

Time to Follow-up After Colorectal Cancer Screening by Health Insurance Type



Nancy Breen, PhD,¹ Celette Sugg Skinner, PhD,^{2,3} Yingye Zheng, PhD,⁴ Stephen Inrig, PhD,²
Douglas A. Corley, MD, PhD,⁵ Elisabeth F. Beaber, PhD,⁴ Mike Garcia, MS,⁴ Jessica Chubak, PhD,⁶
Chyke Doubeni, MD, MPH,⁷ Virginia P. Quinn, MD,⁸ Jennifer S. Haas, MD, MSPH,^{9,10}
Christopher I. Li, MD, PhD,⁴ Karen J. Wernli, PhD,⁶ Carrie N. Klabunde, PhD,¹¹
on behalf of the PROSPR consortium

Introduction: The purpose of this study was to test the hypothesis that patients with Medicaid insurance or Medicaid-like coverage would have longer times to follow-up and be less likely to complete colonoscopy compared with patients with commercial insurance within the same health-care systems.

Methods: A total of 35,009 patients aged 50–64 years with a positive fecal immunochemical test were evaluated in Northern and Southern California Kaiser Permanente systems and in a North Texas safety-net system between 2011 and 2012. Kaplan–Meier estimation was used between 2016 and 2017 to calculate the probability of having follow-up colonoscopy by coverage type. Among Kaiser Permanente patients, Cox regression was used to estimate hazard ratios and 95% CIs for the association between coverage type and receipt of follow-up, adjusting for sociodemographics and health status.

Results: Even within the same integrated system with organized follow-up, patients with Medicaid were 24% less likely to complete follow-up as those with commercial insurance. Percentage receiving colonoscopy within 3 months after a positive fecal immunochemical test was 74.6% for commercial insurance, 63.10% for Medicaid only, and 37.5% for patients served by the integrated safety-net system.

Conclusions: This study found that patients with Medicaid were less likely than those with commercial insurance to complete follow-up colonoscopy after a positive fecal immunochemical test and had longer average times to follow-up. With the future of coverage mechanisms uncertain, it is important and timely to assess influences of health insurance coverage on likelihood of follow-up colonoscopy and identify potential disparities in screening completion.

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From the ¹Office of Science Planning, Policy, Analysis, Reporting and Data, National Institute on Minority Health and Health Disparities, NIH, Bethesda, Maryland; ²Department of Clinical Sciences, Parkland Health and Hospital System/University of Texas Southwestern Medical Center, Dallas, Texas; ³Department of Population Sciences, Simmons Comprehensive Cancer Center, Dallas, Texas; ⁴Department of Biostatistics, Public Health Science Division, Fred Hutchinson Cancer Research Center, Seattle, Washington; ⁵Division of Research, Kaiser Permanente San Francisco Medical Center, San Francisco, California; ⁶Kaiser Permanente Washington Health Research Institute, Seattle, Washington; ⁷Department of Family Medicine and Community Health, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania; ⁸Research and

Evaluation, Kaiser Permanente Southern California, Los Angeles, California; ⁹Brigham and Women's Hospital, Boston, Massachusetts; ¹⁰Harvard Medical School, Boston, Massachusetts; and ¹¹Office of Disease Prevention, NIH, Bethesda, Maryland

Address correspondence to: Nancy Breen, PhD, Office of Science Planning, Policy, Analysis, Reporting and Data, National Institute on Minority Health and Health Disparities, NIH, 6707 Democracy Blvd., Suite 800, MSC 5465, Bethesda MD 20850. E-mail: breenn@mail.nih.gov.
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INTRODUCTION

Annual high-sensitivity stool blood testing is one of several recommended screening options for colorectal cancer (CRC).^{1–3} Stool tests, the least expensive screening option, may have higher rates of initial uptake than colonoscopy.^{4–7} Positive stool tests require follow-up evaluation with diagnostic colonoscopy. Modeling studies suggest colonoscopy and annual fecal immunochemical testing (FIT) have similar effectiveness with perfect adherence⁸ but real-world failures in diagnostic follow-up undermine FIT effectiveness^{9–11} and may compound disparities in screening process completion.^{12,13}

Previous studies have documented highly variable rates for time to follow-up colonoscopy, but few have assessed influence of insurance type. In a study that did not examine insurance, Chubak et al.¹⁴ found completion of follow-up colonoscopy within 12 months varied from 58% to 84% among four health systems; rates were lowest for patients aged 70–89 years, with higher comorbidity scores, and with no previous CRC screening. A study within a large group practice in the northeast found uninsured patients were half as likely as insured patients to undergo follow-up colonoscopy, but findings for Medicaid patients were inconclusive.¹⁵ A randomized trial in a safety-net system serving 25% of Denver, Colorado, residents found patient navigation improved follow-up colonoscopy among commercially insured patients to 94%, but non-attendance remained at 42% among Medicaid patients.¹⁶

The limited literature on the association between health insurance coverage and follow-up of abnormal CRC tests stands in contrast to the large body of work documenting the association between health insurance and initial CRC screening,^{17–21} which consistently shows that commercially insured individuals are more likely to be screened.^{19,22} With Medicaid expansion and new health insurance products introduced in the U.S. through the Affordable Care Act, and with the future of these coverage mechanisms uncertain, it is important and timely to assess the influence of health insurance coverage and setting on likelihood of follow-up colonoscopy and identify potential disparities in screening completion.²³

This study assessed differences in follow-up after a positive FIT by coverage type in three integrated health systems. Whether completion of follow-up colonoscopy varied by coverage type and health system is evaluated. Additionally, patient characteristics associated with completion in two of the systems are examined. The authors hypothesize that patients with Medicaid insurance or Medicaid-like (i.e., Health Plus) coverage will

have longer times to follow-up than patients with commercial insurance, within the same healthcare system.

METHODS

Study Population

This study was conducted as part of the National Cancer Institute's Population-based Research Optimizing Screening through Personalized Regimens (PROSPR) consortium. Described in detail elsewhere,²⁴ PROSPR's overall aim is to conduct multisite, coordinated, transdisciplinary research to evaluate and improve cancer screening processes within diverse healthcare organizations. Data were collected from three integrated health systems evaluating CRC screening: Kaiser Permanente Northern California (KPNC), Kaiser Permanente Southern California (KPSC), and Parkland Health and Hospital System/University of Texas Southwestern Medical Center (PHHS/UTSW). KPNC and KPSC include members insured through commercial plans and through California's Medicaid (Medi-Cal) program. Parkland is an integrated safety-net system of 11 primary care clinics, specialty clinics, and a large hospital funded by Dallas County. Parkland Health and Hospital System is the sole safety-net provider for under- and un-insured Dallas county residences living at <200% of the federal poverty level. Eighty-five percent of Parkland patients received coverage for care through Health Plus. Having one primary care visit during calendar year 2010 was the inclusion criterion for PHHS/UTSW patients. Enrollment in the system in the previous year was the criterion used for inclusion for KPNC and KPSC patients.

The study population included patients aged 50–64 years without colectomy or invasive CRC. Because the goal was to compare time to follow-up after FIT in the three systems, and PHHS/UTSW serves few patients aged >65 years, patients aged ≥65 years were excluded. Data relevant to the CRC screening process were obtained from electronic medical records and clinical and administrative databases, standardized using common data definitions, and submitted to PROSPR's central data repository. All activities were approved by IRBs at each health system and the Fred Hutchinson PROSPR Statistical Coordinating Center.

Analyses were restricted to patients with a positive FIT between January 1, 2011, and December 31, 2012. The first positive FIT recorded was defined as the index test. Because of the focus on insurance coverage, patients with no insurance information during the calendar year prior to index test ($n=5,708$) and without insurance types of interest ($n=4,531$) were excluded (except for Parkland Health Plus patients), including 4,125 patients covered exclusively by Medicare,^a and 364 patients dual enrolled in Medicaid/Medicare. Patients with missing FIT dates ($n=41$) also were excluded. The final analytic cohort included 35,009 patients (18,335 from KPNC, 16,326 from KPSC, and 348 from PHHS/UTSW).

Measures

The main variable of interest—coverage type—was derived from the PROSPR electronic database and categorized as commercial, only Medicaid, or Health Plus (PHHS/UTSW). Nearly all partici-

^aRationale: Medicare coverage prior to age 65 years requires disability or end-stage renal disease.

pants (95.2%) maintained the same coverage type throughout the study period.

Other variables included age at index FIT; race/ethnicity (Hispanic, non-Hispanic [NH] white, NH black, NH Asian, or NH other); sex (male/female); number of primary care visits (zero, one, or two or more); Charlson comorbidity score (0, 1, 2, or ≥ 3); median household income for ZIP code (<\$20,000, \$20,000 to <\$50,000, \$50,000 to <\$100,000, or \geq \$100,000); BMI (<25, 25 to <30, 30 to <35, ≥ 35); and prior CRC testing (FIT, colonoscopy, or sigmoidoscopy prior to index FIT). All covariates except age were measured in the calendar year prior to index FIT.

Primary outcome was time to any follow-up colonoscopy. Patients with no colonoscopy during the follow-up period were censored when they exited the study because of age (65 years); health plan disenrollment; death; or study end date (December 31, 2012), whichever occurred first. Though the effect on CRC mortality of different intervals to follow-up colonoscopy is unknown,^{25,26} diagnostic colonoscopy ≤ 3 months after positive FIT is defined by the PROSPR consortium as timely follow-up.²⁷

Statistical Analysis

Characteristics of patients who received an index FIT are shown by coverage type in [Table 1](#). Time-to-event analyses were used to account for right-censored data.²⁸ Kaplan–Meier estimators were used to compare probabilities of follow-up colonoscopy after abnormal FIT for four intervals (60 days and 3, 6, and 12 months) by coverage type and health system. Log-rank tests assessed statistical significance of differences. Median time to follow-up by insurance type is estimated with 95% CIs using bootstrap resampling.

For KPNC and KPSC, a Cox proportional hazards model tested whether, among people within the same system, rates of follow-up colonoscopy differed by coverage type, adjusting for demographics, health status, prior CRC testing, and number of primary care provider visits in the calendar year prior to index FIT. Because of data constraints, Cox regression could only be conducted on KPNC and KPSC data. Before modeling, the proportional hazards assumption was tested to confirm that effects of covariates were constant over time (proportional); if this assumption is violated, hazard ratios (HRs) from the model are not valid.²⁹

The PHHS/UTSW population was excluded from the Cox model because of insufficient variation in coverage: 85% of PHHS/UTSW patients were covered by Health Plus and no KP patients had Health Plus.

Analyses were conducted using R, version 3.1.1 (www.r-project.org/), and SAS, version 9.3, between 2016 and 2017.

RESULTS

[Table 1](#) shows 34,357 patients (98% of the study population) were covered by commercial insurance; 356 (1%) by Medicaid only; and 296 (0.8%) by Health Plus. Commercially insured and Medicaid-only patients were almost all from KPNC and KPSC, whereas patients with Health Plus coverage were exclusively from PHHS/UTSW. Most patients were from KPNC (52%) or KPSC (47%); 35% were aged 50–54 years at index FIT. About

half were male (54%); half were NH white (51%); and 20% were Hispanic. About half (53%) had more than two primary care visits in the previous calendar year; a quarter (26%) had no prior CRC screening. Most (69%) had a Charlson comorbidity score of 0.

Kaplan–Meier curves estimate probability, by health system and coverage type, of receiving any follow-up colonoscopy after a positive FIT ([Figure 1A–1C](#)). Patients with commercial insurance had higher follow-up rates overall compared with Medicaid patients, at both KPNC ($p < 0.001$) and KPSC ($p = 0.013$; [Figure 1A](#) and [1B](#)). At PHHS/UTSW, pairwise test results showed that differences between patients with Health Plus and Medicaid were statistically significant before the Bonferroni adjustment ([Figure 1C](#); $p = 0.03$).

[Table 2](#) shows follow-up probabilities by coverage type at 3, 6, and 12 months for each system (60 days is presented for comparison with Veterans Affairs data in the Discussion section). At 3 months, follow-up rates were higher for commercial than for Medicaid at both KPNC and the KPSC (KPNC: 76.3%, 95% CI=75.7%, 76.9%, vs 62.8%, 95% CI=53.0%, 70.5%; and KPSC: 72.3%, 95% CI=71.6%, 73.0%, vs 63.4%, 95% CI=55.9%, 69.6%). There were too few patients with commercial insurance or Medicaid at PHHS/UTSW for meaningful comparison. Follow-up rate was 37.5% (95% CI=32.1%, 43.2%) for Health Plus patients.

Median follow-up times from positive FIT to colonoscopy were 42 days (95% CI=42, 43) for KPNC and KPSC patients with commercial insurance; 50 days (95% CI=47, 62) for KPNC and KPSC patients with MediCal; and 162 days (95% CI=107, 343) for patients with Health Plus.

Results from the adjusted Cox model using data from KPNC and KPSC ([Table 3](#)) show that KPNC and KPSC insurance type remained significantly associated with rates of 3-month follow-up after adjustment for age; sex; race/ethnicity; comorbidity index; median ZIP code income (SES proxy); and other potential confounders. Even after adjusting for income, those with MediCal had a 24% lower follow-up rate than commercially insured patients (HR=0.76, 95% CI=0.67, 0.87).

Association between insurance type (MediCal versus commercial) and time to follow-up was significant for both KPNC (HR=0.73, 95% CI=0.59, 0.90) and KPSC (HR=0.80, 95% CI=0.68, 0.95). No statistical evidence of violation of the proportional hazards assumption was found in any Cox model.

DISCUSSION

Positive CRC screening with stool blood testing is a multistep process that requires follow-up colonoscopy.

Table 1. Characteristics of Patients With Positive Fecal Immunochemical Test (FIT) by Type of Healthcare Coverage

Characteristics	Type of healthcare coverage			All, 100% (N=35,009)
	Medicaid only, 1% (n=356)	Commercial, 98% (n=34,357)	Health Plus, 1% (n=296)	
PROSPR research center, %				
Parkland Health and Hospital System/University of Texas Southwestern Medical Center (PHHS/UTSW)	9.55	0.05	100.00	0.99
Kaiser Permanente Northern California (KPNC)	34.83	53.01		52.37
Kaiser Permanente Southern California (KPSC)	55.62	46.94		46.63
Age (years) at index FIT				
50–54	41.29	34.74	32.77	34.79
55–59	32.87	34.11	35.14	34.10
60–64	25.84	31.15	32.09	31.10
Race/ethnicity, %				
NH white	43.54	50.92	14.19	50.54
NH black	22.19	7.68	43.58	8.13
NH Asian/Pacific Islander	8.15	14.65	5.74	14.50
Hispanic	22.47	20.53	36.15	20.68
Unknown/missing	3.65	6.23	0.34	6.15
Sex, %				
Male	37.64	53.79	34.80	53.47
Female	62.36	46.21	65.20	46.53
Charlson score				
Missing	1.69	0.95	1.35	0.96
0	42.98	69.93	44.93	69.44
1	25.00	17.55	35.81	17.78
2	14.89	6.87	7.09	6.96
≥3	15.45	4.70	10.81	4.86
BMI, %				
Missing	0.84	2.61	0.68	2.58
<25	21.07	20.96	14.86	20.91
25–<30	30.90	33.89	33.11	33.85
30–<35	19.10	23.58	28.04	23.57
≥35	28.09	18.95	23.31	19.08
Number of primary care visits, %				
0	13.76	24.68	22.30	24.55
1	16.29	22.16	23.65	22.11
≥2	69.94	53.16	54.05	53.34
Prior colorectal cancer test, %				
No	28.65	26.21	42.23	26.37
Yes	71.35	73.79	57.77	73.63
Median ZIP code income, ^a %				
Missing	0.28	0.46		0.45
<\$20,000	0.28	0.08	0.68	0.09
\$20,000–<\$50,000	30.62	18.39	73.65	18.98
\$50,000–<\$100,000	65.45	71.54	25.68	71.09
≥\$100,000	3.37	9.54		9.39

(continued on next page)

Table 1. Characteristics of Patients With Positive Fecal Immunochemical Test (FIT) by Type of Healthcare Coverage (continued)

Characteristics	Type of healthcare coverage			All, 100% (N=35,009)
	Medicaid only, 1% (n=356)	Commercial, 98% (n=34,357)	Health Plus, 1% (n=296)	
Time in health system, %				
Time indeterminate ^b	9.55	0.05	100.00	0.99
<6 months	1.12	1.22		1.21
6–<12 months	2.25	1.99		1.98
12–<24 months	11.80	7.69		7.67
24–<60 months	24.44	15.84		15.79
≥60 months	50.84	73.20		72.36

^aHealth Plus does not report values of ≥\$100,000.

^bTime in health system.

FIT, fecal immunochemical test; NH, non-Hispanic; PROSPR, Population-based Research Optimizing Screening through Personalized Regimens.

Failure to evaluate a positive stool test with follow-up colonoscopy undermines the effectiveness of stool blood testing. This large study was conducted within three integrated health systems, and included more than 35,000 patients with positive FIT results. Follow-up colonoscopy rates varied by coverage type and health system. At KPNC and KPSC, rates of colonoscopy completion were higher among commercially insured patients than Medicaid-only patients. Completion rates at the safety-net health system in this study were lower than for KPNC and KPSC. Although the PHHS/UTSW–Health Plus members have lower follow-up rates than the KP–Medicaid population, the follow-up rate among PHHS/UTSW–Medicaid members is even lower. Further investigation and replication is warranted in other settings.

Because of lack of consensus in the scientific community regarding how much delay in follow-up colonoscopy causes harm,^{30,31} authors used the same delays in follow-up as other PROSPR (e.g., 3, 6, and 9 months) and Veterans Health Affairs (VHA; 60 days and median time) publications.

Few studies have examined follow-up colonoscopy in integrated health systems^{15,32,33} outside of the VHA system. Even fewer have assessed patients with no insurance, Medicaid coverage, or in safety-net systems. Most follow-up colonoscopy studies were undertaken between 2006 and 2013 in VHA populations,^{25,34–37} where stool testing is the predominant screening strategy.³⁸ Of the 76,243 patients with positive fecal occult blood test/FIT results in 98 VHA facilities 2009 to 2011, 30% completed a colonoscopy at a VHA facility within 60 days and 49% within 6 months.³⁹ Rates of follow-up colonoscopy within 60 days in this study were higher at KPNC and KPSC and lower at PHHS/UTSW. For example, at KPNC, approximately 64% of patients with commercial

insurance and 51% of patients with Medicaid completed follow-up colonoscopy; for Parkland patients covered by Health Plus, 60-day follow-up was 17%. By 6 months, receipt of follow-up colonoscopy was 84% for KPNC Commercial, 70% for KPNC Medicaid, and 52% for Parkland patients covered by Health Plus.

All three health systems are integrated and have electronic medical records for abnormal test notification and retrospective performance monitoring, but there are some notable differences in screening delivery among them. KPNC and KPSC set organizational targets for colonoscopy access, with organized CRC screening programs offered to all screen-eligible patients.⁴⁰ At the Parkland safety-net system, primary care teams design and implement procedures for CRC screening delivery. In sum, KPNC and KPSC have system-based programs to facilitate screening and follow-up, whereas Parkland providers bear primary responsibility and discretion for screening and follow-up.²⁴

Since the expansion of Medicaid under the Affordable Care Act, many providers have experienced surges in demand for services.⁴¹ Newly enrolled Medicaid patients may have previously put off care or have limited health literacy or other socioeconomic challenges that impact care. Integrated healthcare systems using FIT and follow-up colonoscopy are a feasible way to provide the additional capacity needed to meet the surge in demand for services. Integrated health systems have organized population health management to increase screening and follow-up⁴⁰; however, uniformly delivered population health management may not adequately address the needs of all groups.⁴² Medicaid populations may require supplemental services to attain rates and timing of follow-up similar to commercially insured patients (e.g., transportation, dependent care, extended service hours, patient navigation, and identification of

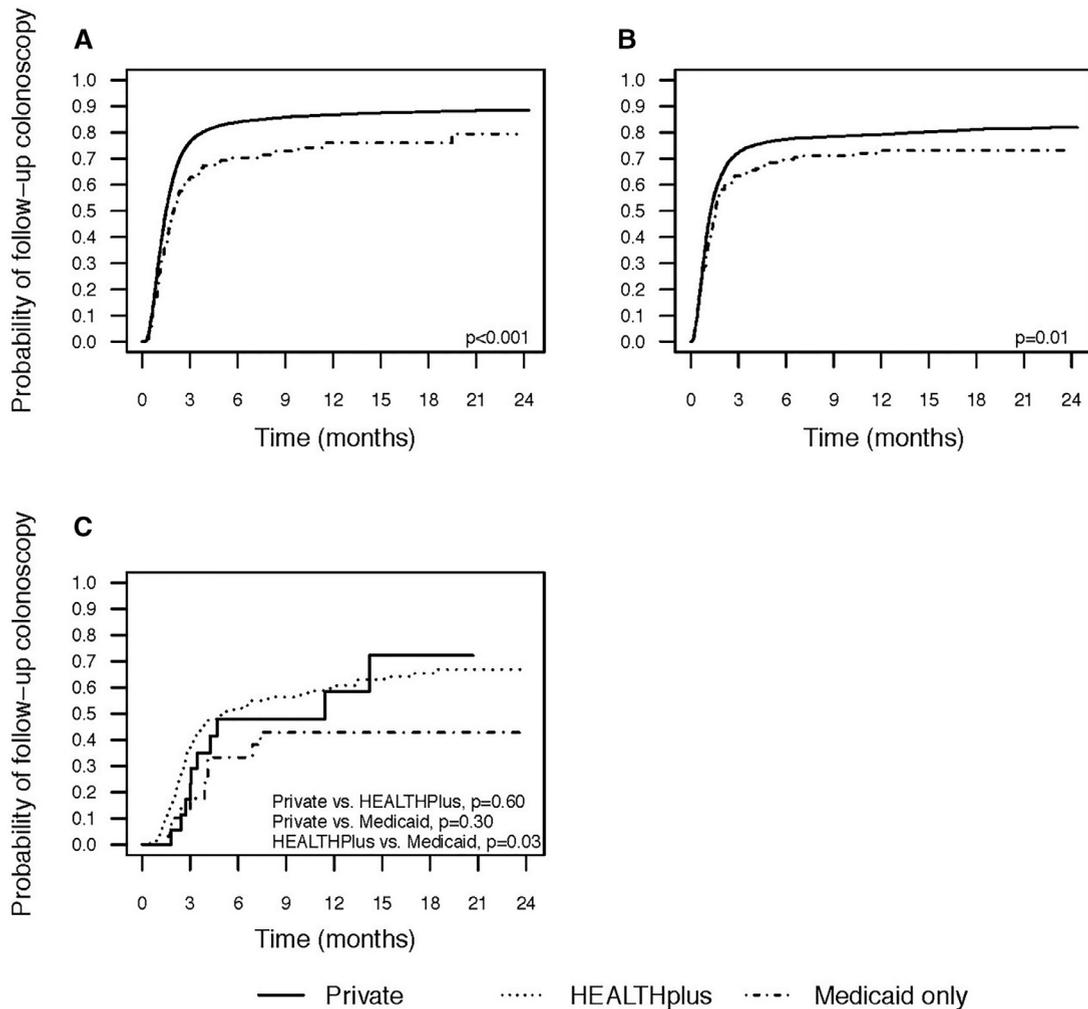


Figure 1. Kaplan–Meier plots of probability of follow-up colonoscopy since index fecal immunochemical test (FIT) by insurance type and healthcare system, 2011–2012. (A) Kaplan–Meier estimates of time to follow-up colonoscopy, KPNC only. (B) Kaplan–Meier estimates of time to follow-up colonoscopy, KPSC only. (C) Kaplan–Meier estimates of time to follow-up colonoscopy, PHHS/UTSW only.

Note: *p*-values from pairwise log-rank tests.

KPNC, Kaiser Permanente Northern California; KPSC, Kaiser Permanente Southern California; PHHS/UTSW, Parkland Health and Hospital System/University of Texas Southwestern Medical Center.

appropriate patient-centered medical home for service coordination).^{43,44}

This study demonstrates the feasibility of achieving timely follow-up care in population-based screening programs, including for Medicaid patients. Nevertheless, at KPNC and KPSC, MediCal populations had lower follow-up rates than commercially insured populations even though outreach efforts were the same; disparities were significant for the MediCal populations even after adjustment for SES. The safety-net health system with no organized follow-up outreach had longer follow-up intervals than commercial or MediCal patients at KPNC and KPSC. Worst off were UTSW–Medicaid patients.

Coverage differences are noteworthy because, compared with fee-for-service providers, integrated systems generally present fewer cost barriers to screening completion. For example, KPNC and KPSC do not charge patients for follow-up colonoscopy after a positive FIT, and Health Plus (which covers most Parkland patients) charges for follow-up colonoscopy on a sliding scale determined by a financial counselor.⁴⁵ The Affordable Care Act's prohibition of copays for screening services does not extend to follow-up diagnostic tests and may inhibit screening completion among lower-income patients with fee-for-service coverage.^{23,46}

Though they have a small percentage of MediCal patients, KPNC and KPSC provide an outstanding

Table 2. Kaplan–Meier Probability Estimates of Follow-up Colonoscopy After Fecal Immunochemical Test (FIT), by Coverage Type and PROSPR Research Center (N=35,009)

Health system and insurance/coverage	n	Median time to follow-up (95% CI)	Percent follow-up (95% CI)			
			60 days	3 months	6 months	12 months
Kaiser only ^a						
Commercial/private	34,339	42 (42, 43)	64.2 (63.7, 64.7)	74.6 (74.1, 75.0)	81.0 (80.5, 81.4)	83.5 (83.1, 83.9)
Medicaid only	322	50 (47, 62)	55.3 (49.5, 60.5)	63.1 (57.4, 68.1)	69.9 (64.2, 74.6)	74.1 (68.3, 78.9)
KPNC						
Commercial/private	18,211	45 (44, 46)	63.7 (63.0, 64.4)	76.3 (75.7, 76.9)	83.9 (83.3, 84.4)	86.8 (86.3, 87.4)
Medicaid only	124	60 (50, 80)	50.8 (41.0, 59.0)	62.8 (53.0, 70.5)	70.3 (60.6, 77.6)	76.0 (65.8, 83.2)
KPSC						
Commercial/private	16,128	38 (37, 39)	64.6 (63.8, 65.4)	72.3 (71.6, 73.0)	77.3 (76.6, 78.0)	79.2 (78.5, 79.9)
Medicaid only	198	47 (41, 56)	58.2 (50.6, 64.6)	63.4 (55.9, 69.6)	69.7 (62.4, 75.7)	73.1 (65.5, 79.0)
PHHS/UTSW						
Commercial/private	18	NA ^b	5.6 (0.0, 15.6)	17.4 (0.0, 33.4)	48.1 (17.2, 67.4)	58.4 (21.2, 78.1)
Health Plus	296	154 (112, 305)	17.2 (12.5, 21.6)	37.5 (31.2, 43.2)	52.1 (45.1, 58.2)	60.8 (53.1, 67.2)
Medicaid only	34	NA ^b	10.1 (0.0, 20.4)	17.6 (2.3, 30.6)	33.3 (12.7, 49.1)	42.9 (19.4, 59.5)

^aKPNC and KPSC combined.

^bCannot estimate median because follow-up in these groups do not reach 50%.

KPNC, Kaiser Permanente Northern California; KPSC, Kaiser Permanente Southern California; NA, not applicable; PHHS/UTSW, Parkland Health & Hospital System/University of Texas Southwestern Medical Center.

Table 3. Hazard Ratios Comparing Time to Follow-up Colonoscopy 3 Months After Positive Fecal Immunochemical Test (FIT), KPNC and KPSC

Characteristics	HR (95% CI)	p-value
Insurance (commercial ref)	0.76 (0.67, 0.87)	<0.001
Medicaid only		
Age (years) at index FIT (<55 ref)		
55–59	0.95 (0.92, 0.97)	<0.001
60–64	0.89 (0.86, 0.91)	<0.001
Race/ethnicity (NH white ref)		
Hispanic	1.01 (0.98, 1.04)	0.663
NH Asian/Pacific Islander	0.93 (0.89, 0.96)	<0.001
NH black	0.95 (0.91, 1.00)	0.030
Unknown/missing	0.88 (0.83, 0.93)	<0.001
Sex (male ref)		
Female	0.99 (0.97, 1.02)	0.605
Charlson comorbidity score (0 ref)		
1	0.95 (0.92, 0.98)	0.002
2	0.89 (0.85, 0.94)	<0.001
≥3	0.81 (0.76, 0.86)	<0.001
Missing	0.96 (0.84, 1.10)	0.534
BMI (<25 ref)		
25–29	1.06 (1.02, 1.09)	0.001
30–34	1.05 (1.02, 1.09)	0.005
≥35	1.00 (0.96, 1.04)	0.88
Missing	0.47 (0.43, 0.52)	<0.001
Number of primary care visits (0 ref)		
1	0.99 (0.95, 1.02)	0.428
≥2	1.05 (1.01, 1.08)	0.005
Prior CRC screening (no ref)		
Yes	1.24 (1.21, 1.28)	<0.001
Median ZIP code income (\$50,000–<\$100,000 ref)		
<\$50,000	0.92 (0.89, 0.95)	<0.001
≥\$100,000	1.08 (1.04, 1.12)	<0.001
Missing	1.01 (0.85, 1.20)	0.913

Note: Boldface indicates statistical significance ($p < 0.05$). CRC, colorectal cancer; FIT, Fecal Immunochemical Test; HR, hazard ratio; KPNC, Kaiser Permanente Northern California; KPSC, Kaiser Permanente Southern California; NH, non-Hispanic.

opportunity for future research to learn how to decrease follow-up time for MediCal patients. The literature provides insights into achieving equal outcomes in timely follow-up among lower-income patients, particularly through patient navigation. A systematic review of studies conducted within federally qualified health centers suggests patient navigation services should be tailored to the specific screening test provided⁴⁷ and exhibit multiple features, including tracking referrals, standing orders, provider feedback, and quality improvement—features that are in place in KPNC and KPSC. The federally

qualified health center demonstrating greatest improvement, a 44% increase in screening completion, had all six protocols in place. Another review identified three activities as essential to successful patient navigation programs: assessing patient barriers to screening, providing education about CRC screening tests, and scheduling appointments. Navigators motivate and support minority and low-income clients.⁴⁷ A synthesis of 27 patient navigation studies showed that a combination of lay and professional patient navigation most cost effectively enhanced CRC screening and completion of follow-up colonoscopy.⁴⁸

Limitations

This study has several limitations. Most (98%) data were from KPNC and KPSC, two similar systems in which most patients had commercial insurance. This potentially limits the generalizability of these results, as does restricting this study to patients aged less than 65 years. Significant differences between coverage type and follow-up time at Parkland may not have been detected because of small samples of patients with commercial and Medicaid coverage. Lack of variation in coverage and missing data restricted inclusion of Parkland data in the pooled Cox regression analyses. Missing insurance coverage made 5,708 PROSPR patients ineligible. Coverage was measured annually, and nearly all participants (95.2%) maintained the same coverage type during the study period. Change in coverage was higher for patients with Medicaid and Health Plus; however, sensitivity analyses demonstrated that change in coverage did not affect the results. Likely this is because Health Plus is continuous, and KPNC and KPSC provide follow-up to patients already in the system even if they lose coverage temporarily. Moreover, unlike states where Medicaid eligibility is reviewed more frequently, California's MediCal eligibility is reviewed annually.

CONCLUSIONS

Consistent with the hypotheses, compared with those with commercial insurance, patients with MediCal were less likely to complete colonoscopy after a positive FIT, and took longer to complete a colonoscopy, even within the same health system and despite standard protocols for encouraging patients with a positive FIT to obtain timely follow-up. Outreach and services may yield different outcomes in commercially versus Medicaid-insured populations. The safety-net system, PHHS, also had a lower rate of follow-up. To increase rates and timeliness of follow-up for vulnerable populations, future studies

should identify and test levers likely to achieve levels of service for disadvantaged and multicultural populations equivalent to commercially insured populations. Effective interventions from the patient navigation literature might be particularly useful in developing new research strategies.

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REFERENCES

- Rex DK, Johnson DA, Anderson JC, et al. American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol*. 2009;104(3):739–750. <https://doi.org/10.1038/ajg.2009.104>.
- Levin B, Lieberman DA, McFarland B, et al. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the U.S. Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. *Gastroenterology*. 2008;134(5):1570–1595. <https://doi.org/10.1053/j.gastro.2008.02.002>.
- U.S. Preventive Services Task Force. Colorectal cancer: screening. www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/colorectal-cancer-screening. Published October 2008. Accessed May 26, 2016.
- Liang PS, Wheat CL, Abhat A, et al. Adherence to competing strategies for colorectal cancer screening over 3 years. *Am J Gastroenterol*. 2016;111(1):105–114. <https://doi.org/10.1038/ajg.2015.367>.
- Quintero E, Castells A, Bujanda L, et al. Colonoscopy versus fecal immunochemical testing in colorectal-cancer screening. *N Engl J Med*. 2012;366(8):697–706. <https://doi.org/10.1056/NEJMoa1108895>.
- Singal AG, Gupta S, Skinner CS, et al. Effect of colonoscopy outreach vs fecal immunochemical test outreach on colorectal cancer screening completion: a randomized clinical trial. *JAMA*. 2017;318(9):806–815. <https://doi.org/10.1001/jama.2017.11389>.
- Singal AG, Gupta S, Tiro JA, et al. Outreach invitations for FIT and colonoscopy improve colorectal cancer screening rates: a randomized controlled trial in a safety-net health system. *Cancer*. 2016;122(3):456–463. <https://doi.org/10.1002/cncr.29770>.
- Knudsen AB, Zauber AG, Rutter CM, et al. Estimation of benefits, burden, and harms of colorectal cancer screening strategies: modeling study for the U.S. Preventive Services Task Force. *JAMA*. 2016;315(23):2595–2609. <https://doi.org/10.1001/jama.2016.6828>.
- Doubeni CA, Gabler NB, Wheeler CM, et al. Timely follow-up of positive cancer screening results: a systematic review and recommendations from the PROSPR Consortium. *CA Cancer J Clin*. 2018;68(3):199–216. <https://doi.org/10.3322/caac.21452>.
- Corley DA, Jensen CD, Quinn VP, et al. Association between time to colonoscopy after a positive fecal test result and risk of colorectal cancer and cancer stage at diagnosis. *JAMA*. 2017;317(16):1631–1641. <https://doi.org/10.1001/jama.2017.3634>.
- Rutter CM, Kim JJ, Meester RGS, et al. Effect of time to diagnostic testing for breast, cervical, and colorectal cancer screening abnormalities on screening efficacy: a modeling study. *Cancer Epidemiol Biomarkers Prev*. 2018;27(2):158–164. <https://doi.org/10.1158/1055-9965.EPI-17-0378>.
- Yabroff KR, Washington KS, Leader A, Neilson E, Mandelblatt J. Is the promise of cancer-screening programs being compromised? Quality of follow-up care after abnormal screening results. *Med Care Res Rev*. 2003;60(3):294–331. <https://doi.org/10.1177/1077558703254698>.
- Zapka J, Taplin SH, Price RA, Cranos C, Yabroff R. Factors in quality care—the case of follow-up to abnormal cancer screening tests—problems in the steps and interfaces of care. *J Natl Cancer Inst Monogr*. 2010;2010(40):58–71. <https://doi.org/10.1093/jncimonographs/lgq009>.
- Chubak J, Garcia MP, Burnett-Hartman AN, et al. Time to colonoscopy after positive fecal blood test in four U.S. health care systems. *Cancer Epidemiol Biomarkers Prev*. 2016;25(2):344–350. <https://doi.org/10.1158/1055-9965.EPI-15-0470>.
- Rao SK, Schilling TF, Sequist TD. Challenges in the management of positive fecal occult blood tests. *J Gen Intern Med*. 2009;24(3):356–360. <https://doi.org/10.1007/s11606-008-0893-5>.
- Raich PC, Whitley EM, Thorland W, Valverde P, Fairclough D. Denver Patient Navigation Research Program. Patient navigation improves cancer diagnostic resolution: an individually randomized clinical trial in an underserved population. *Cancer Epidemiol Biomarkers Prev*. 2012;21(10):1629–1638. <https://doi.org/10.1158/1055-9965.EPI-12-0513>.
- Hiatt RA, Klabunde C, Breen N, Swan J, Ballard-Barbash R. Cancer screening practices from National Health Interview Surveys: past, present, and future. *J Natl Cancer Inst*. 2002;94(24):1837–1846. <https://doi.org/10.1093/jnci/94.24.1837>.
- Breen N, Meissner HI. Toward a system of cancer screening in the United States: trends and opportunities. *Annu Rev Public Health*. 2005;26:561–582. <https://doi.org/10.1146/annurev.publhealth.26.021304.144703>.
- Brown ML, Klabunde CN, Cronin KA, White MC, Richardson LC, McNeel TS. Challenges in meeting Healthy People 2020 objectives for cancer-related preventive services, National Health Interview Survey, 2008 and 2010. *Prev Chronic Dis*. 2014;11:E29. <https://doi.org/10.5888/pcd11.130174>.
- Halpern MT, Romaine MA, Haber SG, Tangka FK, Sabatino SA, Howard DH. Impact of state-specific Medicaid reimbursement and eligibility policies on receipt of cancer screening. *Cancer*. 2014;120(19):3016–3024. <https://doi.org/10.1002/cncr.28704>.
- Sabatino SA, Thompson TD, Guy GP Jr, de Moor JS, Tangka FK. Mammography use among Medicare beneficiaries after elimination of cost sharing. *Med Care*. 2016;54(4):394–399. <https://doi.org/10.1097/MLR.0000000000000495>.
- Klabunde CN, Cronin KA, Breen N, Waldron WR, Ambbs AH, Nadel MR. Trends in colorectal cancer test use among vulnerable populations in the United States. *Cancer Epidemiol Biomarkers Prev*. 2011;20(8):1611–1621. <https://doi.org/10.1158/1055-9965.EPI-11-0220>.
- Green BB, Coronado GD, Devoe JE, Allison J. Navigating the murky waters of colorectal cancer screening and health reform. *Am J Public Health*. 2014;104(6):982–986. <https://doi.org/10.2105/AJPH.2014.301877>.
- Tiro JA, Kamineni A, Levin TR, et al. The colorectal cancer screening process in community settings: a conceptual model for the Population-Based Research Optimizing Screening through Personalized Regimens Consortium. *Cancer Epidemiol Biomarkers Prev*. 2014;23(7):1147–1158. <https://doi.org/10.1158/1055-9965.EPI-13-1217>.
- Gellad ZF, Almirall D, Provenzale D, Fisher DA. Time from positive screening fecal occult blood test to colonoscopy and risk of neoplasia. *Dig Dis Sci*. 2009;54(11):2497–2502. <https://doi.org/10.1007/s10620-008-0653-8>.

26. Wattericher J, Kramer JR, Richardson P, et al. Lagtimes in diagnosis and treatment of colorectal cancer: determinants and association with cancer stage and survival. *Aliment Pharmacol Ther.* 2008;28(9):1166–1174. <https://doi.org/10.1111/j.1365-2036.2008.03826.x>.
27. Tosteson AN, Beaver EF, Tiro J, et al. Variation in screening abnormality rates and follow-up of breast, cervical and colorectal cancer screening within the PROSPR Consortium. *J Gen Intern Med.* 2016;31(4):372–379. <https://doi.org/10.1007/s11606-015-3552-7>.
28. Kalbfleisch JD, Prentice RL. *The Statistical Analysis of Failure Time Data.* Vol. , 360. Hoboken, NJ: John Wiley & Sons, 2011.
29. Schoenfeld D. Partial residuals for the proportional hazards regression model. *Biometrika.* 1982;1(69):239–241. <https://doi.org/10.1093/biomet/69.1.239>.
30. Meester RG, Zauber AG, Doubeni CA, et al. Consequences of increasing time to colonoscopy examination after positive result from fecal colorectal cancer screening test. *Clin Gastroenterol Hepatol.* 2016;14(10):1445–1451. <https://doi.org/10.1016/j.cgh.2016.05.017>.
31. Jensen CD, Quinn VP, Doubeni CA, et al. Colonoscopy delay after a positive fecal test and risk of colorectal cancer-related outcomes. *Gastroenterology.* 2016;150(4):S45–S45. [https://doi.org/10.1016/S0016-5085\(16\)30276-1](https://doi.org/10.1016/S0016-5085(16)30276-1).
32. Green BB, Anderson ML, Wang CY, et al. Results of nurse navigator follow-up after positive colorectal cancer screening test: a randomized trial. *J Am Board Fam Med.* 2014;27(6):789–795. <https://doi.org/10.3122/jabfm.2014.06.140125>.
33. Miglioretti DL, Rutter CM, Bradford SC, et al. Improvement in the diagnostic evaluation of a positive fecal occult blood test in an integrated health care organization. *Med Care.* 2008;46(9 suppl 1):S91–S96. <https://doi.org/10.1097/MLR.0b013e31817946c8>.
34. Partin MR, Powell AA, Nugent S, Ordin DL. Colorectal cancer diagnosis improvement project evaluation demonstrates the importance of using multiple measures to track progress toward timeliness goals. *J Healthc Qual.* 2013;35(3):41–48. <https://doi.org/10.1111/j.1945-1474.2011.00188.x>.
35. Singh H, Kadiyala H, Bhagwath G, et al. Using a multifaceted approach to improve the follow-up of positive fecal occult blood test results. *Am J Gastroenterol.* 2009;104(4):942–952. <https://doi.org/10.1038/ajg.2009.55>.
36. Fisher DA, Jeffreys A, Coffman CJ, Fasanella K. Barriers to full colon evaluation for a positive fecal occult blood test. *Cancer Epidemiol Biomarkers Prev.* 2006;15(6):1232–1235. <https://doi.org/10.1158/1055-9965.EPI-05-0916>.
37. Etzioni DA, Yano EM, Rubenstein LV, et al. Measuring the quality of colorectal cancer screening: the importance of follow-up. *Dis Colon Rectum.* 2006;49(7):1002–1010. <https://doi.org/10.1007/s10350-006-0533-2>.
38. Powell AA, Gravely AA, Ordin DL, Schlosser JE, Partin MR. Timely follow-up of positive fecal occult blood tests strategies associated with improvement. *Am J Prev Med.* 2009;37(2):87–93. <https://doi.org/10.1016/j.amepre.2009.05.013>.
39. Partin MR, Gravely AA, Burgess JF Jr., et al. Contribution of patient, physician, and environmental factors to demographic and health variation in colonoscopy follow-up for abnormal colorectal cancer screening test results. *Cancer.* 2017;123(18):3502–3512. <https://doi.org/10.1002/cncr.30765>.
40. Levin TR, Jamieson L, Burley DA, Reyes J, Oehrli M, Caldwell C. Organized colorectal cancer screening in integrated health care systems. *Epidemiol Rev.* 2011;33:101–110. <https://doi.org/10.1093/epirev/mxr007>.
41. Glied S, Ma S. How will the Affordable Care Act affect the use of health care services? Commonwealth fund Issue Brief. www.commonwealthfund.org/sites/default/files/documents/___media_files_publications_issue_brief_2015_feb_1804_glied_how_will_aca_affect_use_hlt_care_svcs_ib_v2.pdf. Published February 2015. Accessed January 18, 2019.
42. Mehta SJ, Jensen CD, Quinn VP, et al. Race/ethnicity and adoption of a population health management approach to colorectal cancer screening in a community-based healthcare system. *J Gen Intern Med.* 2016;31(11):1323–1330. <https://doi.org/10.1007/s11606-016-3792-1>.
43. Sabatino SA, Lawrence B, Elder R, et al. Effectiveness of interventions to increase screening for breast, cervical, and colorectal cancers: nine updated systematic reviews for the guide to community preventive services. *Am J Prev Med.* 2012;43(1):97–118. <https://doi.org/10.1016/j.amepre.2012.04.009>.
44. Skaer TL, Robison LM, Sclar DA, Harding GH. Financial incentive and the use of mammography among Hispanic migrants to the United States. *Health Care Women Int.* 1996;17(4):281–291. <https://doi.org/10.1080/07399339609516245>.
45. Martin J, Halm EA, Tiro JA, et al. Reasons for lack of diagnostic colonoscopy after positive result on fecal immunochemical test in a safety-net health system. *Am J Med.* 2017;130(1):93.e91–93.e97. <https://doi.org/10.1016/j.amjmed.2016.07.028>.
46. Doubeni CA, Corley DA, Zauber AG. Colorectal cancer health disparities and the role of U.S. law and health policy. *Gastroenterology.* 2016;150(5):1052–1055. <https://doi.org/10.1053/j.gastro.2016.03.012>.
47. Domingo JB, Braun KL. Characteristics of effective colorectal cancer screening navigation programs in federally qualified health centers: a systematic review. *J Health Care Poor Underserved.* 2017;28(1):108–126. <https://doi.org/10.1353/hpu.2017.0013>.
48. Sunny A, Rustveld L. The role of patient navigation on colorectal cancer screening completion and education: a review of the literature. *J Cancer Educ.* 2018;33(2):251–259. <https://doi.org/10.1007/s13187-016-1140-0>.