide longitudinal follow-up.

MATERIALS AND METHODS

Patients

The study included a cohort of cancer-free Medicare beneficiaries who were identified in 1998, the first year in which colorectal cancer screening was reimbursed under Medicare.[6] The dataset was developed in conjunction with the linked Surveillance, Epidemiology, and End Results (SEER)-Medicare database, which consists of Medicare-eligible individuals with cancer and reside in 1 of the geographic areas contained in the SEER registries.[12,13] As an adjunct to the data obtained for cancer patients, the project staff at the National Cancer Institute has included Medicare claims data for a 5% random sample of Medicare beneficiaries who live in the SEER areas but are cancer-free. The Medicare files available for the control group are identical to those of the cancer cases.

We identified all patients in the noncancer control sample in 1998 and excluded those individuals enrolled in a Medicare-sponsored managed care plan (given the lack of claims for individual services) and/or who were not enrolled in Medicare Part B (which provides reimbursement for outpatient screening). Patients who were enrolled in Medicare-sponsored managed care plans for only part of the previous period were included from the date of the first procedure under fee for service Medicare forward. We also limited the study to patients aged $\geq$70 years in 1998 because we were interested in obtaining claims data for procedures received during the previous 5 years of Medicare eligibility.

Measures

The Medicare claims are contained in 3 files: the Medicare Provider Analysis and Review (MEDPAR) files, which include claims for all hospitalizations, short stay, and skilled nursing facilities; the National Claims History (NCH) files, which include claims from physicians, as well as physician assistants, nurse practitioners, independent clinical laboratories, and free-standing ambulatory surgery centers, among other providers; and the Outpatient Files, which include claims from institutional outpatient providers, including hospital outpatient departments, rural health clinics, and renal dialysis facilities. From these files we identified claims for colorectal screening procedures according to International Classification of Diseases, ninth Revision Clinical Modification (ICD-9-CM) and Current Procedural Terminology fourth edition (CPT-4) codes. Procedures included FOBT (CPT-4 82270, 82273, G0107), flexible sigmoidoscopy (CPT-4 45330, 45331, 45333, 45338, 45339, G0104; ICD-9-CM 45.22, 45.24, 48.22, 48.24), colonoscopy (CPT-4 44388, 44389, 44392, 44393, 44394, 45378, 45380, 45382, 45383, 45384, 45385, G0105, G0121; ICD-9-CM 45.23, 45.25, 45.41, 45.42, 45.43, 48.36), and barium enema (CPT-4 74270, 74280, G0106, G0120; ICD-9-CM 87.64). To avoid double counting the same procedure that appeared in more than 1 file, the MEDPAR, Physician/Supplier, and Outpatient files were combined and records unduplicated by procedure and date of service.

A subset of patients, although cancer-free, are likely at increased risk for development of neoplasia due to a prior history of polyps, a family history of colorectal neoplasia, or a personal history of inflammatory bowel disease. Screening and surveillance recommendations in this population are generally more intensive than in patients at average risk for cancer development.[2,3,5,11] Claims from 1991 through 1997 were searched for a diagnosis that constituted increased neoplasia risk or a prior history of polyp removal. Criteria included codes for Crohn disease (ICD-9-CM 555), ulcerative colitis (556), personal history of colon polyps (V12.72), family history of gastrointestinal neoplasm (V16.0), benign neoplasm (polyp) of colon (211.3) or rectum (211.4), and colonoscopy or sigmoidoscopy with polypectomy (CPT-4

44392, 44393, 44394, 45333, 45338, 45339, 45383, 45384, 45385; ICD-9-CM 45.42, 45.43, 48.36).

Medicare claims from the first year of eligibility or 1991, whichever was earlier, through 1997 were searched for receipt of previous colorectal procedures. Among those individuals with codes that indicated increased neoplasia risk as defined above, a colonoscopy between 1993 and 1997 constituted complete previous screening. Among the remaining ("average risk") individuals, a patient was considered to have undergone previous complete screening if they underwent yearly FOBT, a flexible sigmoidoscopy or barium enema between 1993 and 1997 (ie, 5-year interval), or a colonoscopy at any time between 1991 and 1997.

Medicare claims from 1998 through 2004 were searched for codes that indicated subsequent screening procedures. Average risk individuals were considered to have undergone complete screening in follow-up if they received yearly FOBT, a flexible sigmoidoscopy or barium enema between 1998 and 2003, or a colonoscopy if not performed within 10 years. Increased risk individuals were considered to have received complete screening if they underwent colonoscopy between 1998 and 2003 or within 5 years of the most recent colonoscopy.

Comorbidity was determined using the previously validated Charlson index and its claims-based adaptation.[14,15] All claims from 1991 through 1998 were searched for relevant diagnosis codes and 2 separate indices were calculated, 1 for inpatient claims and 1 for outpatient claims.

As a proxy for individual level socioeconomic measures, which are unavailable in Medicare claims, the files contain ecological measures of socioeconomic status at the ZIP code level. Relevant measures in 1998 included median household income and proportion of persons aged $\geq$25 years with at least some college level education. Measures for each patient in the cohort were rank-ordered and divided into quartiles according to rank. A separate category for missing socioeconomic data was included.

Statistical Analysis

The association between patient characteristics and receipt of subsequent screening was evaluated using chi-square analysis. Because of death or disenrollment from fee-for-service Medicare, follow-up time among individual patients varied. Therefore, we used a Cox proportional hazards model to measure time to receipt of complete screening in follow-up. Independent variables in the model included age, sex, race, comorbidity score, risk group (average vs increased), receipt of previous screening, geographic area of residence, and ecological measures of socioeconomic status.

TABLE 1
Characteristics of the 153,469 Patients in the Study Cohort

Characteristic	No.	%
Age group, y		
70–74	53,187	34.7
75–79	44,664	29.1
80–84	29,774	19.4
≥85	25,844	16.8
Gender		
Female	101,435	66.1
Male	52,034	33.9
Racial group		
White	131,693	85.8
African American	10,000	6.5
Asian	4773	3.1
Hispanic	3613	2.4
Other or unknown	3390	2.2
Inpatient comorbidity score		
0	141,658	92.3
1	7916	5.2
≥2	3895	2.5
Outpatient comorbidity score		
0	142,930	93.1
1	8296	5.4
≥2	2243	1.5
Risk group		
Average	135,529	88.3
Increased	17,940	11.7
Previous screening		
No	108,703	70.8
Yes	44,766	29.2

RESULTS

We identified a total of 153,469 Medicare beneficiaries in 1998 who met the enrollment criteria, including 17,940 patients with $\geq$1 risk factors for neoplasia and 135,529 "average risk" individuals. Characteristics of the cohort are shown in Table 1. The mean age was 78.6 $\pm$ 6.3 years and the majority of patients were female and white. Most patients were without major comorbid illnesses, as measured by the inpatient or outpatient Charlson scores. When compared with average risk individuals, patients who met the criteria for increased cancer risk were somewhat younger (mean age of 78.2 $\pm$ 5.8 years vs 78.7 $\pm$ 6.4 years) and more likely to be white (88.6% vs 85.5%), male (39.2% vs 33.2%), and reside in the highest quartiles of income and educational level ($P < .001$ for all comparisons). Previous complete screening was performed in 29.2% of the cohort, including 76.7% of the increased risk group and 22.9% of other patients ($P < .001$).

In the entire study cohort, criteria for complete screening during the follow-up period were met in

39,008 patients (25.4%). Procedures included colonoscopy (17.6%), flexible sigmoidoscopy (2.9%), yearly FOBT (0.8%), and barium enema (0.1%). More than 1 method of screening was performed in 4.1% of patients. Among average risk patients, complete screening was performed in 24.5%, and was most commonly delivered through colonoscopy (15.6%) and flexible sigmoidoscopy (3.3%). For individuals at increased cancer risk, complete screening was performed during follow-up in 32.5% of patients and based on study criteria was performed entirely with colonoscopy. In addition, 20.8% of increased risk patients who did not receive colonoscopy underwent another screening procedure, and 21.5% of increased risk patients who were screened with colonoscopy also underwent other procedures.

Characteristics that were associated with receipt of recommended screening are shown in Table 2. Screening was more commonly performed in younger individuals (age 78.4 ± 5.9 years vs 78.7 ± 6.5 years without screening, $P < .001$). In addition, whites, men, and residents of areas with higher income and educational level were more likely to receive screening ($P < .001$), although the differences were quantitatively not large. There was no substantive difference in screening with different levels of comorbidity. Differences were also observed according to geographic area, with rates ranging from 20.8% to 27.9% ($P < .001$, data not shown). The factor with the strongest association with subsequent screening was receipt of previous screening. Among patients with previous complete screening, 35.7% received subsequent screening, compared with 21.2% of others ($P < .001$).

In a multivariate Cox proportional hazards model, several factors were found to be independently associated with time to receipt of recommended screening (Table 3). As in the univariate analyses, screening was more common in younger patients, with patients aged ≥85 years particularly less likely to receive screening. Race was also strongly associated with receipt of screening, with the lowest rates observed in Hispanics, Asians, and members of other or unknown racial groups. The interaction term for age and race was modestly associated with screening (hazards ratio [HR]: 1.03; 95% confidence interval [95% CI], 1.02–1.04). Although educational level in the ZIP code of residence was associated with an incremental likelihood of screening, no association was observed for household income. In contrast to univariate analyses, increased inpatient or outpatient comorbidity scores were associated with a greater likelihood of screening. There were also modest differences according to geographic region, with HRs ranging from 0.95 to 1.15 (data not shown). Consistent with the univariate analyses, receipt of previous screening had the largest association with subsequent screening (HR: 1.78; 95% CI, 1.74–1.82). There was no association of risk group with receipt of screening, which may be attributed to different screening criteria for average versus increased risk individuals.

TABLE 2
Associations With Recommended Screening: Univariate Analyses

Characteristic	% With recommended screening	*P*
Age group, y		.001
70–74	31.6	
75–79	27.6	
80–84	21.8	
≥85	13.0	
Gender		.001
Female	24.6	
Male	27.0	
Racial group		.001
White	25.9	
African American	23.7	
Asian	22.7	
Hispanic	22.7	
Other or unknown	18.6	
Educational level		.001
Quartile 1	23.4	
Quartile 2	25.1	
Quartile 3	26.1	
Quartile 4	27.4	
Missing	24.6	
Median income		.001
Quartile 1	24.1	
Quartile 2	25.3	
Quartile 3	25.8	
Quartile 4	26.8	
Missing	24.6	
Inpatient comorbidity score		.03
0	25.5	
1	24.6	
≥2	24.0	
Outpatient comorbidity score		.88
0	25.4	
1	25.2	
≥2	25.6	
Risk group		.001
Average	24.5	
Increased	32.5	
Previous screening		.001
No	21.2	
Yes	35.7	

DISCUSSION

Colorectal cancer screening is now an accepted preventive health recommendation by all professional

TABLE 3
Associations With Recommended Screening: Multivariate Cox Proportional Hazards Model*

Characteristic	Hazards ratio (95% CI)	*P*
Age group, y		
70–74	†	
75–79	0.84 (0.81–0.86)	.001
80–84	0.66 (0.63–0.69)	.001
≥85	0.43 (0.41–0.46)	.001
Gender		
Male	†	
Female	0.94 (0.92–0.96)	.001
Racial group		
White	†	
African American	0.89 (0.85–0.94)	.001
Asian	0.73 (0.69–0.79)	.001
Hispanic	0.75 (0.68–0.83)	.001
Other or unknown	0.61 (0.53–0.71)	.001
Educational level		
Quartile 1	†	
Quartile 2	1.09 (1.05–1.13)	.001
Quartile 3	1.14 (1.10–1.19)	.001
Quartile 4	1.22 (1.17–1.28)	.001
Missing	‡	
Median income		
Quartile 1	†	
Quartile 2	1.01 (0.98–1.05)	.43
Quartile 3	0.99 (0.96–1.03)	.68
Quartile 4	0.99 (0.94–1.03)	.53
Missing	1.08 (1.03–1.13)	.001
Inpatient comorbidity score		
0	†	
1	1.16 (1.10–1.22)	.001
≥2	1.21 (1.12–1.31)	.001
Outpatient comorbidity score		
0	†	
1	1.14 (1.09–1.20)	.001
≥2	1.30 (1.17–1.43)	.001
Risk group		
Average	†	
Increased	1.02 (0.99–1.05)	.20
Previous screening		
No	†	
Yes	1.78 (1.74–1.82)	.001

95% CI indicates 95% confidence interval.

* The model contained all covariates in the table as well as geographic region and age/race interaction term.

† Referent group.

‡ The same patients for whom the educational level was missing also were missing income data. Therefore, only missing income was included in the model.

society guidelines, with the choice of screening method typically left to the discretion of the physician and patient. The increased use of screening has been speculated as a major reason for the decline in colon cancer mortality noted in the U.S.,[16] and many of the preexisting barriers to receipt of screening including insurance reimbursement and public and professional awareness have been overcome. Given the diversity of screening options and the different payers for healthcare in the U.S., it is difficult to obtain population-based data to quantitate screening receipt. Previous studies have often been limited to single procedures such as colonoscopy and typically collect cross-sectional rather than longitudinal data. However, given the recommendations that typically specify screening intervals, cohort studies are of particular interest.

Using a population-based sample of Medicare beneficiaries in 1998, we studied the previous and future use of colorectal screening tests considering the various options that are recommended. Overall, we found that only 29.2% and 25.4% of patients met the guideline-based criteria for screening in the previous and subsequent time periods, respectively. Consistent with survey data such as the BRFSS and NHIS,[9,10] we found lower subsequent screening rates in subgroups of patients including nonwhite and lower income individuals. In addition, we observed significantly lower rates with increased age, which may be justified in part given diminishing life expectancy and lower anticipated benefit in terms of prolonging life.[17,18] The higher screening rates associated with increased comorbidity is somewhat counterintuitive but could be explained by more contacts with the healthcare system and greater opportunities to receive screening. However, the strongest predictor of future screening was the receipt of previous screening, suggesting that whereas a subset of patients received colorectal testing at regular intervals, most patients did not undergo guideline-recommended screening. Future efforts should clearly focus on this chronically unscreened population, especially younger individuals with fewer comorbidities.

Our findings of low overall screening rates are consistent with previous cross-sectional studies that used Medicare data. Using Medicare claims for the state of Washington, Ko et al.[19] examined rates of flexible sigmoidoscopy, colonoscopy, and barium enema for 1994, 1995, and 1998 and also evaluated FOBT use for 1998. Overall, fewer than 4% of their sample received a screening procedure in a given year, with rates generally lower in women, nonwhite patients, patients aged ≥80 years, and those residing in rural areas. Richards and Reker[20] used a national 5% random sample of Medicare physician claims from 1999 and found low overall procedure rates, including colonoscopy in 6.2%, flexible sigmoidoscopy in 2.6%, and barium enema in 1.6%. Rates of sigmoidoscopy and colonoscopy procedures were lower in African Americans. In a more recent analysis

that included claims from 3 states for the years 2002 and 2003,[21] the overall use of screening increased from studies that used data from earlier time periods.[19,20,22] However, only 18.3% of the most recent sample underwent a colorectal procedure, which mostly consisted of colonoscopy (53.7%) and FOBT (42.1%). Of note, because all these previous studies did not consider serial FOBT, the quoted use of this procedure was higher than in our study.

A population-based Canadian study that included a similar design as the present study also found low rates of screening.[23] Among individuals from Ontario aged 50–59 years in 1995, nearly 80% received no colorectal testing from 1995 through 2000. In contrast to Medicare studies in which colonoscopy was the dominant screening method, 1 or more FOBTs were performed in 9.3%, barium enema was performed in 8.0%, flexible sigmoidoscopy in 8.0%, and colonoscopy was received by only 6.3%.

We recognize several important limitations of the current study. First, because Medicare claims data are collected for billing purposes and not research, there exist potential questions regarding the completeness and accuracy of the data. One likely example of underreporting is FOBT, in which a much smaller proportion of patients undergoing FOBT were identified through claims data than through population surveys. Because FOBT is a low-cost procedure that may be performed in practitioners' offices, it is not surprising that it may be underreported. In addition, our requirement of yearly testing resulted in a much lower proportion than cross-sectional measures of Medicare beneficiaries, in whom the prevalence of testing in a given year has been shown to be as high as 18%.[22] Another example of possible underreporting is comorbidity, with fewer than 10% of patients having codes for comorbid illnesses in inpatient or outpatient claims. Although this cohort represents an overall healthier population than in studies of hospitalized patients, lack of financial incentives to document all comorbid illnesses may also influence coding practices. In addition, the prevalence of certain risk factors identified through coding, such as a family history of cancer, was also likely underreported in these data. Nonetheless, even among patients considered to be at increased risk through coding, only a minority of patients received colonoscopy within recommended intervals.

Another limitation of the data from the current study is the inability to differentiate true screening tests from studies performed to evaluate signs and symptoms. Thus, the overall rates for certain procedures may have actually overestimated the prevalence of actual screening. Although it is likely that a significant number of colonoscopies were performed for indications other than screening, receipt of the procedure would still fulfill guideline-based recommendations regardless of indications. The study was also limited to patients aged $\geq$70 years who were insured under fee-for-service Medicare and, thus, the generalizability to others including younger individuals or managed care enrollees in not known. The uniform insurance coverage in this cohort may also account for the relatively modest racial differences that were observed. In addition, because the sample size was large, statistically significant differences that were observed were not necessarily clinically relevant.

In summary, we have demonstrated in a population-based cohort significant underuse of colorectal testing. Although previous screening was strongly associated with the receipt of future screening, a majority of patients received incomplete or no screening. Given the ability of screening tests to reduce cancer incidence and mortality, continued efforts to promote screening are clearly warranted.

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