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Prevalence of Colonoscopy Before Age 50

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Abstract

Objective—Describe the prevalence of colonoscopy before age 50, when guidelines recommend initiation of colorectal cancer screen for average risk individuals.

Method—We assembled administrative health records that captured receipt of colonoscopy between 40 and 49-years of age for a cohort of 204,758 50-year-old members of four US health plans and used backward recurrence time models to estimate trends in receipt of colonoscopy before age 50 and variation in early colonoscopy by age and sex. We also used self-reported receipt of colonoscopy from 27,157 40- to 49-year-old respondents to the 2010 National Health Interview Survey (NHIS) to estimate the association between early colonoscopy and sex, race/ethnicity, and geographic location based on logistic regression models that accounted for the complex NHIS sampling design.

Results—About 5% of the health plan cohort had a record of colonoscopy before age 50. Receipt of early colonoscopy increased significantly from 1999 to 2010 (test for linear trend, $p < 0.0001$), was more likely among women than men (RR= 1.9, 95% CI 1.14–1.24) and in the east coast health plan compared to west coast and Hawaii plans. The NHIS analysis found that early

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Note: Elements of the data infrastructure were developed for the HMO Cancer Research Network Virtual Data Warehouse (U19 CA 79689, to Wagner/Hornbrook/Kushi³⁹).

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colonoscopy was more likely in Northeastern residents compared to residents in the West (odds ratio = 1.75, 95% CI 1.28–2.39).

Conclusion—Colonoscopy before age 50 is increasingly common.

Introduction

Randomized trials,^{1–7} observational studies,⁸ and modeling analyses^{9–11} have demonstrated that colorectal cancer (CRC) screening effectively reduces both CRC incidence and mortality. National guidelines recommend that average-risk individuals begin colorectal cancer (CRC) screening at age 50,^{12–16} with colonoscopy every 10 years, flexible sigmoidoscopy every 5 years, or high-sensitivity fecal occult blood tests every year. Rates of CRC screening in US adults over 50 have increased over time, and about 62% of eligible US adults participate in CRC screening.^{16–18} There remains considerable room for improvement in CRC screening rates, as evidenced by the recent National Colorectal Cancer Round-table “80% by 2018” initiative to regularly screen 80% of adults 50 and older for colorectal cancer.¹⁹ Among those screened, colonoscopy is now the most commonly used test.²⁰

It is difficult to estimate colorectal cancer screening rates because structured procedure codes, including version 9 of International Classification of Disease diagnosis codes, Current Procedural Terminology codes, and Health Care Procedure Coding System procedure codes, do not distinguish colonoscopy exams carried out for screening from those carried out for diagnostic evaluation of signs and symptoms or exams carried out for ongoing adenoma surveillance or surveillance of other conditions such as inflammatory disease. Several groups have attempted to develop algorithms to identify screening exams using administrative records with varying degrees of success.^{21, 22,23–26}

An alternative approach to understanding screening is to focus on receipt of test among individuals who become eligible at age 50, assuming that most 50-year-olds are screening eligible.²⁷ But there is limited information to support this assumption, and individuals may be misclassified as non-adherent to screening because of earlier testing. Receipt of colonoscopy before age 50 poses special challenges when analyzing health records data because individuals with negative colonoscopy findings (no adenomas) are not eligible to return for screening for ten years after the negative exam, and so may incorrectly appear to be non-adherent to screening. In this report, we describe secular trends in receipt of colonoscopy before age 50 and variation in this early testing by patient age and sex.

Materials and Methods

Our primary analyses use a retrospective cohort study to estimate receipt of colonoscopy between the ages of 40 and 50 among adults who were enrolled in one of four U.S. managed care organizations on their 50th birthday, and whose 50th birthday was between January 1, 1999 and December 31, 2007. Two sites provided additional data for individuals who turned 50 between 1/1/2008 and 12/31/2010. All four organizations participate in the HMO Cancer Research Network²⁸: Group Health Cooperative (GHC) in western Washington State; Kaiser Permanente in Hawaii; Kaiser Permanente Northwest in Oregon and southern Washington states; and Reliant Medical Group in central Massachusetts. All sites have

electronic utilization data from their member populations dating back to at least 1995. The Institutional Review Boards at each participating institution approved this project.

We used electronic administrative and medical records data to identify eligible adults and receipt of colonoscopy. Individuals entered the cohort on their 40th birthday or upon health plan enrollment between the ages 40 and 50. Because our focus was on colonoscopy before age 50 in individuals who were otherwise CRC-screening eligible, individuals diagnosed with CRC or who had colectomy before age 50 were excluded from analyses. Cancer diagnosis was ascertained from state and local tumor registries. Colectomy was ascertained from procedure codes (Current Procedural Terminology (CPT) and International Classification of Diseases, ninth revision (ICD-9)). Available data included each individual's sex, health plan enrollment dates, procedure and test dates (colonoscopy, flexible sigmoidoscopy, and fecal tests), age at the time of each procedure or test, and age on December 31st of each year. Colonoscopy was identified using procedure codes (CPT codes: 45378-45388, 45391, 45392, G0105, G0121; ICD-9 codes 45.21, 45.23, 45.25, 45.43, 98.04).

We used proportional hazards backward recurrence time models to estimate the prevalence of colonoscopy before age 50,²⁹ with analyses carried out in R using the "Efron" method to adjust for tied event times.³⁰ The starting point for backward recurrence models was the earlier of December 31st in an individual's 50th birth-year or their earliest tests/procedures once age 50. We looked back from this starting point to the most recent of the following events: colonoscopy at or after age 40, January first of the year of their 40th birthday, enrollment in the health plan, or the beginning of data capture. Subjects with colonoscopy before age 50 had the event of interest. All other individuals were censored. Backward recurrence time models assume that censoring and event time distributions are independent, that is, that the probability of receiving a colonoscopy between the ages of 40 and 50 is independent of the age at entry to the cohort.

Proportional hazards models included the year the individual turned 50, sex, and health plan. The year of 50th birthday was included in models as a categorical variable with a test for linear trend. Because this was a large dataset, we evaluated the proportional hazards assumption using plots of weighted residuals, rather than focusing on tests of statistical significance.³¹ To provide an alternative description of secular trends, we estimated of the percentage of individuals with colonoscopy between the ages of 40 and 50 by combining the estimates from the proportional hazards model with the estimated baseline hazard.³⁰

Supplementary analyses used data from the 2010 National Health Interview Survey (NHIS)^{20, 32} to estimate systematic differences in receipt of colonoscopy among 40- to 49-year-olds across geographic regions. The NHIS is a cross-sectional survey of the civilian non-institutionalized United States population that collects data on a broad range of health topics. Households are selected for participation using a multistage area probability-design, permitting representative sampling of households. In conducting the statistical analyses, we used logistic regression models to estimate the odds of colonoscopy as a function of geographic region, adjusting for sex, race/ethnicity, and insurance coverage while accounting for NHIS's complex survey design. These analyses were carried out in Stata³³.

Results

The health plan cohort included data from 204,765 individuals (Table 1). Overall, 4.9% of the cohort (n=10,100) had a colonoscopy documented in their medical record data before age 50. The average length of time in the cohort prior to 50th birthday was 4.7 years (4.8 years among participants without colonoscopy) and ranged from 4 days to 11 years, with a median of 4 years. Among cohort members with documented colonoscopy before age 50, the average age at colonoscopy was 47.2 years. The average age at colonoscopy was similar from 1999 to 2010 (range 46.9 to 47.9). The distribution of the age at most recent colonoscopy among those with early colonoscopy was: 37% (N=3972) at 49 years old, 22% (N=2360) at 48 years old, 15% (N=1611) at 47 years old, 10% (N=1059) at 46 years old, 7% (N=745) at 45 years old, and 10% (N=1044) between the ages of 39 and 44 years old.

Estimates based on a backward recurrence model (Table 2) indicate that colonoscopy before age 50 was more likely for women than men, and increased over time (test for linear trend, $p<0.001$). Individuals who turned 50 in 2010 were more than three times as likely to have had a prior colonoscopy compared to those turned 50 in 1999. The estimated proportion of individuals with colonoscopy before 50 varied across health plans; Compared to Group Health, Reliant members were more than twice as likely to have colonoscopy before 50, while members of Kaiser-Hawaii and Kaiser Northwest health plans were less likely to have colonoscopy before 50. In Table 3 we reformulate these results as estimated percentages of individuals with colonoscopy before age 50 in 1999 and 2010. These estimates demonstrate that between 1999 and 2010 the percentage of health plan members with colonoscopy before 50 increased, and also show differences in the percentage with early colonoscopy across health plans and for men versus women.

The NHIS sample included 4,820 40–49 year olds, an estimated 5.9% of whom had previously undergone colonoscopy. Logistic regression models that adjusted for gender, race, and insurance status found that, compared to respondents in the West, the relative odds of colonoscopy was 1.75 (95% confidence interval (CI): 1.28–2.39) in the Northeast, 1.42 (95% CI 1.03–1.94) in the North Central and Midwest region, and 1.81 (95% CI 1.35–2.41) in the South.

Discussion

Colonoscopy before age 50 is becoming more common. These increases parallel the increase in CRC screening observed in individuals 50–75.¹⁶ We found higher rates of early colonoscopy among individuals enrolled in the East Coast health plan compared to plans in the western United States, findings that were corroborated in analysis of a nationally representative sample of adults in the United States.

Backward recurrence time models, which account for incomplete look-back information, indicate that in 2010 more than 10% of the insured population is likely to have had colonoscopy before age 50. Results from analysis of health plan data, in combination with NHIS results, suggest that rates of early colonoscopy may be even higher in the Northeastern United States. This has implications for observational studies of screening, as

well as health plan reporting of patient uptake of colonoscopy, particularly among patients who change health plans around their 50th birthday. Health plans could capture receipt of colonoscopy prior to enrollment by directly asking members about their testing history, including results from colonoscopy and resulting pathology that drive the need for further screening and surveillance. If these patient reports were documented in the medical record, this could, in turn, benefit both clinical care and ongoing research focused on screening behaviors and outcomes.

Our study was limited by available data. We studied individuals who were insured in managed care organizations. Rates of early colonoscopy may differ for individuals in other types of insurance plans. Uninsured individuals may be less likely to have early colonoscopy. It is not clear yet how the Affordable Care Act will impact rates of early colonoscopy. In the insured cohort that we studied, individuals who turned 50 in 1999 had an average of only 2.7 years of prior enrollment history, while those who turned 50 in 2010 had an average of over 6 years of prior enrollment history. Estimates of the percentage of health plan members who underwent colonoscopy between 40 and 50 years old were possible because we assumed proportional hazards with a common baseline hazard. We also had very limited patient-level covariate information. For each patient, we had age on December 31st and age at time of exam, but we did not have date of birth. Though we were able to exclude colonoscopy that occurred at age 50, some of the look-back will include periods when patients were 50 years old. We also lacked information about patient race/ethnicity, which may be related to receipt of early colonoscopy.

Several factors could drive increasing rates of colonoscopy before age 50, such as increasing awareness of the symptoms of CRC, greater understanding and measurement of family history, changing guidelines,^{14, 34, 35} and the diffusion of colonoscopy as a screening test.^{20, 36–38} Colonoscopy before age 50 is relatively common, yet there are many open questions related to this practice. Further study is needed to understand the factors driving increases in colonoscopy before 50, the effectiveness of screening before 50 to prevent CRC, whether this early colonoscopy represents over-use, symptomatic assessment, or high-risk screening, and how early colonoscopy is related to later screening adherence and CRC.

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Highlights

- In 2010 more than 107.9% of insured individuals had colonoscopy between the ages of 40 and 49
- Colonoscopy between the ages of 40 and 49 increased significantly from 1999 to 2010
- Colonoscopy between the ages of 40 and 49 was more likely for women than men
- Colonoscopy between the ages of 40 and 49 was most common in the Northeastern U.S.

Table 1

Description of study sample and estimated relative risk of colonoscopy before age 50, based on a backward recurrence time model.

Characteristic	Percent of the Cohort (N)	Relative Risk	95% CI
Gender			
Male	46.7% (95,647)	reference	
Female	53.3% (109,118)	1.19	(1.14, 1.24)
Health Plan			
Reliant	5.5% (11,241)	2.19	(2.03, 2.37)
Group Health	35.5% (72,803)	reference	
Kaiser-Hawaii	15.5% (31,821)	0.59	(0.55, 0.64)
Kaiser-Pacific Northwest	43.4% (88,900)	0.75	(0.72, 0.79)
Year of 50th birthday			
1999	8% (16,848)	reference	
2000	9% (18,493)	1.27	(1.08, 1.49)
2001	9% (18,992)	1.44	(1.24, 1.69)
2002	9% (19,609)	1.72	(1.48, 2.00)
2003	9% (19,112)	1.91	(1.64, 2.21)
2004	9% (19,162)	2.10	(1.82, 2.43)
2005	9% (18,658)	2.23	(1.93, 2.58)
2006	9% (18,481)	2.72	(2.36, 3.14)
2007	9% (17,827)	2.82	(2.44, 3.25)
2008	6% (12,669)	3.17	(2.74, 3.67)
2009	6% (12,310)	3.58	(3.10, 4.14)
2010	6% (12,604)	3.76	(3.26, 4.35)

Table 2

Model-based estimates of the percentage of 50 year olds with colonoscopy in the last 10 years, with 95% confidence intervals.

	1999	2010
Men		
GHC	3.6% (3.1%, 4.1%)	12.9% (12.1%,13.7%)
Reliant	7.8% (6.6%, 8.8%)	26.2% (23.9%,28.4%)
KPH	2.2% (1.8%, 2.5%)	7.9% (7.1%, 8.6%)
KPNW	2.7% (2.4%, 3.1%)	9.9% (9.3%,10.6%)
Women		
GHC	4.3% (3.7%, 4.8%)	15.2% (14.3%,16.1%)
Reliant	9.2% (7.8%,10.5%)	30.3% (27.8%,32.7%)
KPH	2.6% (2.2%, 2.9%)	9.3% (8.5%, 10.2%)
KPNW	3.2% (2.8%, 3.7%)	11.7% (11.0%,12.4%)

Table 3

Estimated odds ratios of prior colonoscopy among 40- to 49-year-old participants in the 2010 National Health Interview Survey, based on a logistic regression model.

Characteristic	Relative Risk	95% CI
Gender		
Male	reference	
Female	0.95	(0.77,1.17)
Race/Ethnicity		
Non-Hispanic white	reference	
African American	1.10	(0.83,1.43)
Asian-Pacific	0.53	(0.34,0.81)
Hispanic	0.97	(0.72,1.22)
All others	0.96	(0.48,1.91)
Insurance		
Private	reference	
Government-Sponsored	1.32	(0.94, 1.85)
All others	0.62	(0.47, 0.82)
Region *		
West	reference	
Northeast	1.75	(1.28,2.39)
Midwest	1.42	(1.03,1.94)
South	1.81	(1.35,2.41)

* **West:** Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming; **Northeast:** Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont; **Midwest:** Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; **South:** Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia.