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Primary care visit utilization following positive fecal immunochemical test for colorectal cancer screening

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Abstract

Background—For some patients, positive cancer screening test results can be a stressful experience which can affect future screening compliance and increase the utilization of healthcare services unrelated to medically-indicated follow-up.

Methods—Among 483,216 individuals, aged 50–75 years, who completed a fecal immunochemical test to screen for colorectal cancer at a large integrated health care setting between 2007 and 2011, we evaluated whether a positive test was associated with a net change in outpatient primary care visit use in the year following screening. We used multivariable regression models to evaluate the relationship between test result group and net changes in primary care visits following fecal immunochemical test.

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Results—In the year following the fecal immunochemical test, utilization increased by 0.60 clinic visits for true positives. The absolute change in visits was largest (3.00) among test positive patients diagnosed with colorectal cancer but significant small increases were also found for polypectomy/no neoplasia (0.36) and normal exam/no polypectomy (0.17). Groups that demonstrated an increase in net visit use compared to the true negative group included true positives (OR 1.60, 95% CI 1.54–1.66), and positive groups with colorectal cancer diagnosis (OR 7.19, 95%CI 6.12–8.44), polypectomy/no neoplasia (OR 1.37, 95%CI 1.27–1.48) and normal exam/no polypectomy groups (OR 1.24, 95%CI 1.18–1.30).

Conclusion—Given the large size of outreach programs, these small changes can cumulatively generate thousands of excess visits and have substantial impacts on total health care utilization and thus should be included in colorectal cancer screening cost models and their causes investigated further.

Keywords

Colorectal cancer; early detection of cancer; delivery of health care; primary health care

INTRODUCTION

Colorectal cancer (CRC) is the third leading cause of cancer and cancer-related death in the United States.[1] Current screening guidelines offer endoscopic, radiologic, and fecal-based test options for screening average-risk adults age 50 years and older[2–4] and, of these, colonoscopy is the most commonly used CRC screening modality in the U.S.[5] In comparison to breast and cervical cancer screening rates, CRC screening coverage in the U.S. remains relatively low (67.6% vs. 72.8% for mammogram and 82.6% for Pap test).[6] In order to reach the unscreened portion of the screening-eligible population many large healthcare organizations have adopted organized population-based screening programs using high sensitivity fecal occult blood testing (e.g. the fecal immunochemical test [FIT]),[7] making FIT the second most commonly used CRC screening modality in the U.S. Organized FIT screening is particularly well-suited to CRC screening for individuals that may be resistant to the use of colonoscopy, who are not good candidates for this procedure due to comorbidities, or who are unable to access endoscopic services. Additionally, a recent study of the CDC's Colorectal Cancer Control Program (CRCCP) found that non-clinical costs associated with colonoscopy and FIT/FOBT-based programs are similar but clinical costs differ considerably. Compared to $1150 per individual screened for colonoscopy programs in the CRCCP, the average annual clinical cost for screening and diagnostic testing for FIT/FOBT-based programs is $304, making stool-based programs very cost-effective as well.[8]

Undergoing cancer screening is a stressful experience for some and having an abnormal result can be especially distressing. Studies assessing the immediate psychological effect of breast cancer screening, found that women with false positive or abnormal results had statistically more symptoms of emotional distress,[9–12] anxiety,[13–16] worry about future illness and breast cancer.[15,16] Similar reactions have been reported with abnormal cervical cancer screening test results[17–19] and fecal occult blood tests for CRC.[20–23] Beyond the emotional stress and anxiety associated with abnormal cancer screening test findings, which constitute a large portion of positive screens, abnormal cancer screening results can affect

future screening compliance[24,25] and increase the utilization of healthcare services unrelated to medically indicated positive screening test follow-up.[10]

Each year, millions of Americans undergo FIT screening and yet, to date, no prior studies have examined the influence of positive FIT results on outpatient primary care visit use. In a cohort of adults undergoing CRC screening with FIT at a large integrated healthcare organization in the United States, we conducted a study to evaluate changes in outpatient primary care visit use in the year following a positive FIT screening versus the preceding 2 years, as compared to patients with true negative FIT results. We hypothesized that, similar to other positive cancer screening tests, some patients may increase their healthcare utilization behavior (e.g. seeking additional outpatient services [9,25,26]). Our hypothesis is based on The Transactional Model of Stress and Coping,[27–29] a theoretical framework that conceptualizes stressful experiences and coping as transactions between the patient and the environment. This model emphasizes personal appraisals of the perceived harm and threat presented by the stressor and the cultural and social resources at the individual's disposal with which to cope with the stressor.

METHODS

Study Setting

This retrospective cohort study was conducted among members of Kaiser Permanente Northern California (KPNC), an integrated health care organization with over 3.5 million members in urban, suburban, and semirural regions within a large geographic area.[30] The study was conducted as part of the National Cancer Institute's Cancer Research Network (CRN) and the *Population-based Research Optimizing Screening through Personalized Regimens* (PROSPR) consortium.[31] The PROSPR consortium conducts multisite, coordinated, transdisciplinary research to evaluate and improve cancer-screening processes.[32]

FIT screening is a primary method of CRC screening at KPNC.[31] Briefly, each year the program mails a FIT kit to average-risk health plan members aged 50–75 years who have no record of a colonoscopy within 10 years, sigmoidoscopy within 5 years, or fecal blood test within the previous year. The completed FIT kits are returned by mail to a regional laboratory for analysis. Patients can also be given a FIT kit though in-reach, such as during a clinic visit. Those with a positive FIT result are referred for follow-up colonoscopy. Patients with possible colorectal cancer symptoms are referred for colonoscopy.

All data were extracted from KPNC electronic clinical databases. Diagnoses of CRC were confirmed through the KPNC cancer registry, which is part of the Surveillance, Epidemiology, and End Results (SEER) registry. This research was approved by the Columbia University Medical Center and Kaiser Permanente Northern California (KPNC) institutional review boards.

Eligibility Criteria

Records of all KPNC patients aged 50–75 years and enrolled between 2007 and 2011 were identified. Individuals were eligible for the study if they completed at least one FIT during

the study period and were enrolled in KPNC continuously for at least 24 months prior to and for 12 months after their first FIT. Patients were ineligible if they had a history of CRC, inflammatory bowel disease, or colectomy prior to FIT screening.

FIT Result Groups and Covariates

Four major FIT result groups were created: (1) "true negative" (TN) included those with a negative FIT and no colonoscopy or CRC diagnosis within 12 months after the index FIT; (2) "true positive" (TP) were those who had a positive FIT and completed a diagnostic colonoscopy within 12 months of the FIT which detected one or more adenomas or CRC; (3) "false positive" (FP) were those who had a positive FIT and a diagnostic colonoscopy within 12 months that did not detect adenomas or CRC; and (4) "positive FIT/no colonoscopy" (pos FIT/no COL) were those who had a positive FIT but did not complete a diagnostic colonoscopy within 12 months after the index FIT.

Those with a positive FIT result who completed a diagnostic colonoscopy were subcategorized based on colonoscopy findings. True positives were grouped as "CRC", "advanced adenoma (i.e. tubulovillous and villous)", and "non-advanced adenoma" and false positives as "polypectomy/no neoplasia (i.e. no adenoma or CRC detected)" and "normal exam/no polypectomy".

Covariates of interest included age, gender, race/ethnicity, and Charlson comorbidity score [33] in the year before FIT screening.

Primary Outcome

The primary outcome of interest was net change in outpatient primary care visit use before and after the first FIT. If more than one FIT was completed during the study period, the first FIT was considered to be the "index FIT" and used to determine outcomes. Outpatient primary care visit use was defined as ambulatory outpatient and urgent care visits with physicians, physician assistants, and nurse practitioners in the departments of internal medicine, family practice, obstetrics/gynecology, community health, gerontology/geriatrics, and primary care; excluded were visits to mental health and chemical dependency departments. Primary care visit counts were limited to a maximum of one visit per patient per day.

Outpatient primary care visit use in the period before the index FIT was the annualized mean of the number of primary care visits in the 2 years preceding the index FIT. For all major FIT groups (TN, TP, FP and pos FIT/no COL) and positive FIT subgroups (CRC, advanced adenoma, non-advanced adenoma, polypectomy/no neoplasia, and normal exam/no polypectomy), visit use after screening was examined in two ways: 1) the 12 month period beginning on the day following the FIT result minus any primary care visits related to the follow-up diagnostic colonoscopy (e.g., bowel preparation class and the colonoscopy visit) for those individuals who had this procedure; and 2) beginning on the day following the diagnostic colonoscopy for those with a positive FIT.

Data Analyses

Differences in demographic and clinical characteristics between FIT result groups were evaluated using the Chi square test. For each patient, the net difference in the mean number of primary care visits in the 12 months after FIT screening minus the annualized mean number of primary care visits in the 2 years before FIT screening or after the diagnostic colonoscopy for individuals with a positive FIT was calculated. The cumulative monthly primary care visit use before and after FIT was calculated and contrasted for the four major FIT screening result groups and FIT-positive subgroups using difference-in-difference analysis.[34]

Multivariable logistic regression models were used to evaluate the relationship between FIT result group (TN, TP, FP, and pos FIT/no COL), and positive FIT subgroups (CRC, adenoma with advanced histology, adenoma, polypectomy/no neoplasia, and normal exam/no polypectomy) and the risk of a net increase in the number of primary care visits following FIT screening, with the TN group serving as the referent. These procedures were then repeated for the secondary analysis where the post-FIT observation period for the FIT positive groups was shifted from the 1 year interval following the FIT result to the year immediately following the diagnostic colonoscopy. The purpose of the sensitivity analysis was to determine if additional primary care utilization occurred in the period between the positive FIT and the date of the colonoscopy that may have been due to colonoscopy-related visits. For all models, odds ratios (ORs) and 95% confidence intervals (CIs) were adjusted for patient age, gender, and Charlson comorbidity score in the 12 month period prior to the index FIT. All analyses were performed using SAS® version 9.3 (Cary, NC).

RESULTS

Demographic and clinical characteristics

A total of 483,216 individuals completed a FIT between 2007 and 2011 (Table 1). Overall, 456,324 (94.4%) had a TN result. Among the 26,892 persons with a positive FIT, 11,072 had a TP (41.2%), 9,701 had a FP (36.1%), and 6,119 had a pos FIT/no COL (22.8%). Compared to those with a TN, patients with a positive FIT were more often older in age, male, had more comorbid conditions and more often had 4 or more annual primary care visits in the 2 years before FIT screening. Among individuals with a pos FIT/no COL, 9.2% had 10 or more outpatient primary care visits.

Net Change in Primary Care Visit Use Before and After the Index FIT

Major FIT Result Groups—Primary care visits for the 4 major FIT result groups (TN, TP, FP, and pos FIT/no COL) ranged overall between 0 and 16 visits before the index FIT and between 0 and 18 visits after FIT. In general, primary care visit use was lowest among the TN (2.14 visits before and 2.17 visits after) and highest among individuals with pos FIT/no COL (3.61 visits before and 4.22 visits after) (Table 2). In the 12 month period after the index FIT, the net change in use of primary care visits for those in the TN group was negligible (+0.02 visits), but was increased by 0.60 visits (OR 1.60, 95% CI 1.54–1.66) in the TP, by 0.22 visits for the FP group (OR 1.27, 95% CI 1.22–1.33) and by 0.49 visits (OR 1.50, 95% CI 1.43–1.58) in the pos FIT/no COL groups.

True Positive FIT Result Subgroups—In the true positive subgroup, visits after the diagnostic colonoscopy increased by 3.00 visits among those who were diagnosed with CRC (OR 7.19, 95% CI 6.12–8.44) and by 0.44 visits among those with advanced adenomas (OR 1.54, 95% CI 1.42–1.67), while those diagnosed with a non-advanced adenoma had an increase of 0.33 visits (OR 1.36, 95% CI 1.30–1.43) (Table 2).

False Positive FIT Result Subgroups—Net changes in primary care visits in the year after FIT screening for the FP group were greatest among those who had a polypectomy but no pathological finding with an increase of 0.36 visits (OR 1.37, 95% CI 1.27–1.48) whereas those with exams within normal limits only increased by 0.17 visits (OR 1.24 95% CI 1.18–1.30).

Alternate Observation Period Following Positive FIT—When the observation period was shifted to 12 month period beginning on the day following the diagnostic colonoscopy vs. on the day following the positive FIT for the FIT positive groups, the net increase in visits was about half of that observed when the follow-up period commenced immediately following the FIT (Table 3). The exception was the case of the FP group where visit use decreased by 0.10 visits (OR 0.91, 95% CI 0.86–0.95).

Monthly Cumulative Visits—Unadjusted monthly cumulative outpatient primary care visits before (solid line) and after FIT screening (dashed line) are displayed in Figures 1A–D. Findings indicate that the timing of the initiation of increased use varied by major FIT result group; within 1–2 months for the pos FIT/no COL group, within 2–3 months for the TP group and, within about 4–5 months for the FP group. Among the FIT-positive subgroups, an increase in use of primary care visits among the subgroups of the TP FIT (CRC, advanced adenoma, and non-advanced adenoma) began 1–2 months following FIT, while the increase occurred a little later (2–3 months after FIT) for the polypectomy/no neoplasia subgroup (Figures 2A–E).

DISCUSSION

We found that, among individuals undergoing CRC screening in a large integrated healthcare setting, outpatient primary care utilization following FIT screening increased for all major FIT result groups (TN, FP, and pos FIT/no COL) but was greatest among those in the TP group (+0.60 visits). This effect was due in part to the subgroup of FIT-positive patients diagnosed with CRC who had a net increase of 3.00 primary care visits in the year after screening. Patients with TP and diagnosed with an adenoma, with and without advanced histology, also had significant net increases in primary care visits in the year following FIT screening (+0.44 and +0.33 additional visits, respectively). Those with a positive FIT but who did not complete a diagnostic colonoscopy increased their use about one half visit and among the FP group, those had a polypectomy with no adenoma or CRC detected, increased their use by 0.36 visits. Shifting the follow-up time interval for the positive FIT groups from the day following the FIT to the day after the diagnostic colonoscopy resulted in small decreases in primary care visit use. This suggests that little change in primary care use occurs in the period between the positive FIT and the diagnostic colonoscopy and that the observed increases in utilization occurred following the definitive diagnosis with

colonoscopy for FIT positive results. That the direction of utilization reversed for those with a polypectomy with no neoplasia from an increase of 0.17 visits to −0.10 likely reflects the large sample size and potential outliers but requires further investigation.

Our findings support our hypothesis that a positive FIT may result in an increase in outpatient primary care visit use and are consistent with studies of breast and lung cancer screening, where healthcare utilization increased after an abnormal screening test even after excluding medically required diagnostic visits.[9,10,25,26] Our hypothesis was framed by the Transactional Model of Stress and Coping[27–29] that offers a possible explanation as to how the stress of a positive FIT results may upset an individual's psychological well-being such that poor coping efforts drive them toward healthcare utilization in order to restore balance.

Barton et al. found that, among enrollees of a large New England health maintenance organization, having positive mammography results that did not yield a cancer diagnosis (false positive) was a significant and independent predictor of a 14% increase (incidence ratio 1.14, 95% CI 1.03–1.25) in non-breast related healthcare utilization in the form of breast- and non-breast related ambulatory visits and mental health professional visits.[9] Byrne et al.[26] examined healthcare utilization after screening for lung cancer and found that healthcare use increased in all result groups but was greatest among those with a suspicious result. A single study conducted among a subsample of the Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial (PLCO) participants from a single Midwestern site between 1993 and 1999 evaluated healthcare expenses following a flexible sigmoidoscopy.[35] Excluding the cost of the diagnostic colonoscopy, medical expenses in the 12 months following a false positive sigmoidoscopy were found to be nearly double ($p < 0.0001$) that in the 12 month period prior to the test. The false positive test was considered to be the primary driver of the increased expenditures.

Another notable finding in our study was that 22.8% of patients who had a positive FIT did not have a diagnostic colonoscopy within 12 months after their screening test. This group was older, had more comorbid conditions, and had more annual primary care visits both prior to and following screening than the other 3 major FIT result groups; thus, this group likely includes some individuals who were not ideal candidates for CRC screening with FIT. Within KPNC, monitoring and tracking of diagnostic colonoscopy follow-up is conducted at the local level.[30] Common reasons for patients failing to follow-up abnormal results include breadth of services at or distance to specialty clinics, poor communication (e.g. no patient reminders), and limited insurance cover have been cited.[36] Investigating factors associated with failure to receive a follow-up diagnostic colonoscopy after a positive FIT may inform efforts to increase CRC screening adherence and avoid inappropriate FIT screening and the attendant costs among those likely to decline or who cannot complete subsequent diagnostic testing with colonoscopy.

Strengths of the current study include its large size and the ability to adjust for potential confounders such as age and gender; and comprehensive capture of FIT results in a large community-based, diverse population that is similar in socioeconomic characteristics to the region's census demographics. Further, we utilized validated approaches for capturing pathology data, follow-up colonoscopy exams as well as CRC case ascertainment through

cancer registries that report to SEER. That we used an observational study design that precludes assigning and the possible influence of unmeasured confounders, for example, baseline inter-individual differences in the use of outpatient visits in the 2 years prior to FIT, specific socioeconomic factors, family history of adenomas, alcohol and tobacco use, obesity, and sedentary lifestyle were limitations of this study. In particular, mental health and substance abuse diagnoses are not included in the Charlson Comorbidity Index; prior studies have reported that these diagnoses are associated with CRC screening, follow-up testing and outpatient visit use, and therefore, could potentially confound the association between FIT result group and change in primary care visit use after FIT screening. Additionally, the Charlson Comorbidity Index, developed to assess inpatient comorbidity, is less effective in identifying outpatient comorbidities therefore our comorbidity scores may actually underestimate existing chronic conditions among this patient population, although between 10.0% (TN) and 21.6% (pos FIT/no COL) of individuals had 2 or more comorbidities using this measure. which may imply that this group could be “sicker” at baseline. Comparison of mean baseline outpatient visit use between the groups, however, shows that visit use is comparable (overlapping SD), suggesting that, although the positive FIT group has more comorbidity, they do not appear to be utilizing more outpatient visits prior to FIT. Some of the additional visits observed in patients who had a colonoscopy after a positive FIT may be related to treatment planning for the CRC cases diagnosed or possibly to complications from the colonoscopy procedure (e.g., pain or bleeding), particularly among those who had polypectomy. However, as such events are relatively rare, are a direct result of the screening process, and would not be expected in the absence of screening, these visits were not excluded. Additionally, although the population studied is similar in characteristics to the region’s census demographics, our findings may not be generalizable to CRC screening in other populations or healthcare settings.

We observed increases in outpatient primary care visits, albeit, the increase was small in some groups, after FIT screening, with utilization patterns dependent on test results. We also showed that change in visit use takes place in close proximity to the FIT result. Given the large size of outreach programs, which include the majority of the screening-eligible adult population, even small increases in primary care visit cumulatively can generate large numbers of visits and can have substantial impacts on total health care utilization. For example, if 1 of every 2–3 positive FIT tests results in a single additional visit, the result could be thousands of excess visits exerting strain on systems and staff. This is of particular interest for a CRC screening test that is assumed to be inexpensive (FIT in cost models is estimated to be <$20 per test), where even a modest increase in more costly primary care visits may impact cost-effectiveness assumptions and outcomes. In programs such as the CDC’s CRCCP where resources are limited, additional unaccounted for costs may restrict allocation of services to those in need.[8] In either case, management of unexpected costs associated with increased primary care utilization as a result of FIT requires further modeling and investigation.

Further, whether the observed increase in health care utilization is beneficial to the patient and is evoked by a negative psychological reaction to the positive test and an ensuing coping behavior is of great interest. Thus, a closer examination of the additional visits and the psychological drivers motivating behavior following a positive FIT screening result,

represent the next steps in this inquiry. Our findings also underscore the need to account for changes in primary care visit use in the calculation of healthcare costs associated with screening effectiveness. Further investigation of the specific changes in visit use, the effect of repeated annual FIT testing on primary care visit use, impact of increased primary care visits among those who do not comply with diagnostic colonoscopy and whether or not this group attends CRC screening in the future and the influence that behavior has on CRC morbidity and mortality in this group is indicated.

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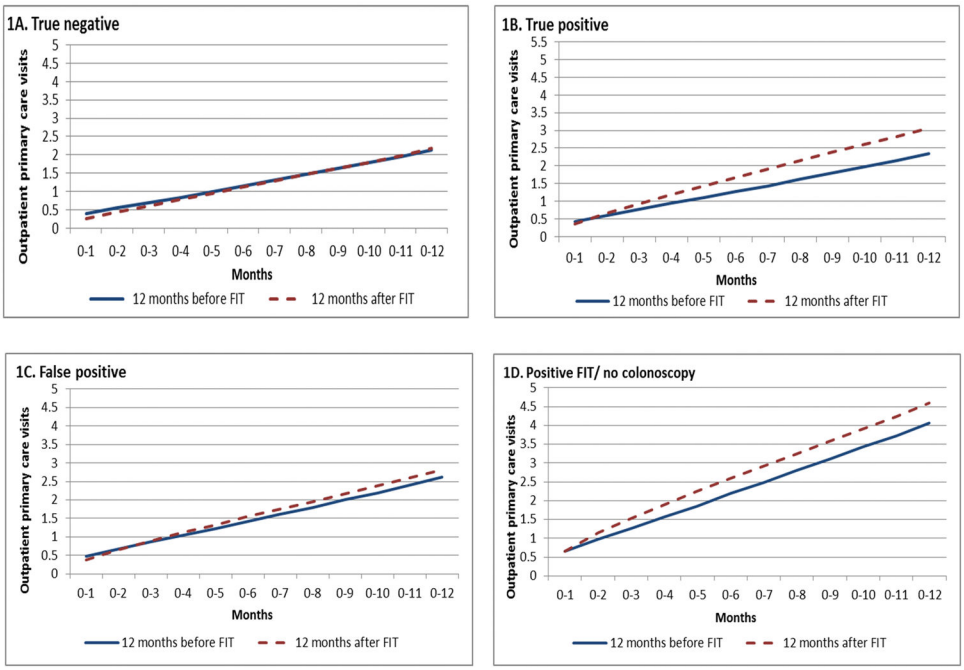

Figure 1A–D.

Unadjusted change in cumulative monthly healthcare utilization within FIT screening result groups comparing the 12 month period prior to FIT to the 12 month period after Kaiser Permanente Northern California between 2007 and 2011.

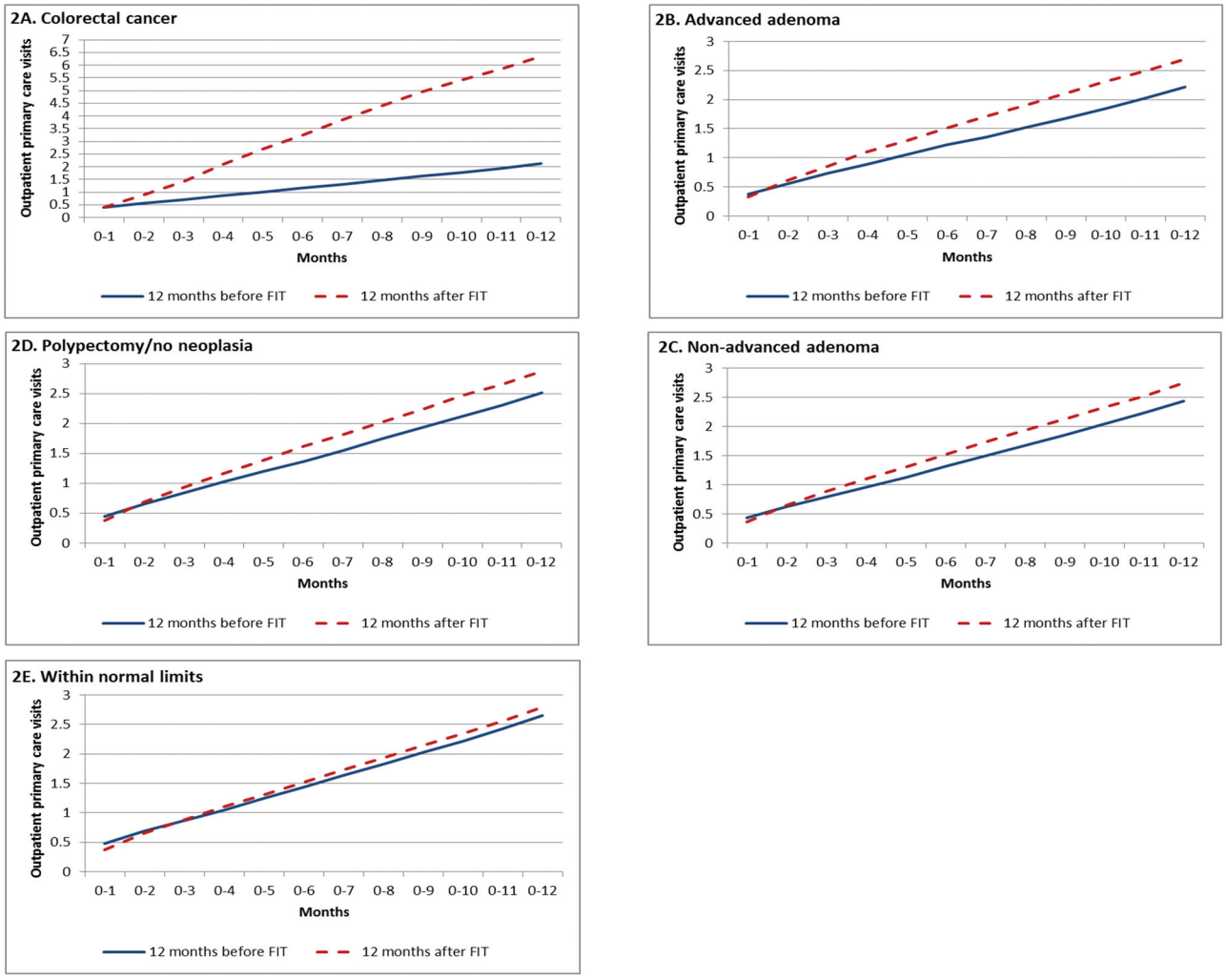

Figure 2A–E.

Unadjusted change in cumulative monthly healthcare utilization within FIT-positive screening result subgroups comparing the 12 month period prior to FIT to the 12 month period after Kaiser Permanente Northern California between 2007 and 2011.

Table 1

Demographic characteristics among individuals 50–75 years old who completed FIT screening at Kaiser Permanente Northern California between 2007 and 2011 (n = 483,216).

	Total (n = 483,216)	Negative FIT	Positive FIT (n = 26,892)			P value
		True negative (n = 456,324)	True positive (n =11,072)	False positive (n =9,701)	Positive, no colonoscopy (n =6,119)	
	N (%)	N (%)	N (%)	N (%)	N (%)	
Age						<0.0001
50–64	351,693 (72.8)	334,783 (73.4)	6,761 (61.1)	6,569 (67.7)	3,580 (58.5)	
65–75	131,523 (27.2)	121,541 (26.6)	4,311 (38.9)	3,132 (32.3)	2,539 (41.5)	
Gender						<0.0001
Female	257,232 (53.2)	245,175 (53.7)	4,167 (37.6)	5,081 (52.4)	2,809 (45.9)	
Male	225,944 (46.8)	211,111 (46.3)	6,904 (62.4)	4,619 (47.6)	3,310 (54.1)	
Missing/Unknown[a]	40 (0.0)	38 (0.0)	1 (0.0)	1 (0.0)	0(0.0)	
Race						<0.0001
White	291,252 (60.3)	275,059 (60.3)	6,756 (61.0)	5,891 (60.7)	3,546 (58.0)	
Black	30,855 (6.4)	28,889 (6.3)	865 (7.8)	642 (6.6)	459 (7.5)	
Asian	75,736 (15.7)	71,784 (15.7)	1,525 (13.8)	1,536 (15.8)	891 (14.6)	
Other	29,204 (6.0)	27,281 (6.0)	758 (6.8)	678 (7.0)	487 (8.0)	
Missing/Unknown[a]	56,169 (11.6)	53,311 (11.7)	1,168 (10.5)	954 (9.8)	736 (12.0)	
Ethnicity						<0.0001
Hispanic	54,518 (11.3)	51,403 (11.3)	1,292 (11.7)	1,083 (11.2)	740 (12.1)	
Non-Hispanic	354,886 (73.4)	334,896 (73.4)	8,252 (74.5)	7,361 (75.9)	4,377 (71.5)	
Missing/Unknown[a]	73,812 (15.3)	70,025 (15.3)	1,528 (13.8)	1,257 (13.0)	1002 (16.4)	
Comorbidity score						<0.0001
0	353,585 (73.2)	336,714 (73.8)	6,971 (63.0)	6,356 (65.5)	3,544 (57.9)	
1	79,236 (16.4)	73,973 (16.2)	2,157 (19.5)	1,854 (19.1)	1,252 (20.5)	
≥2	50,395 (10.4)	45,637 (10.0)	1,944 (17.6)	1,491 (15.4)	1,323 (21.6)	
Primary care visits[b]						<0.0001
None	88,870 (18.4)	84,721 (18.6)	1,930 (17.4)	1,353 (14.0)	866 (14.2)	

	Total (n = 483,216)	Negative FIT	Positive FIT (n = 26,892)			P value
		True negative (n = 456,324)	True positive (n =11,072)	False positive (n =9,701)	Positive, no colonoscopy (n =6,119)	
	N (%)	N (%)	N (%)	N (%)	N (%)	
1–3	303,194 (62.8)	287,592 (63.0)	6,719 (60.7)	5,900 (60.8)	2,983 (48.6)	
4–9	84,815 (17.6)	78,671(17.2)	2,213 (20.0)	2,226 (23.0)	1,705 (27.9)	
≥10	6,337 (1.3)	5,340 (1.2)	210 (1.9)	222 (2.3)	565 (9.2)	

Note: FIT = fecal immunochemical test.

[a]Excluded from univariable analysis.

[b]Annualized number of outpatient primary care visits in the 2 years before FIT screening.

Table 2

Comparison of the net change in outpatient primary care visits before and after index FIT by result group among individuals at Kaiser Permanente Northern California between 2007 and 2011 (n = 483,216).

FIT result group	Total	Outpatient primary care visits			
		Before index FIT[a]	After index FIT/diagnostic colonoscopy[b]	Change in visits (absolute [SD])	OR (95% CI)[c]
		Mean [SD]	Mean [SD]		
True negative	456,324	2.14 [1.8]	2.17 [2.2]	0.02 [1.9]	Referent
True positive	11,072	2.30 [2.1]	3.05 [3.1]	0.60 [2.3]	1.60 (1.54–1.66)
CRC	1,041	2.14 [2.0]	6.27 [4.5]	3.00 [2.7]	7.19 (6.12–8.44)
Advanced adenoma[d]	2,500	2.20 [2.0]	2.69 [2.6]	0.44 [2.0]	1.54 (1.42–1.67)
Non-advanced adenoma[e]	7,531	2.36 [2.1]	2.73 [2.6]	0.33 [2.1]	1.36 (1.30–1.43)
False positive	9,701	2.54 [2.2]	2.80 [2.7]	0.22 [2.1]	1.27 (1.22–1.33)
Polypectomy, no pathology[f]	2,496	2.45 [2.1]	2.87 [2.7]	0.36 [2.1]	1.37 (1.27–1.48)
Within normal limits	7,205	2.57 [2.2]	2.78 [2.6]	0.17 [2.1]	1.24 (1.18–1.30)
Positive FIT/no COL	6,119	3.61 [3.5]	4.22 [4.2]	0.49 [2.7]	1.50 (1.43–1.58)

Note: CI = confidence interval; Col = colonoscopy; CRC = colorectal cancer; FIT = fecal immunochemical test; OR = odds ratio; SD = standard deviation

[a] Annualized average of primary care visits in the 2 years before the index FIT.

[b] Annual average of primary care visits in the 1 year after the index FIT result.

[c] Multivariable analysis examining the relationship between FIT result group and increased outpatient primary care visits after FIT screening, adjusted for age, gender, and Charlson comorbidity score.

[d] Villous and tubulovillous histology.

[e] Non-advanced adenomas (e.g., no villous or tubulovillous histology).

[f] No CRC or adenoma detected.

Table 3

Comparison of outpatient primary care visits before and after FIT for true negative and positive FIT, no colonoscopy and after diagnostic colonoscopy for FIT-positive groups and subgroups at Kaiser Permanente Northern California between 2007 and 2011 (n = 483,216).

FIT result group	Total	Outpatient primary care visits			
		Before index FIT[a]	After index FIT/diagnostic colonoscopy[b]	Change in visits (absolute [SD])	OR (95% CI)[c]
		Mean [SD]	Mean [SD]		
True negative	456,324	2.14 [1.8]	2.17 [2.2]	0.02 [1.9]	Referent
True positive	11,072	2.33 [2.1]	2.81 [3.0]	0.34 [2.3]	1.23 (1.19–1.27)
CRC	1,041	2.14 [2.0]	6.47 [3.0]	3.00 [2.7]	6.21 (5.33–7.24)
Advanced adenoma[d]	2,500	2.20 [2.0]	2.47 [2.5]	0.24 [2.0]	1.21 (1.12–1.31)
Non-advanced adenoma[e]	7,531	2.36 [2.1]	2.47 [2.6]	0.07 [2.1]	1.05 (1.00–1.10)
False positive	9,701	2.57 [2.2]	2.50 [2.6]	−0.10 [2.1]	0.91 (0.86–0.95)
Polypectomy, no pathology[f]	2,496	2.45 [2.2]	2.65 [2.6]	0.15 [2.1]	1.11 (1.03–1.21)
Within normal limits	7,205	2.57 [2.2]	2.50 [2.6]	−0.10 [2.1]	0.91 (0.86–0.95)
Positive FIT/no COL	6,119	3.61 [3.5]	4.22 [4.2]	0.49 [2.7]	1.50 (1.43–1.58)

Note: CI = confidence interval; Col = colonoscopy; CRC = colorectal cancer; FIT = fecal immunochemical test; OR = odds ratio; SD = standard deviation

[a] Annualized average of primary care visits in the 2 years before the index FIT.

[b] Annual average of primary care visits in the 1 year after the index FIT result for the true negative and positive FIT, no colonoscopy groups and after the diagnostic colonoscopy for the true positive and false positive groups and subgroups.

[c] Multivariable analysis examining the relationship between FIT result group and increased outpatient primary care visits after FIT screening, adjusted for age, gender, and Charlson comorbidity score.

[d] Villous and tubulovillous histology.

[e] Non-advanced adenomas (e.g., no villous or tubulovillous histology).

[f] No CRC or adenoma detected.