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Influence of Age and Comorbidity on Colorectal Cancer Screening in the Elderly

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Abstract

Introduction—Expert recommendations differ for colorectal cancer screening in the elderly. Recent studies suggest that healthy adults aged >75 years may benefit from screening. This study examined screening use and follow-up, and how they varied by health status within age strata, among a large cohort of elderly individuals in community settings.

Methods—A population-based, longitudinal cohort study was conducted among health plan members aged 65–89 years enrolled during 2011–2012 in three integrated healthcare systems

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participating in the Population-Based Research Optimizing Screening through Personalized Regimens consortium. Comorbidity measurements used the Charlson index. Analyses, conducted in 2015, comprised descriptive statistics and multivariable modeling that estimated age by comorbidity-specific percentages of patients for two outcomes: colorectal cancer screening uptake, and follow-up of abnormal fecal blood tests.

Results—Among 846,267 patients, 72% were up-to-date with colorectal cancer screening. Of patients with a positive fecal blood test, 65% received follow-up colonoscopy within 3 months. Likelihood of being up-to-date and receiving timely follow-up was significantly lower for patients aged ≥ 76 years than their younger counterparts ($p < 0.001$). Comorbidity was less influential than age, and more strongly related to timely follow-up than being up-to-date. In all age groups, considerable numbers of patients with no/low comorbidity were not up-to-date or did not receive timely follow-up.

Conclusions—In three integrated healthcare systems, many older, relatively healthy patients were not screening up-to-date, and some relatively young, healthy patients did not receive timely follow-up. Findings suggest a need for re-evaluating age-based screening guidelines and improving screening completion among the elderly.

Introduction

Although expert groups in the U.S. are consistent in recommending colorectal cancer (CRC) screening for adults aged 50–75 years as a means of reducing CRC mortality, they vary for adults aged ≥ 75 years. The U.S. Preventive Services Task Force recommends against routine screening in people aged 76–84 years with adequate prior screening, but indicates that those in this age group who have not previously been screened should be evaluated to determine whether screening is appropriate for them; it recommends against screening people aged ≥ 85 years because the benefits of screening are unlikely to outweigh the harms.¹ The U.S. Multisociety Task Force's guidelines do not specify an upper age limit,² whereas the American College of Physicians recommends discontinuing screening in adults aged ≥ 75 years and in those with a life expectancy < 10 years.³ The American Geriatrics Society recommends that screening decisions be individualized rather than set only by age.⁴ This position is reinforced by results from recent studies^{5–7} indicating that people aged ≥ 75 years without terminal illnesses may benefit from screening.

Understanding completion of CRC screening in the elderly may help in developing more-informed screening recommendations. Improved knowledge about this population is important given the rapid growth in numbers of people in the U.S. aged ≥ 65 years⁸ and because CRC is largely a disease of the elderly, with nearly 25% of cases diagnosed among those aged 75–84 years.⁹ There are knowledge gaps about CRC screening in older populations, though. Some studies indicated screening use is lower in the elderly and in those with comorbid conditions.^{10–15} Others have found that older patients and those with comorbidities are more likely to be up to date with screening, possibly because of their more frequent contact with the healthcare system.^{16–19} There also is lack of understanding of the full screening process, as prior studies have focused primarily on uptake, or one-time screening, rather than the multiple components of the screening process (uptake, follow-up of abnormal results, rescreening, or surveillance).

It is therefore difficult to determine whether CRC screening is being used appropriately in the elderly, especially among those with comorbid conditions. As viewed within the IOM's quality of healthcare framework,²⁰ screening people who might not benefit owing to advanced age or poor health status is a form of healthcare overuse.^{20–25} Conversely, older adults with excellent health status might benefit from screening, and not offering it solely on the basis of their chronological age represents a form of healthcare underuse. Finally, lack of follow-up of positive screening tests may reflect system breakdown or, for older patients who decline follow-up, a misuse of healthcare resources.²⁶

This study examined the influence of age and comorbidity on CRC screening use and follow-up of abnormal tests in a multicenter, community-based cohort of elderly patients. An assessment of screening use and follow-up among a large cohort of older patients, and how they may vary by health status within age strata, has not previously been undertaken. Study findings may help to inform clinical practice and health policy decisions regarding use of CRC screening among the elderly.

Methods

Study Setting and Design

This study was conducted within the National Cancer Institute-funded Population-Based Research Optimizing Screening through Personalized Regimens (PROSPR) consortium. PROSPR's goal is to conduct multisite, coordinated, transdisciplinary research to evaluate and improve cancer screening processes. The ten PROSPR research centers reflect the diversity of U.S. delivery system organizations. This study used data derived from three integrated healthcare systems studying the CRC screening process within PROSPR.²⁷ Group Health provides health coverage and care to approximately 600,000 members in Washington State and northern Idaho. Kaiser Permanente, Northern California and Kaiser Permanente, Southern California are integrated healthcare plans that serve a combined membership of about 7 million people. These systems contributed data on patients aged 65–89 years who were enrolled during January 1, 2011 through December 31, 2012. For Group Health, the patients included in this study were paneled with primary care providers in Group Health Medical Centers, because data on these patients are relatively complete. Patient demographics, health status, and healthcare utilization data were obtained from the systems' electronic clinical and administrative databases and submitted in standardized, structured formats to PROSPR's central data repository. Patients with a history of partial or total colectomy or invasive CRC were excluded. Comprehensive patient data for prior screening history were retrospectively available in electronic databases to 2006 for Group Health and to 1999 for Kaiser Permanente, Northern California and Southern California. Further details about PROSPR data, the CRC research centers, and their healthcare systems have been published.²⁷

The influence of elderly patients' age and comorbidity on two outcomes was evaluated:

1. being up-to-date with CRC screening; and

2. among those screened with fecal blood tests (i.e., fecal immunochemical test or guaiac-based fecal occult blood test), the likelihood of receiving follow-up colonoscopy within 3 months after a positive test result.

The term “up-to-date” is used to reflect recency of screening only, and is not a measure of guideline compliance. To ensure a sufficient look-back period for ascertaining CRC screening status as well as a 1-year look-forward period for assessing follow-up, the cohort was restricted to members continuously enrolled with no more than a 90-day enrollment gap during calendar year 2011. The final study population included 846,267 elderly individuals. All activities were approved by the IRBs at each research center and the PROSPR Statistical Coordinating Center.

Measures

Comorbidity was measured with the Charlson index²⁸ by applying a standardized electronic algorithm to the ICD-9-CM codes associated with inpatient and outpatient care episodes during calendar year 2010. The enhanced ICD-9-CM coding scheme of Quan et al.²⁹ was used to identify comorbid conditions and generate a comorbidity score for each patient. Patients were grouped into five categories (0, 1, 2, 3, and 4), with higher scores representing a greater burden of illness, or poorer health status.

Other covariates included age, sex, race/ethnicity, BMI measured in 2010, type of health insurance coverage, and whether the patient had a visit to a primary care physician (PCP) and the number of healthcare provider visits in 2011.

Patients' CRC screening status was measured as up-to-date (or not) as of December 31, 2011. Patients classified as up-to-date (regardless of age) had completed a fecal blood testing kit during the period January 1, 2010–December 31, 2011, sigmoidoscopy during January 1, 2007–December 31, 2011, or colonoscopy during January 1, 2002–December 31, 2011. Patients receiving in-office fecal blood testing (CPT code 82272) were classified as not up-to-date.

Information on fecal blood testing completion date and result (positive versus negative) was used to calculate the time from the date of a positive test to the date of colonoscopy. For patients who completed more than one fecal blood test during January 1, 2010–December 31, 2011 ($n=146,178$), the most recent abnormal test was used in assessing timely follow-up. Timely follow-up was defined as receipt of colonoscopy within 3 months of the abnormal result.³⁰ The length of the follow-up period varied by patient, depending on the date on which the test was completed. The minimum follow-up period was 12 months; the maximum was 36 months (median, 23 months). Patients who disenrolled, reached age 90 years, or died within 3 months following an abnormal test were excluded from the timely follow-up assessment ($n=20$).

Statistical Analysis

Descriptive statistics were used to characterize elderly patients' demographics, health status, healthcare access/utilization, and CRC screening and follow-up status. Percentages of patients up-to-date with screening and having timely follow-up were then calculated by age

group, adjusting for comorbidity, and by comorbidity group, adjusting for age. Multivariable logistic regression models that included age by comorbidity interaction terms were fit to assess the joint association of age and comorbidity on the likelihood of:

1. being up-to-date with screening versus not; and
2. receiving timely follow-up versus not, adjusting for all demographic (age, sex, race/ethnicity), health status (comorbidity, BMI), and healthcare access/utilization (health insurance type, recent PCP visit, number of healthcare visits, PROSPR site) characteristics in each model.

Model results, shown in the Appendix, were used to estimate age by comorbidity-specific percentages (i.e., predictive margins) of patients who were screening up-to-date, or had received timely follow-up. The predictive margin for a specific group represents the average predicted response if everyone in the study population had been in that group.^{31,32} Bootstrap resampling methods were used to calculate 95% CIs for the predictive margins. Owing to large sample sizes, the CI widths were very narrow and therefore are not displayed on the graphs in the data presentation. Sensitivity analyses were conducted to assess whether the influence of age and comorbidity on screening up-to-date varied by length of enrollment; there were no differences when comparing results for all patients versus restricted to patients with 10 years (Kaiser Permanente, Northern California and Southern California) or 6 years (Group Health) of enrollment (data not shown).

Analyses were conducted in 2015 using SAS, version 9.4 and R, version 3.2.3.

Results

Sixty-four percent of study members were aged 65–75 years, while 28% were aged 76–84 years and 8% were aged 85–89 years (Table 1). One half had a Charlson score of 0, 21% had a score of 1, 20% had scores of 2 or 3, and 10% had a score of 4. Fifty-five percent were female and 61% were non-Hispanic white. Ninety percent had both Medicare and commercial health insurance coverage. More than 90% had a PCP visit in 2011, whereas 5% had no healthcare provider visits in that year. Seventy-two percent had been continuously enrolled in the healthcare systems for 10 years.

Seventy-two percent of study members were up-to-date with CRC screening (Table 2). This ranged from 86% for those aged 70–75 years to 32% for those aged 85–89 years, and from 73% for individuals with a Charlson score of 0 or 1 to 70% for those with a score of 4. Of those who were up-to-date, 38% were screened by fecal blood testing only, 36% by colonoscopy only, 8% by sigmoidoscopy only, and 18% by a combination of tests. Among those aged 65–69 and 70–75 years, screening with fecal blood testing only was most common, followed by colonoscopy only (Figure 1A). Among patients aged >75 years, the percentages up-to-date by colonoscopy only were similar to those for the younger age groups, but lower percentages were up-to-date by fecal blood testing. When examined by Charlson score groupings, screening with fecal blood testing only was less common with increasing comorbidity (Figure 1B).

Multivariate-adjusted percentages of patients who were up-to-date with screening are shown in Figure 2A. Patients aged 70–75 years with a Charlson score of 0 were the most likely to be up-to-date (89%); the likelihood of being up-to-date decreased with greater comorbidity to 84% for patients with a Charlson score of 4. The percentages of patients who were up-to-date were slightly lower among those aged 65–69 years, ranging from 88% for those with a Charlson score of 0 to 82% for those with a score of 4. Significantly lower percentages of patients aged 76–84 and 85–89 years were up-to-date. For example, 56% of patients aged 76–84 years with a Charlson score of 0 were up-to-date, as were 56% of patients in this age group with a score of 4. Among patients aged 85–89 years, 30% of those with a Charlson score of 0 were up-to-date, increasing to 37% for patients with a score of 4. All age group and comorbidity score pairwise comparisons were statistically significant ($p<0.001$).

Among patients screened with fecal blood testing, 8.5% had a positive result, and 65% of those received timely follow-up (Table 2). Timely follow-up was highest for patients aged 65–69 years (69%) and lowest for those aged 85–89 years (37%); it was highest for patients with a Charlson score of 0 (69%) and lowest for those with a score of 4 (53%).

Multivariate-adjusted percentages of patients who received timely follow-up are shown in Figure 2B. The percentages of patients receiving timely follow-up were highest for the younger age groups and decreased with greater comorbidity. Among patients aged 65–69 years with a Charlson score of 0, 75% received timely follow-up, compared with 57% of those with a score of 4. In patients aged 70–75 years, 71% of those with a Charlson score of 0 received timely follow-up, decreasing to 54% for patients with a Charlson score of 4. Among patients aged 76–84 years with a Charlson score of 0, 63% received timely follow-up, compared with 45% of those with a score of 4. In those aged 85–89 years, 43% of patients with a Charlson score of 0 received timely follow-up, compared with 29% of those with a score of 4. All age group and comorbidity score pairwise comparisons were statistically significant ($p<0.001$).

Discussion

Completion of CRC screening—including follow-up of abnormal tests—among the elderly is an understudied area that is important for patients, clinicians, policymakers, and researchers to consider so that screening resources are directed to those who may benefit most. This study used data from a multisite research consortium that is evaluating cancer screening processes in community settings to assess how patient age and comorbidity are related to CRC screening completion, and found that 72% of all individuals aged 65–89 years were up-to-date with screening. Of those up-to-date by fecal blood testing and having a positive result, 65% received follow-up colonoscopy within 3 months. However, these estimates varied by patient age and comorbidity. Age was more strongly related than comorbidity to both screening up-to-date and timely follow-up. Comorbidity was more strongly related to timely follow-up than to screening up-to-date. In all age groups, considerable numbers of patients with no or low comorbidity were not up-to-date with screening or did not receive timely follow-up.

The finding that age has greater influence than comorbidity on CRC screening use in the elderly is consistent with practice guidelines that emphasize age cut offs in determining who should be screened.^{1,3} The physicians and health systems represented in this study appear to be adhering to age-focused guidelines. Yet, evidence from clinical trials and simulation models and some guidelines are evolving to reflect the varied health status of the elderly population.^{33,34} In particular, the concept of “health-adjusted age” has been introduced in recognition of healthy seniors who exceed chronological age limits and may benefit from screening.^{6,35} However, the lack of tools to assist clinicians and elderly patients in shared decision making about screening that incorporates the patient's age, health status, preferences, and ability to tolerate screening tests and interventions presents a significant challenge to implementing guidelines that call for more-individualized recommendations. Moreover, the quality metrics measuring clinicians' screening performance in many healthcare systems will need to be modified to support individualized as opposed to age-based screening.³³

The finding that the likelihood of receiving timely follow-up after a positive fecal blood test decreases with increasing age and comorbidity is especially concerning, because the elderly patients in this study were all insured members of integrated healthcare systems with comprehensive patient tracking, advice, and proactive scheduling of colonoscopy appointments that many small primary care practices lack.^{36,37} Initiating fecal blood testing in elderly patients without ensuring a desire for and receipt of timely follow-up is a potential misuse of healthcare resources. The elderly may present special challenges to completing timely follow-up because of such issues as mobility limitations, transportation barriers, and difficulties with pre-colonoscopy bowel preparation. More in-depth examination of the patient, provider, and healthcare system factors that affect follow-up in the elderly is needed.

Of particular note were the elderly patients in all age groups with low or no comorbidity who were not screening up-to-date or did not receive timely follow-up. Evidence and some expert groups indicate that relatively healthy adults aged >75 years may benefit from screening.^{1,2,4-7} The importance of timely follow-up for anyone undergoing cancer screening is also widely acknowledged. Especially because more than 90% of the elderly patients in this study had a recent PCP visit, these results point to the need for improved communication about and monitoring systems for CRC screening among patients aged 65 years.

Limitations

Study limitations include lack of information on patient preferences for CRC screening, functional limitations, and family history of CRC. The measure of screening up-to-date was a prevalence outcome ascertained with retrospective data, and true CRC screening status may have been underascertained. For some patients, only limited information on CRC testing prior to the study period was available, and chart review to determine CRC screening status prior to healthcare system enrollment was not conducted. Timely follow-up of positive fecal occult blood testing/fecal immunochemical testing may have been slightly overestimated because a small proportion of patients (<10%) had more than one positive fecal occult blood test/fecal immunochemical test, and the study assessed timely follow-up

for the most recent as opposed to the first positive test. Differences in CRC screening and follow-up policies and practices attributable to clinicians or facilities were not fully captured. Comorbidity was measured with the Charlson index, which does not fully incorporate disease severity nor some conditions such as depression, arthritis, and osteoporosis that are common in the elderly. Finally, although the study did not distinguish between procedures done for screening versus diagnostic purposes, including all procedures is an acceptable approach when estimating the percent of patients up-to-date with CRC screening.³⁸

Conclusions

In the U.S, CRC is a common and costly disease, and its burden is borne largely by the elderly.^{8,39} This study documented underuse of both CRC screening and timely follow-up among a large cohort of elderly patients who were members of three integrated healthcare systems in the western U.S. Findings support those of a recent study showing low national rates of both CRC screening and provider recommendation among U.S. seniors aged 76–84 years.⁴⁰ There are many opportunities for improvement in screening completion among the elderly. Primary care practices need to develop and integrate systems to support individual decision making, including risk assessment tools that consider age and comorbidity in estimates of benefits and harms. Information about invasive follow-up tests should be presented at the time of initial screening to ascertain patient preferences and willingness to complete the entire screening process.⁴¹ More research is needed to understand facilitators of and barriers to completing CRC screening, including timely follow-up of abnormal tests, in the elderly. Multilevel interventions addressing patient-, provider-, and system-level factors also are needed to support appropriate use and completion of screening in this population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
 Elderly patients' colorectal cancer screening status
 A. By age group, adjusted for comorbidity.
 B. By Charlson comorbidity score, adjusted for age.

Figure 2.
Multivariate-adjusted percentages of elderly patients by age group and comorbidity score
A. Up-to-date with colorectal cancer screening
B. Receiving timely follow-up

Table 1

Characteristics of Elderly Patients in Three Health Systems (n=846,267)

Characteristics	n	%
Age		
65-69	298,027	35.2
70-75	247,575	29.2
76-84	234,963	27.8
85-89	65,702	7.8
Charlson comorbidity score		
0	421,230	49.8
1	172,972	20.4
2	117,352	13.9
3	53,511	6.3
4+	81,202	9.6
Sex		
Male	380,774	45.0
Female	465,471	55.0
Missing	22	0.0
Race/ethnicity		
NH white	519,210	61.3
NH black	66,683	7.9
NH Asian/Pacific Islander	90,243	10.7
Hispanic	125,685	14.9
NH other (includes American Indian/Alaska Native and multiple races)	3,630	0.4
Unknown/missing	40,816	4.8
BMI (kg/m ²)		
<25	249,459	29.5
25 to <30	313,199	37.0
30 to <35	161,655	19.1
35+	88,414	10.4
Missing	33,540	4.0
Health insurance		
Medicare + commercial	763,238	90.2
Medicare only	30,848	3.7
Medicaid any	26,410	3.1
Commercial/private only	25,752	3.0
Other/missing/unknown	19	0.0
PCP visit in 2011		
No	77,821	9.2
Yes	768,446	90.8
# health care visits in 2011		

Characteristics	n	%
0	44,310	5.2
1	59,422	7.0
2-5	271,347	32.1
6-9	181,045	21.4
10+	290,143	34.3
# of years of continuous enrollment prior to 12/31/2011		
1-<5	87,733	10.4
5-<10	152,328	18.0
10+	606,206	71.6
PROSPR site		
KPSC	384,417	45.4
KPNC	407,896	48.2
Group Health	53,954	6.4

NH, non-Hispanic; PROSPR, Population-Based Research Optimizing Screening through Personalized Regimens; KPNC, Kaiser Permanente, Northern California; KPSC, Kaiser Permanente, Southern California; PCP, primary care physician

Table 2

Colorectal Cancer Screening and Follow-up Status Among Elderly Patients in Three Health Systems
(n=846,267)

Status		n	%
Colorectal cancer screening uptake ^a			
Up-to-date (all)		612,788	72.4
By age:	65-69	248,292	83.3
	70-75	213,137	86.1
	76-84	130,250	55.4
	85-89	21,109	32.1
By Charlson score:	0	305,209	72.4
	1	128,563	74.3
	2	84,991	72.4
	3	37,495	70.1
	4+	56,530	69.6
Type of colorectal cancer screening (for those up-to-date)			
Fecal blood test (FIT or gFOBT)		233,259	38.1
Colonoscopy		219,686	35.9
Sigmoidoscopy		49,580	8.1
Test combination ^b		110,263	18.0
Positive fecal blood test (for those screened with FIT or gFOBT)		27,517	8.5
Received timely follow-up of positive fecal blood test ^c			
Yes (all)		17,854	64.9
By age:	65-69	7,602	68.8
	70-75	7,394	66.8
	76-84	2,543	55.9
	85-89	315	37.1
By Charlson score:	0	7,963	69.1
	1	3,908	66.6
	2	2,718	64.6
	3	1,238	59.0
	4+	2,027	53.2

FIT, Fecal Immunochemical Test; gFOBT, Guaiac-based Fecal Occult Blood Test

^aUp-to-date with screening is defined as having fecal blood testing in the past 24 months, sigmoidoscopy in the past 5 years, or colonoscopy in the past 10 years.

^bIncludes fecal blood testing + Sigmoidoscopy; fecal blood testing + Sigmoidoscopy + Colonoscopy; fecal blood testing + Colonoscopy where the fecal blood test result is normal

^cTimely follow-up of a positive fecal blood test is defined as receiving colonoscopy within 3 months of fecal blood test completion.