Premature Fecal Immunochemical Testing in British Columbia Canada: a Retrospective Review of Physician and Screening Participant Characteristics

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BACKGROUND: Colorectal cancer (CRC) screening is an evidence-based strategy to reduce CRC-related mortality.
OBJECTIVE: This study identifies physician and participant characteristics, as well as previous FIT values associated with premature FIT usage.
DESIGN: This is a retrospective review of all FITs ordered from January 1, 2016, until June 30, 2017. For each ordered FIT, the participant's chart was reviewed to identify if a previous FIT had occurred in the prior 21 months. A premature FIT was defined as an ordered test with a negative FIT in the preceding 21 months.
PARTICIPANTS: Screening participants were average risk for CRC, aged 50–74, and had a FIT ordered by their primary care provider in British Columbia, Canada.
MAIN MEASURES: The BC College of Physicians and Surgeons' database was used to identify the location of referring physician, date of graduation from medical school, and gender. The participant's age, gender, and value of previous FIT were recorded. Physician and participant variables and previous FIT value were examined with logistic regression to identify associations with premature FIT ordering.
KEY RESULTS: In total, 385,375 FITs were ordered during this period with 116,727 representing participants returning following a previous negative FIT. In total, 35,148 (30.1%) returned early for screening. Men were more likely to return early than women (OR 1.14; 95% CI 1.11–1.17; $p < 0.0001$). Male physicians were more likely to order premature FITs (OR 1.15; 95% CI 1.06–1.24; $p < 0.0001$). A higher quantitative FIT value (ng/mL) of the previous FIT was also associated with early screening (OR 1.11; 95% CI 1.09–1.14; < 0.0001).
CONCLUSIONS: This study found that approximately 30% of FIT tests, ordered for CRC screening, were ordered before they were due. This may lead to wasted resources, unnecessary participant stress, and unwarranted patient risk.

INTRODUCTION

Colorectal cancer (CRC) is the third most common cancer in North America.[1,2] Multiple randomized prospective studies have showed a reduction in colorectal cancer (CRC) mortality from fecal occult blood testing (FOBT).[3–5] Endoscopic removal of precursor lesions has been shown to reduce the risk of developing cancer.[6] The fecal immunochemical test (FIT) has replaced the previous guaiac fecal occult blood test (gFOBT) as the noninvasive screening test of choice.[7–11] The U.S. Multi-Society Task Force on Colorectal Cancer has recommended annual FIT testing[12] as one of the modalities for CRC screening whereas the Canadian Task Force on Preventative Health Care recommends biennial screening.[13]

Cancer screening programs have studied participation rates[14,15] and interventions to improve screening rates.[16–19] Once screened, participants are recalled for re-screening at appropriate intervals. Quality initiatives such as automated reminders[20] are becoming standard, but physicians can order FITs independent of recommended intervals. The Canadian Task Force on Preventive Health Care recommends FIT every 2 years based on the reduction in colon cancer mortality with biennial gFOBT.[21] The 2-year interval may improve adherence, but this is unproven.[22] The pooled sensitivity for a one-time FIT in the detection of CRC is 79%.[23]

VHA studies have assessed early return for repeat screening in the USA. Fisher et al. studied gFOBTs ordered by primary care professionals at a single VHA Medical Center. They reported that 7% of the 500 FOBTs ordered were inappropriate because the screening participant had a colonoscopy in the prior 5 years.[24] Ahmed et al. performed a single-center retrospective chart review of patients who had gFOBT who had already had a total colon examination.[25] Powell et al. identified a specific realm of inappropriate testing whereby screening participants are tested with a gFOBT prior to being recalled after a previous negative gFOBT result.[26] The authors identified that inappropriate screening strains resources, adds unnecessary stress to participants, and exposes participants to risk. Partin et al. recommended that additional studies are required to look at rates of overuse of noninvasive CRC screening modalities.[27,28]

A FIT is offered in British Columbia (BC) for all patients between the ages 50 and 75 at an average risk of CRC.

Participants with a previous negative FIT in the program are recalled for repeat FIT every 2 years. A recall letter is sent by the BC Colon Screening Program (BCCSP) at 22 months from the last negative FIT. Patients then see their primary care provider to receive a FIT requisition. Once the test has been completed, results are sent to the BCCSP and positive FITs are referred for colonoscopy consideration. However, physicians in the screening program may order FITs for their patients prior to the 2-year recall. This study investigates factors associated with premature FIT ordering.

METHODS

The study was a retrospective review of all FITs performed in the BC Colon Screening Program from January 1, 2016, to June 30, 2017. We defined a premature FIT as one in which a participant had a negative FIT in the preceding 21 months. The study was approved by the BC Cancer Agency Research Ethics board on October 6, 2017.

The BC Colon Screening Program (BCCSP) was commenced in 2013 and is a publicly funded program available to average-risk individuals, age 50 to 75 years. Participants are screened every 2 years with a quantitative FIT (NS-Plus, Alfresa, Japan) at a cutoff of positivity of 50 ng/mL buffer (10 μg/g feces). Physicians and participants have access to their quantitative FIT value. Screening participant data, including FIT values, is collected by the BC Cancer Agency and maintained in the BCCSP database.

Physician characteristics including gender, location of training, year of graduation from medical school, and location of practice were from the BC College of Physicians and Surgeons' physician directory and adhered to the College's acceptable use policy. Classification of urban versus rural location of practice was determined by the Canadian Partnership Against Cancer definition.[29] The Postal Code Conversion File Plus (PCCF +, Statistics Canada, Ottawa) was used to obtain population size and access to services by postal code. The categories were collapsed into a binary variable of rural or urban. Postal codes beginning with V0 that could not be assessed by PCCF+ were assigned as rural.

The association between patient, physician, year of return, and test characteristics with premature FIT was investigated using logistic regression. To control for the repeat nature of analyzing the same referring physician for multiple patients, a generalized estimating equation (GEE) was used. For this data, an exchangeable correlation structure was specified. Interactions between clinically significant independent variables were assessed. Significance threshold was $p \leq 0.05$. Cluster analysis was used to categorize variables. Gower distance was calculated for patient age, FIT value, and year of medical graduation, considering the proportion of inappropriate FITs for each value. A partitioning around mediods (PAM) algorithm was used and the number of clusters chosen maximized silhouette width. Statistical analyses were performed using SAS 9.4. (SAS Institute, Cary, NC) R version 3.4.2 (R Foundation for Statistical Computing, Vienna[30]).

RESULTS

In total, 385,375 FITs were ordered during this period with 116,727 being returns from a previous negative FIT. In total, 35,148 (30.1%) patients returned early for screening (Fig. 1). The percentage of premature FITs changed over the study period. From January 2016 to June 2016, the proportion of premature FITs was 48.26% compared with 27.34% from July to December. The proportion was even lower in 2017 at 21.17% from January to June 2017. Characteristics of the screening participants returning for FIT testing are provided in Table 1 and characteristics of physicians ordering premature FITs are presented in Table 2.

With regard to premature FITs (Table 3), male participants were more likely to receive premature FIT orders than females (OR 1.14; 95% CI 1.11–1.17; $p < 0.0001$). Younger age was associated with premature return (OR 1.04; 95% CI 1.01–1.06; $p = 0.003$). In terms of physician characteristics (Table 3), male physicians were more likely to order premature FITs (OR 1.15; 95% CI 1.06–1.24; $p < 0.0001$). Physicians in urban practices who went to medical school in Canada were more likely to order premature FITs (OR 1.32; 95% CI 1.11–1.58; $p = 0.002$). The BC Colon Screening Program defines a positive FIT as greater than or equal to 50 ng/mL buffer. A higher value of the previous negative FIT, defined as 20–49 ng/mL compared with 0–19 ng/mL, was associated with early repeat FITs (OR 1.11; 95% CI 1.09–1.14; $p < 0.0001$) (Table 3). Patients screened in the first half of 2016 had the highest association with premature testing (OR 3.35 95% CI 3.18–3.52; $p < 0.0001$).

Of the premature FITs, 27.3% were ordered by a different physician from the previous FIT (Table 4). Having a different provider order, the FIT was associated (OR 1.26; 95% CI 1.19–1.35; $p < 0.0001$) with early repeat FIT. Interactions between independent variables were investigated. Physician gender had no interaction with patient gender, degree year, degree location, patient age, or location of practice. Patient gender was associated with physician degree year, but the relationship was not significant. There was a significant interaction between location of medical training and location of practice.

CONCLUSIONS

Males, screening participants aged 50–62, and those with a higher previous quantitative FIT were more likely to get an early FIT. Male physicians and physicians in urban practices were more likely to order early FITs. Compared with other studies, our proportion of premature screening of 30.1% is high. Powell et al.'s study looked at annual FOBTs and reported that 13.9% of the 901,292 FOBTs were not due for screening as the patient had a FOBT within the prior 10 months, colonoscopy within the prior 9.5 years, or a sigmoidoscopy or barium enema within the prior
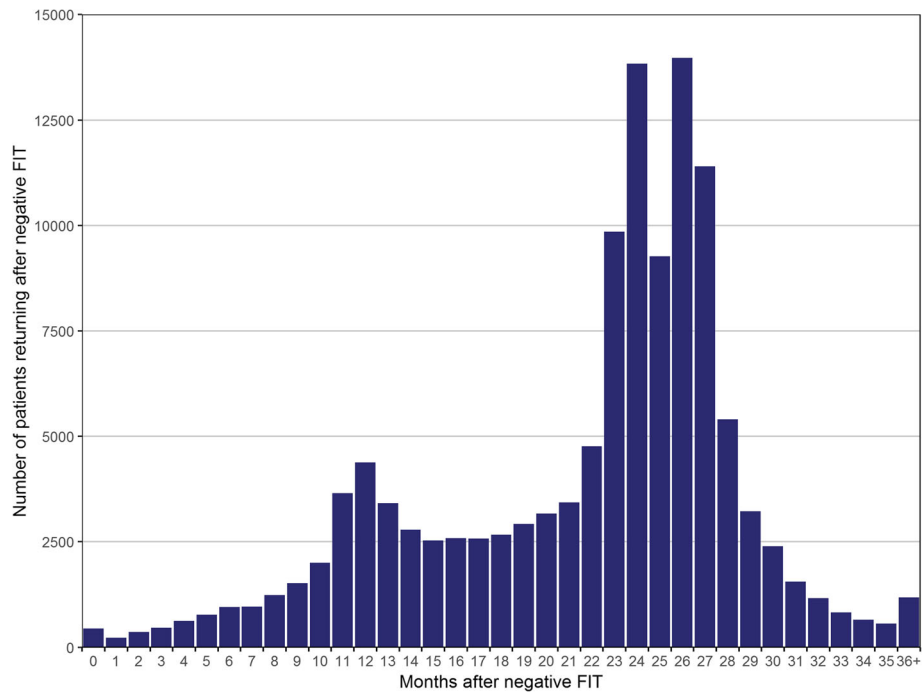
Figure 1 Number of FITs by number of months after negative FIT.

4.5 years.[26] In Partin's study using an annual FOBT for screening, 8% of the FOBTs were coded as overused if their last prior FOBT occurred in the preceding 10 months.[28]

The direct risk of early colorectal screening is potential for the serious complications of colonoscopy.[26] Other consequences of early screening include inconvenience and subjective stress to the screening participant. For screening colonoscopists and the BC CSP, the early FITs represent a strain on resources and could inflate wait times for other individuals in need of screening.

A number of explanations are likely contributing to early return in our study. The spike at 1 year (Fig. 1) may be due to the legacy of 2013 provincial recommendation for FIT every 1 to 2 years, revised to specify every 2 years in 2016.[31] From 2016 to 2017, the percentage of premature FITs significantly decreased. This likely represents uptake and familiarity of the 2016 guidelines by ordering physicians. In addition, as wait times for publicly funded colonoscopies are long,[32] primary care physicians may order FIT early for diagnostic purposes, anticipating an expedited procedure for a positive FIT within

the BCCSP. Primary care physicians may have also determined that a higher value of a previous negative FIT justified an earlier repeat FIT, perhaps supported by participant concerns as BC citizens can access their laboratory results online and could request repeat testing. Finally, physicians often do not access tests ordered by a different physician unless they work in joint practices or review the separate provincial database called CareConnect. Therefore, a patient in an urban setting who sees multiple doctors may have a FIT ordered because the physician is not aware that a patient is up to date with screening. This is supported by the increased premature FIT associated with different ordering physicians.

The literature on the harms of cancer screening is evolving. Authors have clarified the terminology on the harms of screening[33] and types of inappropriate screening.[26] This study only focuses on the interval of CRC screening and early return. This study does not address other aspects of inappropriate screening such as ordering FIT for higher-risk participants in a colonoscopy surveillance program, screening participants with limited life expectancy, individuals at higher risk for CRC (i.e., IBD), and those with a family history of CRC or

Table 1 Characteristics of Screening Participants Returning for FIT Testing from January to June 2017

Patient characteristic		*N*	*(%)*
Age	50–62	56,480	(48.4)
	63–74	60,247	(51.6)
Gender	Male	55,032	(47.2)
	Female	61,695	(52.8)
Previous FIT value	0–19 ng/mL	74,833	(64.1)
	20–49 ng/mL	41,894	(35.9)
Same physician as previous visit	Same	89,827	(77.0)
	Different	26,900	(23.0)

Table 2 Characteristics of Ordering Physicians for Premature FITs

Physician characteristic		*N*	*(%)*
Gender	Male	2529	(58.8)
	Female	1776	(41.2)
Degree year	1960–1983	1058	(24.6)
	1984–2014	3247	(75.4)
Location of training	Canada	2737	(63.6)
	Outside of Canada	1568	(36.4)
Location of practice	Urban	3736	(86.8)
	Rural	569	(13.2)

Table 3 Variables Associated with Premature FIT: Estimated Odds Ratios, 95% Confidence Intervals and *p* Values from GEE Logistic Regression

Variable		Odds ratio	95% CI	*p* value
Patient gender	Female	Reference	-	-
	Male	1.14	1.11–1.17	< 0.0001
Patient age	63–74	Reference	-	-
	50–62	1.04	1.01–1.06	0.003
Previous FIT value	0–19	Reference	-	-
	20–49	1.11	1.09–1.14	< 0.0001
Same physician as previous visit	Same	Reference	-	-
	Different	1.26	1.19–1.35	< 0.0001
Physician gender	Female	Reference	-	-
	Male	1.15	1.06–1.24	< 0.0001
Physician graduation year	After 1984	Reference	-	-
	1960–1983	1.03	0.94–1.13	0.571
Year of Return	2017: January to June 30	Reference	-	-
	2016: January to June 30	3.35	3.18–3.52	< 0.0001
	2016: July to December 31	1.47	1.41–1.52	< 0.0001
Location of degree (Canada and OoC*)	Canada (rural)	Reference	-	-
	Canada (urban)	1.32	1.11–1.58	0.002
Location of practice (rural and urban)	OoC* (urban)	1.77	1.52–2.06	0.005
	OoC* (rural)	0.98	0.79–1.22	0.87

*Outside of Canada

with symptoms of CRC. Our data is also not sensitive enough to identify participants returning for FIT with an earlier FIT performed outside the BCCSP. Colon cancer screening with colonoscopy alone is also not addressed in this study. FITs ordered by physicians who did not have office information available on the BC College of Physicians and Surgeons' website were excluded. Because of the above factors, it is likely that 30.1% is an underestimation of the true burden of inappropriate screening FITs ordered in BC.

We propose that the amount of premature screening be included as a quality measure in the evaluation of CRC screening programs. We recommend other programs adopt our practice of using a report card to disseminate individual

Table 4 Characteristics of Participants Returning for a FIT by Premature Return or Routine Return

Participant characteristic		Premature FIT	Routine return
		N = 35,148 (%)	*N* = 81,570; *N* (%)
Age	50–62	17,099 (48.6)	39,381 (48.3)
	63–72	18,049 (51.4)	42,198 (51.7)
Gender	Male	17,862 (50.8)	37,170 (45.6)
	Female	17,286 (49.2)	44,409 (54.4)
Previous FIT value	0–19	21,785 (62.0)	53,048 (65.0)
	20–49	13,363 (38.0)	28,531 (35.0)
Same physician as previous visit	Same	25,557 (72.7)	64,270 (79.8)
	Different	9591 (27.3)	17,309 (21.2)

and aggregate data for participating physicians. We suggest there should be mechanisms in CRC screening programs to prevent against ordering FITs for diagnostic purposes. A possible mechanism to enforce adherence to guideline would be to restrict reimbursement for premature FITs. Despite the use of an organized CRC screening program, 30% of FITs ordered in the BCCSP were premature. This finding represents an objective target for quality improvement initiatives to reduce the burden of overscreening for CRC.

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