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Limited Life Expectancy Among a Subgroup of Medicare Beneficiaries Receiving Screening Colonoscopies

Sahil Mittal,[*,‡] Yu–Li Lin,[§] Alai Tan,[§] Yong–Fang Kuo,[§] Hashem B. El–Serag,[*,‡] and James S. Goodwin[§]

*Section of Gastroenterology and Hepatology, Baylor College of Medicine, Houston, Texas; ‡Houston VA Health Services Research and Development Center of Excellence, Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas; and §Department of Medicine and Sealy Center of Aging, University of Texas Medical Branch, Galveston, Texas

BACKGROUND & AIMS: **Life expectancy is an important consideration when assessing appropriateness of preventive programs for older individuals. Most studies on this subject have used age cutoffs as a proxy for life expectancy. We analyzed patterns of utilization of screening colonoscopy in Medicare enrollees by using estimated life expectancy.**

METHODS: **We used a 5% random national sample of Medicare claims data to identify average-risk patients who underwent screening colonoscopies from 2008 to 2010. Colonoscopies were considered to be screening colonoscopies in the absence of diagnoses for nonscreening indications, which were based on either colonoscopies or any claims in the preceding 3 months. We estimated life expectancies by using a model that combined age, sex, and comorbidity. Among patients who underwent screening colonoscopies, we calculated the percentage of those with life expectancies <10 years.**

RESULTS: **Among the 57,597 Medicare beneficiaries 66 years old or older who received at least 1 screening colonoscopy, 24.8% had an estimated life expectancy of <10 years. There was a significant positive association between total Medicare per capita costs in hospital referral regions and the proportion of patients with limited life expectancies (<10 years) at the time of screening colonoscopy ($R = 0.25$; $P < .001$, Pearson correlation test). In a multivariable analysis, men were substantially more likely than women to have limited life expectancy at the time of screening colonoscopy (odds ratio, 2.25; 95% confidence interval, 2.16–2.34).**

CONCLUSIONS: **Nearly 25% of Medicare beneficiaries, especially men, had life expectancies <10 years at the time of screening colonoscopies. Life expectancy should therefore be incorporated in decision-making for preventive services.**

Keywords: Colon Cancer; Colonoscopy; Life Expectancy; Medicare.

It is important to consider overall health and prognosis when considering cancer screening decisions in older patients.[1,2] For example, screening colonoscopy is the dominant screening modality for colorectal cancer.[3] Evidence from observational studies suggests that few polyps will form and progress to cancer in fewer than 10 years.[4] In addition, complications related to colonoscopy are more common in those with significant comorbidities or advanced age.[5] Thus, older patients with limited life expectancy are at risk of harm from screening or treatment of a condition that may never manifest in their lifetime.[6,7] For these reasons, the United States Preventive Services Task Force (USPSTF) has recommended against routine screening for colorectal cancer in those aged 75–84 and against any screening in those older than 85.[8] The task force reasoned that with the limited life expectancy of those older than age 75, "the gain in life years associated with extending screening [above age 75] was small in comparison to the risks of screening." Others and we have reported on potential overuse of screening colonoscopies in those older than age 75 and older than 85.[9–11]

However, the chronological age of the patient is less relevant than life expectancy, or whether the patient can

Abbreviations used in this paper: CPT, Current Procedural Terminology; HRR, hospital referral region; ICD-9-CM, International Classification of Disease-Ninth Revision-Clinical Modification; MedPAR, Medicare Provider Analysis and Review; OutSAF, Outpatient Standard Analytical File; USPSTF, United States Preventive Services Task Force.

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expect to survive long enough after the test to reap benefits that outweigh the risks.[12–14] Recently, we developed an algorithm estimating life expectancy in older Medicare patients that is substantially more accurate than using age alone.[15]

In this study, we estimate life expectancy in Medicare recipients who underwent screening colonoscopy in 2008–2010 in the United States and report on the proportion of patients who had a life expectancy of less than 10 years. We also analyze how this proportion varies by patient and provider characteristics and by geographic location.

Materials and Methods

Data Source

Claims from 2007–2010 for a 5% random sample of Medicare beneficiaries were used, including Medicare beneficiary summary files, Medicare Provider Analysis and Review (MedPAR) files, Outpatient Standard Analytical File (OutSAF), and Medicare Carrier files. Provider information was obtained from the American Medical Association Physician Masterfile.

Study Cohort

Colonoscopy claims were identified from 2008–2010 Carrier and OutSAF data by using Current Procedural Terminology (CPT) codes 45378, 45380, 45382, 45383, 45384, and 45385 and Health Care Procedure Coding System codes G0105 and G0121. For OutSAF data, the following International Classification of Disease-Ninth Revision-Clinical Modification (ICD-9-CM) codes were also used: 45.23, 45.25, 45.27, 45.41, 45.42, and 45.43. We linked the colonoscopy claims from the Carrier files to the admission records in the MedPAR files to identify and remove inpatient colonoscopies. We identified 435,452 outpatient colonoscopies but used only the first colonoscopy for each beneficiary in 2008–2010, resulting in 392,985 colonoscopies. From these, we excluded beneficiaries aged 65 and younger (N = 79,625), those without complete Parts A and B enrollment, and those with any health maintenance organization enrollment during the 12 months before colonoscopy (N = 30,274), leaving 283,086 colonoscopies performed in as many patients. We then identified colonoscopies performed for the purpose of colon cancer screening, which was defined as outpatient colonoscopies without a possible indication. A colonoscopy was excluded when the patient had anemia, gastrointestinal bleeding, abdominal pain, constipation, change in bowel habits, or other relevant diagnoses on the colonoscopy claim; a barium enema or abdominal computed tomographic scan; or a diagnosis of diverticulitis, anemia, gastrointestinal bleeding, change in bowel habits, or other relevant diagnosis during the 3 months before the colonoscopy (see Supplementary Appendix for full list).[10] Of the 283,086 colonoscopies analyzed, 57,597 were identified as screening colonoscopies. As we previously discussed,[10,11] the sensitivity of this estimate of screening colonoscopy is conservative compared with estimates that use chart review[16] but should have excellent specificity.

Measures

Beneficiary characteristics. We captured age, sex, and ethnicity by using Medicare beneficiary summary files. We used the Medicaid indicator as a proxy of low socioeconomic status. Rural or urban residence was based on the 2003 Rural-Urban Continuum Codes developed by the U.S. Department of Agriculture. The education level at the zip code of residence was obtained from the 2011 American Community Survey estimates of the U.S. Census. Residential hospital referral region (HRR) was identified by the zip code–HRR crosswalk obtained from the Dartmouth Atlas of Health Care.[17]

Colonoscopist characteristics. We identified colonoscopist gender, years in practice, and U.S.-trained vs foreign-trained by using the American Medical Association files. Provider specialty was based on Part B claims in the Medicare Carrier files. Our data source is a 5% national sample of Medicare beneficiaries, so we defined the volume as the number of outpatient colonoscopies performed by the colonoscopist in the year of the patient's colonoscopy, multiplied by 20.

Hospital referral region characteristics. The Medicare standardized per capita cost by HRR in 2009 was obtained from the Institute of Medicine.[18] For colonoscopist availability in an HRR, we first identified providers with any colonoscopy billing from the Carrier and OutSAF data (N = 24,160) and then removed any duplicate billings for the same beneficiary on the same date to determine the number of colonoscopy billings in 2008–2010 for each provider. To exclude providers who rarely performed colonoscopies, we selected those with at least 4 billings (equivalent to >80 colonoscopies in the 100% Medicare data) during the 3 years of the study period, resulting in 18,179 colonoscopists. A colonoscopist was considered to be available in all HRRs with which he or she billed. Availability was presented as the number of colonoscopists per 10,000 beneficiaries aged 65+ years in the HRR for 2009. The percentages of female and older residents (age 75 years or older) in the HRR were computed from the 2009 population estimates from the Dartmouth Institute.[17]

Study Outcomes

We estimated life expectancy by using a sex-specific model developed by Tan et al[15] combining age and Elixhauser comorbidity. For each patient, the claims in the year before colonoscopy were examined for the 31 conditions comprising the Elixhauser comorbidity index conditions by using enhanced ICD-9-CM coding algorithms developed by Quan et al.[19] The median survival time (life expectancy) for each beneficiary was computed by applying the baseline hazard and the coefficients of age and the 31 comorbidity indicators. The C statistics for the models predicting 10-year mortality are 0.77 and 0.80 for men and women, respectively. Among men who had less than 10 years of life expectancy predicted by this algorithm, 74.3% actually died within 10 years. For women, it was 75.1%.[15] Table 1 shows examples of beneficiaries with an estimated life expectancy between 9 and 10 years at the time of colonoscopy.

Statistical Analyses

The proportion of beneficiaries with less than 10 years of life expectancy at the time of screening colonoscopy was calculated and then stratified by patient characteristics. The χ^2 test was used to examine differences in proportions by patient characteristics. The Cochran–Armitage trend test was used to examine the trend in proportions by education. To examine how patient and provider characteristics impact this proportion, hierarchical generalized linear models were used. These models account for the clustering of beneficiaries within colonoscopists. The correlation of HRR characteristics with the proportion of patients with limited life expectancy in the HRR was examined by Pearson correlation test and Pearson partial correlation test, controlling for sex (% female) and age (% aged 75 or older) in the HRR. The map showing the proportion of beneficiaries with less than 10 years of life expectancy in HRRs was constructed by using ArcMap 9.3. Data were not shown for the 8 HRRs with fewer than 30 screening colonoscopies. All other analyses were performed with SAS version 9.2 (SAS Inc, Cary, NC).

To further explore the impact of sex, we examined the screening colonoscopy prevalence rate in 2008–2010 by sex. We selected beneficiaries aged 67 or older in 2010 with complete Parts A and B enrollment and without any HMO enrollment for the 3 years (36 months) from 2008–2010 (N = 1,125,863). Then we identified those with any screening colonoscopy in this period that was based on the aforementioned definition, stratified by age and sex.

Table 1. Examples of Beneficiaries With More Than 9 But Less Than 10 Years of Estimated Life Expectancy[a] at the Time of Colonoscopy

Description	Estimated life expectancy (*y*)
Male, age 77 without comorbidity	9.8
Male, age 73 with chronic pulmonary disease	9.3
Male, age 73 with diabetes	9.1
Male, age 72 with congestive heart failure	9.5
Male, age 70 with peripheral vascular disease and chronic pulmonary disease	9.3
Male, age 68 with chronic pulmonary disease and diabetes	9.2
Male, age 67 with congestive heart failure and chronic pulmonary disease	9.7
Female, age 81 without comorbidity	9.5
Female, age 77 with congestive heart failure	9.1
Female, age 76 with uncomplicated hypertension and diabetes	9.7
Female, age 74 with peripheral vascular disease and chronic pulmonary disease	9.2
Female, age 74 with peripheral vascular disease, hypertension, and diabetes	9.4
Female, age 71 with chronic pulmonary disease and diabetes	9.9
Female, age 67 with congestive heart failure, chronic pulmonary disease, and diabetes	9.6

[a]Based on algorithm using age, sex, and comorbidity developed by Tan et al.[15]

Results

The cohort included 57,597 Medicare beneficiaries aged 66 years and older who received at least 1 screening colonoscopy in 2008–2010. Of these, we estimated that 24.8% had less than 10 years of life expectancy at the time of screening colonoscopy. Patient characteristics associated with having an estimated life expectancy of less than 10 years at the time of index screening colonoscopy are listed in Table 2. Those who had limited life expectancy at time of screening colonoscopy were more likely to be male and be eligible for Medicaid.

Figure 1 shows the percentage of patients with life expectancy less than 10 years among those receiving a screening colonoscopy for each HRR in 2008–2010. There was considerable variation from ≥35% in the top 5% of HRRs to <17% in the bottom 5%. The highest rates (>40%) were seen in New Brunswick and Newark, NJ and Odessa, TX; Stockton, CA had the lowest rate of 5.7%.

Table 3 presents patient and health care provider characteristics associated with the likelihood of having less than 10 years of life expectancy at the time of colonoscopy. For this analysis we used multilevel modeling to account for the clustering of outcomes at the level of the colonoscopist. We present 2 models: Model 1, which was adjusted for patient characteristics, and Model 2, which was adjusted for both patient and provider characteristics. The likelihood of having a limited life expectancy at the time of screening colonoscopy was significantly higher among patients eligible for Medicaid. The likelihood also increased with the number of years the provider was in practice. There was a weak association with colonoscopy volume of the provider and when the colonoscopist was a surgeon as compared with a gastroenterologist. There were no significant associations with provider gender or whether their medical school training was in the United States. In the models in Table 3, we assessed the intraclass correlation coefficient at the level of the colonoscopist. The intraclass

Table 2. Proportion of Patients With Less Than 10 Years of Life Expectancy at the Time of Screening Colonoscopy, by Patient Characteristics

Patient characteristics	No. of patients	% of Patients with <10 y of life expectancy	*P* value
Overall	57,597	24.8	
Sex			
Male	28,605	32.0	
Female	28,992	17.6	<.001
Age (*y*)			
66–74	38,426	5.9	
75–84	17,791	59.5	
≥85	1380	100.0	<.001
Race			
Non-Hispanic white	51,656	24.9	
Black	3195	23.2	
Hispanic	1438	24.8	
Asian/Pacific Islander or other	1308	22.3	.028
Medicaid eligibility			
Yes	2522	29.9	
No	55,075	24.5	<.001
Rural/urban[a]			
Metropolitan	43,340	25.1	
Non-metropolitan	12,299	23.8	
Rural	1807	23.9	.009
Education at zip code level (% high school graduates)[a,b]			
Q1 (≤83.9)	14,283	24.6	
Q2 (83.9–89.6)	14,221	25.9	
Q3 (89.6–93.5)	13,988	24.7	
Q4 (93.5–100)	14,139	24.0	.003[b]

[a]There were missing data on Rural/urban (0.3%) and Education (1.7%).
[b]Cochran–Armitage trend test. All others were χ^2 tests.

correlation coefficient was 2.7% for Model 1 and 2.5% for Model 2, indicating that variation among colonoscopists contributed relatively little to the variation in whether a patient receiving screening colonoscopy had limited life expectancy.

In both unadjusted (Table 2) and adjusted (Table 3) analyses, patient sex was a strong predictor, with men having a 2-fold higher probability of having a limited life expectancy at the time of screening colonoscopy than women (eg, odds ratio, 2.25; 95% confidence interval, 2.16–2.34). Two factors contribute to this sex difference. First, at any age, men were more likely to undergo screening colonoscopy than women. Second, men at any age who underwent screening colonoscopy were more likely than women to have limited life expectancy. This is illustrated in Figure 2, which plots the rates of screening colonoscopy for men and women as a function of age and also the percent of patients with a life expectancy less than 10 years. For example, at age 68, the rates of screening colonoscopy for men and women were 8.7% and 7.1%, respectively, whereas the proportions of recipients with limited life expectancy were 4.0% and 0.6%, respectively. At age 75, the screening colonoscopy rates in men and women were 7.6% and 5.5%, respectively, whereas the proportions of screening colonoscopy recipients with limited life expectancy were 36.2% and 10.8%, respectively.

We also explored whether the geographical variation shown in Figure 1 reflected patterns in overall health care utilization across HRRs or the availability of colonoscopists. There was a significant positive association between total Medicare per capita costs in HRRs and the proportion of patients with limited life expectancy at the time of screening colonoscopy ($R = 0.25$; $P < .001$, Pearson correlation test). We did not find significant associations between the number of colonoscopists in an HRR and the percent of screening colonoscopy recipients with limited life expectancy ($R = –0.10$, $P = .08$ for any colonoscopist and $R = 0.02$, $P = .71$ for gastroenterology colonoscopists, Pearson correlation test). We repeated this analysis after adjusting for sex and age composition in HRRs and found similar results.

Discussion

One-fourth of Medicare beneficiaries aged 66+ years who underwent screening colonoscopy in 2008–2010 had an estimated life expectancy of less than 10 years at the time of screening. Men were considerably more likely than women to have limited life expectancy at the time of

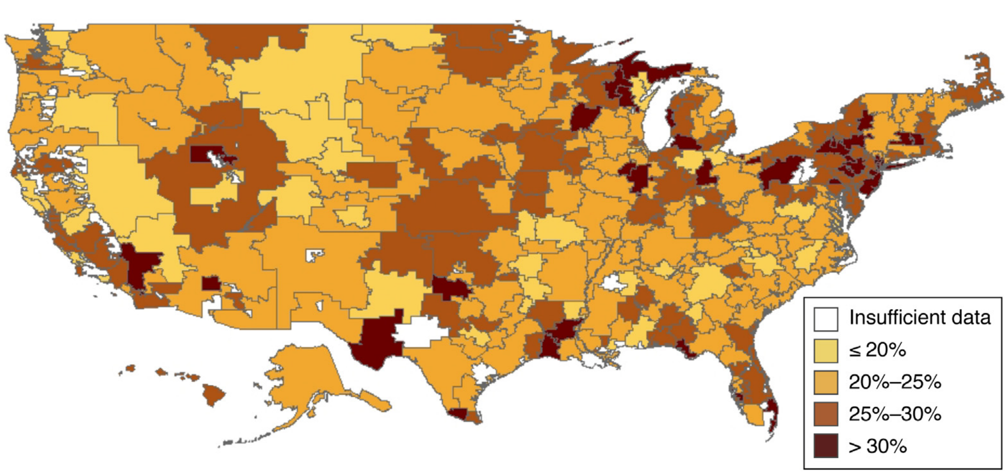

Figure 1. Proportion of patients with less than 10 years of predicted life expectancy at the time of screening colonoscopy by HRR. There are 8 HRRs with less than 30 screening colonoscopies, and their data are not shown.

Table 3. Effect of Patient and Colonoscopist Characteristics on the Likelihood of Having Less Than 10 Years of Life Expectancy at the Time of Screening Colonoscopy by Multilevel Multivariable Analyses

	Odds ratio (95% Confidence interval)	
	Model 1	Model 2
Patient characteristics		
Sex		
Male	2.25 (2.16–2.34)[a]	2.24 (2.16–2.33)[a]
Female	1.00	1.00
Race		
Non-Hispanic white	1.00	1.00
Black	0.92 (0.84–1.00)	0.92 (0.84–1.01)
Hispanic	0.88 (0.77–1.00)	0.89 (0.78–1.01)
Asian/Pacific Islander or other	0.80 (0.70–0.92)[a]	0.81 (0.70–0.93)[a]
Medicaid eligibility		
Yes	1.61 (1.46–1.76)[a]	1.62 (1.48–1.78)[a]
No	1.00	1.00
Rural/urban[b]		
Metropolitan	1.00	1.00
Non-metropolitan	0.90 (0.85–0.94)[a]	0.90 (0.85–0.95)[a]
Rural	0.89 (0.79–1.00)	0.90 (0.80–1.01)
Education at zip code level (% high school graduates)[b]		
Q1 (≤83.9)	1.00	1.00
Q2 (83.9–89.6)	1.05 (1.00–1.12)	1.06 (1.00–1.12)[a]
Q3 (89.6–93.5)	0.98 (0.93–1.04)	0.99 (0.93–1.05)
Q4 (93.5–100)	0.93 (0.88–0.99)[a]	0.94 (0.89–1.00)[a]
Colonoscopist characteristics		
Sex		
Male		1.07 (0.97–1.18)
Female		1.00
Trained in U.S.		
Yes		1.00
No		1.00 (0.95–1.06)
Years of practice		
Q1 (≤20)		1.00
Q2 (21–26)		1.11 (1.05–1.18)[a]
Q3 (27–32)		1.21 (1.14–1.29)[a]
Q4 (>32)		1.24 (1.17–1.32)[a]
Specialty		
Gastroenterologist		1.00
Surgeon		1.06 (1.00–1.13)[a]
Generalist		0.97 (0.90–1.05)
Other		0.86 (0.71–1.04)
Volume[c]		
Q1 (≤140)		1.00
Q2 (160–240)		0.98 (0.93–1.04)
Q3 (260–380)		1.02 (0.96–1.09)
Q4 (≥400)		1.07 (1.01–1.15)[a]

[a]Statistically significant ($P < .05$).
[b]There were missing data on Rural/urban (0.3%) and Education (1.7%).
[c]Number of outpatient colonoscopies performed by the physician in the year of patient's colonoscopy in the 5% data multiplied by 20.

screening. There was also considerable geographical variation in the proportion of screening colonoscopy recipients having limited life expectancy.

The use of life expectancy as a cutoff to decide when to stop screening produces different estimates of potential overuse than the use of an age cutoff. For example, USPSTF guidelines do not recommend routine colorectal cancer screening in patients aged 75–84 years. Approximately 40% of individuals in this age group had an estimated life expectancy of more than 10 years. Conversely, 5.9% of those aged 65–74 had an estimated life expectancy of less than 10 years.

The rate of inappropriate screening colonoscopy varied by endoscopist specialty and the number of years the provider was in practice. Screening colonoscopy guidelines were updated in 2008 to include a stop age for screening.[8] Physicians who are further out of training or non-gastroenterology endoscopists are less likely to be exposed to these recent recommendations. Measures to improve dissemination of updated guidelines may improve compliance with these recommendations. The geographical differences in proportion of screening colonoscopy recipients having limited life expectancy were not explained by colonoscopist availability, suggesting that restricting number of colonoscopists is unlikely to decrease overuse.

The sex differences in life expectancy are not reflected in the screening rates. At each age, men were more likely to be screened, and men who were screened were substantially more likely to have an estimated life expectancy of <10 years than women who were screened. Prior studies have shown that men are more likely than women to undergo screening colonoscopy.[20] This finding may reflect the somewhat higher age-adjusted incidence of colorectal cancer in men.[21] Other factors could include physician gender bias in recommending the procedure and greater concerns among women about the procedure.[22–24] For example, lack of availability of a female colonoscopist may lower acceptance among women.[22]

Providers find it difficult to integrate age and comorbidities into estimates of life expectancy.[25,26] Indeed, physicians receive little exposure in their training to estimating life expectancy.[27] Another factor may be the recent modifications in recommendations about colorectal cancer. In addition, people with multiple comorbidities (and therefore lower life expectancy) are more likely to visit multiple providers, which increases the chances of receiving testing.[28] Prior research found that individuals with multiple comorbidities and limited life expectancy also undergo routine screening for breast and prostate cancer, suggesting a widespread issue in decision-making in preventive care.[29,30] A common factor among all these tests may be an overestimation among the general public about their benefits.[31,32]

For our analysis, we defined screening colonoscopy by excluding procedures accompanied by a diagnosis on the claim or in the previous 3 months suggesting an indication other than screening. We chose this strategy instead of using the CPT code for screening colonoscopy because endoscopists continued to use diagnosis codes for screening colonoscopy after Medicare started reimbursing for screening colonoscopy in 2001. For example, in 2007–2008, although an estimated two-thirds of

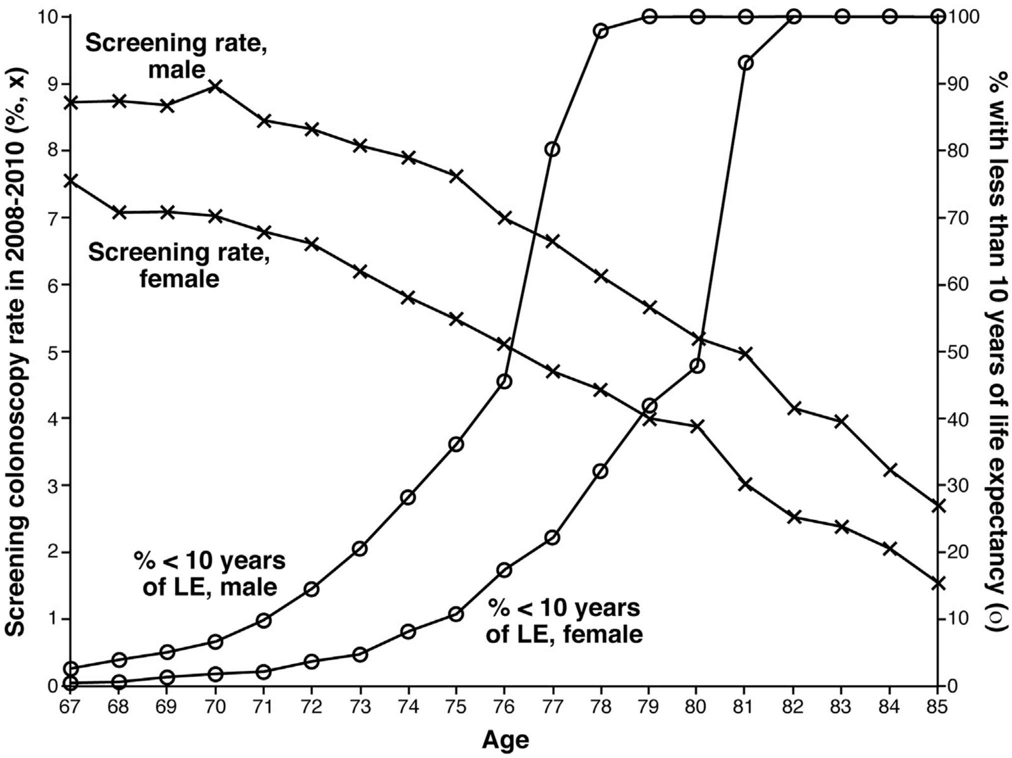

Figure 2. Screening colonoscopy rates by age for men and women and the proportions of screening colonoscopy recipients with less than 10 years of life expectancy by age for both sexes.

colonoscopies performed on Medicare beneficiaries were for screening, only 14.6% were submitted by using screening codes.[33]

The biological evidence for screening colonoscopy is based on the adenoma-carcinoma sequence. The progression rate of adenomatous polyps to cancer is low, an estimated 2.5 polyps per 1000 per year.[34] Investigators at the Mayo Clinic found that even for polyps more than 1 cm in size, the rate of conversion to cancer was 2.5% at 5 years and 8% at 10 years.[35] The average time lag is approximately 4.8 years between development of cancer and onset of clinical symptoms.[36] Indirect evidence from case-control and observational studies shows that the protective effect of screening colonoscopy lasts for at least 10 years.[37,38] Therefore, few patients with life expectancy of less than 10 years are likely to benefit from a screening colonoscopy.

We used a predictive algorithm that included age, sex, and comorbidity. The model had good predictive discrimination in a validation study, with approximately 75% of those with an estimated life expectancy of less than 10 years actually dying within 10 years.[15] A major criticism of prognostic indexes is that they lack precision at the level of the individual.[2] However, cancer screening recommendations are based on risks and benefits at the population level.[31,32]

There are some limitations to our study. The algorithm used to identify screening colonoscopies may also catch surveillance colonoscopies, and this may have led to slight overestimation of inappropriate use of screening colonoscopy. However, many surveillance colonoscopies are follow-up exams for negative screening or low-risk adenomas, and the American Gastroenterological Association guidelines published in 2012 recommend deciding about surveillance in context of life expectancy.[39,40] Few people with limited life expectancy stand to gain from surveillance colonoscopy. We did not include flexible sigmoidoscopy in the algorithm because if a flexible sigmoidoscopy triggered a colonoscopy for colitis, cancer, gastrointestinal bleeding, etc, the colonoscopy will not be considered as screening. If adenoma detected on flexible sigmoidoscopy leads to a colonoscopy, it will be captured, because we did not exclude ICD-9-CM codes for history of colon or rectal polyps. We could not capture information regarding confounders for colorectal cancer risk such as family history, smoking, and obesity. There is also the possibility of coding inaccuracies and misclassification. However, it is unlikely that these limitations explain the main study finding or the wide geographical or sex variation in results.

In summary, nearly 25% of patients receiving screening colonoscopy had limited life expectancy at time of screening, especially men. This represents a substantial proportion of colonoscopy workload and Medicare expenditure. There is a need to educate both physicians and the general public about the importance of life expectancy in determining the risk-benefit ratio for preventive screening.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Clinical*

Gastroenterology and Hepatology at www.cghjournal.org, and at http://dx.doi.org/10.1016/j.cgh.2013.08.021.

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Reprint requests
Address requests for reprints to: Sahil Mittal, MD, Section of Gastroenterology and Hepatology, Baylor College of Medicine, 1 Baylor Plaza, Houston, Texas 77030. e-mail: smittal@bcm.edu; fax: (713) 873-3505.

Conflicts of interest
The authors disclose no conflicts.

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Supplementary Appendix. Codes Used to Determine Indications of Colonoscopy

A colonoscopy was excluded when the patient was high risk for colorectal cancer or had anemia, gastrointestinal bleeding, or other relevant diagnoses on the colonoscopy claim or had a barium enema or abdominal computed tomographic scan, or a diagnosis of diverticulitis, anemia, gastrointestinal bleeding, or other relevant diagnoses in 3 months before the colonoscopy (The codes below are ICD-9-CM diagnosis codes unless indicated otherwise.)

1. High-risk diagnoses: history of colon cancer (153.0, 153.1, 153.2, 153.3, 153.4, 153.6, 153.7, 153.8, 153.9, 154.0, 154.1, 230.3, 230.4, V10.05, V10.06), inflammatory bowel diseases (555.0, 555.1, 555.2, 555.9, 556.0, 556.1, 556.4, 556.9, 556.2, 556.6, 556.8, 556.5), and other conditions where a colonoscopy might plausibly be indicated (260–263, 558.1, 560.2, 560.30, 560.39, 793.4, 783.21, 569.82, 558.1, 569.2, 569.41, 569.61, 569.62, 569.69, 569.81, 569.82, 596.1, 710.3, 863.44, 863.45, 936, 997.4, V44.3, V45.3, V55.3, V58.42, V58.49, V58.75, V67.0, V67.1, V67.9).
2. Anemia (280.0, 280.1, 280.8, 280.9, 281.0, 281.8, 281.9, 285.1, 285.2, 285.9).
3. Gastrointestinal bleeding (286.5, 459.0, 562.02, 562.03, 562.12, 562.13, 569.3, 569.84, 569.85, 569.86, 578.1, 578.9, 792.1, 998.11).
4. Other related symptoms: constipation (564.0, 564.00, 564.09, 564.01, 564.02), diarrhea (008.42, 008.43, 008.45, 008.5, 008.8, 009.0–009.3, 558.2, 558.3, 558.9, 564.4, 564.5, 564.8, 564.9, 787.91), abdominal pain (789.0, 787.3, 789.4, 789.6), ischemic bowel disease (557.0, 557.1, 557.9), irritated bowel syndrome (564.1), bowel habits change (787.99), hemorrhoid (455), and weight loss (783.2, 783.7).
5. Diverticulitis (562.11).
6. Barium enema: CPT codes 74270, 74280, Health Care Procedure Coding System codes G0106, G0120, G0122, and ICD-9-CM procedure code 87.64.
7. Abdominal computed tomographic scan: CPT codes 72191, 72192, 72193, 72194, 74150, 74160, 74170, 74175, 75635, 74261, 74262, 74263 and ICD-9-CM procedure codes 88.01, 88.02.