



# Colorectal cancer screening in Canada: results from the first round of screening for five provincial programs

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## ABSTRACT

### Background

Early implementation of programmatic colorectal cancer (CRC) screening for average-risk individuals 50–74 years of age in Canada has used fecal occult blood tests [FTs (guaiac or immunochemical)] and colonoscopy for follow-up of abnormal FTs. This paper presents results of an evaluation of this CRC screening.

### Methods

Five Canadian provincial programs provided aggregated data for individuals with a first-round FT processed between January 1, 2009, and December 31, 2011.

### Results

The 104,750 people who successfully completed a first round of screening represented 16.1% of those who had access to the programs between January 1, 2009, and December 31, 2011 (mean age: 61.2 years; men: 61.4 years; women: 61.1 years). Of those participants, 4661 had an abnormal FT (4.4%). Uptake of colonoscopy within 180 days after an abnormal FT was 80.5%, ranging from 67.8% to 89.5% by program. The positive predictive value (PPV) for adenoma was 35.9% for guaiac FT and 50.6% for immunochemical FT. Adenoma and CRC detection rates were, respectively, 16.9 and 1.8 per 1000 screened. Of invasive CRCs detected, 64.6% were stage I or II.

### Conclusions

Considering the variation in characteristics and stage of implementation of each provincial program, the collaboration of the provinces leading to this report on the early performance of CRC screening in Canada

is a major milestone. Targets are met or nearly met for significant indicators such as PPV for adenoma and cancer detection rate. Participation is expected to increase as programs are fully implemented in the provinces. Additional effort may be needed to improve timely access to follow-up colonoscopy.

## KEY WORDS

Colorectal cancer, screening programs, fecal occult blood test, guaiac, immunochemical, average risk

## 1. INTRODUCTION

Based on randomized controlled trial evidence that colorectal cancer (CRC) mortality can be reduced by screening with fecal occult blood testing (FT), Canadian guidelines for CRC screening were published in 2001 by the Canadian Task Force on Preventive Health Care and in 2002 by the Public Health Agency of Canada. Both sets of guidelines recommend FT screening for the average-risk population 50–74 years of age<sup>1,2</sup>.

After the publication of Canadian guidelines recommending CRC screening, most of the provinces and territories began to plan for organized CRC screening programs. In Canada, CRC screening strategies and programs are the responsibility of the 10 provincial and 3 territorial health authorities. The first provincial program in Canada was announced in 2007, and by 2010, all 10 provinces had announced funding for organized screening programs or pilot programs using FT. Key program characteristics vary among the 5 provinces that were able to submit data (Table I).

For CRC screening reports at the national level, a set of quality indicators was developed in 2009 by representatives of the provinces and territories<sup>3</sup>. Through the National Colorectal Cancer Screening Network, consensus was reached on targets for 6 of the 22 indicators (Table II). Performance monitoring

TABLE 1 Key characteristics of biennial colorectal cancer screening programs in five Canadian provinces for the period January 1, 2009, to December 31, 2011

Province	Program start date	Type of test, brand, and threshold cut-off	Availability <sup>a</sup> (%)	Samples (n), days (n), and positivity	First-round screened <sup>b</sup> (n)
Manitoba	2007	FTg	100	2	30,291
		Hemoccult II Sensa <sup>c</sup>		3	
		—		At least 1	
British Columbia	2009	FTi	4.0	2	9,951
		OC-Auto Micro 80 <sup>d</sup>		2	
		≥100 ng/mL		At least 1	
Nova Scotia	2009	FTi	100	2	56,012
		Hemoccult ICT <sup>e</sup>		2	
		0.3mg Hb/g		At least 1	
Prince Edward Island	2011	FTg	100	2	2,224
		Hema Screen <sup>e</sup>		3	
		—		At least 1	
Saskatchewan	2009	FTi	6.2	1	6,272
		OC Fit-Chek <sup>f</sup>		1	
		100 ng/mL		At least 1	

<sup>a</sup> Percentage of provincial population at December 31, 2011.

<sup>b</sup> January 1, 2009, to December 31, 2011.

<sup>c</sup> Beckman Coulter, Brea, CA, U.S.A.

<sup>d</sup> Somagen, Edmonton, AB.

<sup>e</sup> Immunostics, Ocean, NJ, U.S.A.

<sup>f</sup> Polymedco, Cortlandt Manor, NY, U.S.A.

FTg = guaiac fecal occult blood test; FTi = immunochemical fecal occult blood test.

reports have been initiated, phasing in the reporting of indicators for which data are available.

The 5 provinces able to provide data on 10 short-term quality indicators for evaluation of CRC screening in the average-risk population were British Columbia, Saskatchewan, Manitoba, Nova Scotia, and Prince Edward Island. These initial data provide, for the first time, an aggregate picture of the performance of CRC screening programs in Canada, adding to the body of knowledge internationally on such programs<sup>3-9</sup>.

## 2. METHODS

The data definitions for the 10 quality indicators reported in this paper are outlined in Table II. Aggregated data were provided by the 5 provincial programs for individuals with a first-round screen between January 1, 2009, and December 31, 2011. Data were provided in 5-year age groups, by sex. Because the provincial programs use different FTS, data were analyzed by type of test, where applicable. Some provinces provided data for only a portion of

the period under study or for specific geographic regions, depending on the degree and method of organized program implementation. Of the 5 provinces, 4 provided data on CRC detection and staging.

## 3. RESULTS

Overall, across the 5 provincial programs, 104,750 individuals successfully completed a FT between January 1, 2009, and December 31, 2011 (Table III). The FT inadequacy rate was 3.8% (4185 of 109,016 individuals participating in the first round of screening).

The mean age of participants was 61.2 years, with no difference by sex (men: 61.4 years; women: 61.1 years). The varying availability of these early-stage programs means that reporting of participation rates in the total target population is not possible, but the 5 programs were available to 649,133 individuals, representing a participation rate of 16.1%. Availability was determined by each province and might represent people in a geographic area or pilot population, or people mailed a personal invitation, referred by a family physician, or self-referred. Participation

TABLE II Selected quality indicators and targets

<i>Indicator</i>	<i>Definition</i>	<i>Target</i>
Participation	Percentage of the target population that successfully complete a FTg or FTi	≥60%
FT inadequacy rate	Percentage of individuals whose FT was inadequate and who have not repeated the test to obtain a successful FT result	≤5%
Positivity rate	Percentage of individuals with an abnormal FT result	ND
Follow-up colonoscopy uptake	Percentage of individuals with an abnormal FT result having a follow-up colonoscopy within 180 days	≥85% within 180 days
Wait time to colonoscopy	Time from an abnormal FT result to follow-up colonoscopy	≤60 days from abnormal FT for ≥90% of individuals
PPV adenoma	Percentage of individuals with an abnormal FT result diagnosed with one or more adenomas	≥35% for FTg, ≥50% for FTi
Adenoma detection rate	Number of individuals with one or more adenomas confirmed by pathology from a follow-up colonoscopy performed within 180 days of an abnormal screening FT per 1000 screened	ND
PPV CRC	Percentage of individuals with an abnormal FT result diagnosed with CRC	ND
CRC detection rate	Number of individuals with CRC confirmed by pathology from a follow-up colonoscopy performed within 180 days of an abnormal screening FT per 1000 screened	≥2 per 1000 screened
Invasive CRC stage distribution	Distribution of screen-detected invasive CRC by stage within a specific period	ND

FTg = guaiac fecal occult blood test; FTi = immunochemical fecal occult blood test; FT = fecal test; ND = not yet determined; PPV = positive predictive value; CRC = colorectal cancer.

increased by age to 21% in the 70–74 age group from 13.4% in the 50–54 age group and was higher in women (18.1%) than in men (14.2%).

The positivity rate was 4.4%, representing 4661 individuals with an abnormal FT result<sup>a</sup>.

Positivity was higher with immunochemical FT (FTi, 4.8%) than with guaiac FT (FTg, 3.7%, Table III). Positivity was higher in men (5.9%) than in women (3.4%), and it increased with age to 5.7% in the 70–74 age group from 3.4% in the 50–54 age group.

Compliance with follow-up colonoscopy (within 180 days) was 80.5%, ranging from 67.8% to 89.5% in the reporting provinces. Wait times for follow-up colonoscopy, expressed as the 90th percentile in calendar days, ranged from 63 to 160 days among people who had a follow-up colonoscopy within 180 days.

Overall, the adenoma detection rate was 16.9 per 1000 people screened. The rate varied significantly

by test, with the FTi rate being double the FTg rate (20.1 vs. 9.7 per 1000 people screened). The PPV for adenoma was higher in men than women (54.3% vs. 37.7%) and steadily increased with age to 53.0% in the 70–74 age group from 35.1% in the 50–54 age group. The PPV for adenoma was 35.9% for FTg and 50.6% for FTi (Table III).

Of the 5 reporting provinces, 4 provided data about CRC, allowing for an evaluation of cancer outcomes in 48,738 screening participants. Overall, the CRC detection rate was 1.8 per 1000 screened, and the PPV for CRC was 4.4% (Table IV). Invasive CRC was found in 86 individuals, and stage I or II cancers in 64.6%.

#### 4. DISCUSSION

Participation is a key indicator of program success. Although the screening participation rate in a given jurisdiction's eligible target population is the best indicator of population impact, it is less informative as an indicator when programs are in the early stages of implementation and are not yet available to the entire target population. However, reported participation among the 649,133 people to whom the 5 provincial programs were available allows for an assessment

<sup>a</sup> See Table I for immunochemical FT detection thresholds [at least 1 positive sample represents a positive (abnormal) test regardless of the number of samples used for screening]. For programs using a guaiac FT, at least 1 positive window represents a positive test regardless of the number of samples or cards used for screening.

TABLE III Summary of performance indicator results for first-round screening between January 1, 2009, and December 31, 2011, reported by type of fecal test and overall in five provinces of Canada

Indicator	Test group		
	FTi	FTg	Overall
Tested population (n)	72,235	32,515	104,750
Positive results [n (%)]	3,447 (4.8)	1,214 (3.7)	4,661 (4.4)
Follow-up colonoscopies <sup>a</sup> [n (%)]	2,869 (83.2)	882 (72.7)	3,751 (80.5)
PPV adenoma (%)	50.6	35.9	47.2
Adenoma detected <sup>b</sup>	20.1	9.7	16.9

<sup>a</sup> Within 180 days.

<sup>b</sup> Per 1000 screened.

FTi = immunochemical fecal occult blood test; FTg = guaiac fecal occult blood test; PPV = positive predictive value.

of screening uptake thus far, which is valuable for monitoring program implementation.

At 16.1%, participation in first-round CRC screening programs is much lower than the national target of 60% or better. The hope is that this target, set by the National Colorectal Cancer Screening Network in the early stages of program development, will be attained as the programs continue. Increased participation is a priority of all cancer screening programs, because the population benefit of screening, as demonstrated by the screening trials, will be realized only if participation is high. In the early stages of program implementation, Australia<sup>4</sup> and the United Kingdom<sup>5</sup> reported uptakes of 45.4% and 56.8% respectively. Those rates are much higher than the Canadian rate reported here, but direct comparisons cannot be made because of differences in timing and program setting. However, the comparison is useful in facilitating the identification of successful recruitment methods internationally.

In Canada, as shown by self-reported rates from the *Colon Cancer Screening in Canada* survey<sup>10</sup>, wide access to screening with FT, flexible sigmoidoscopy, and colonoscopy also occurs outside of screening programs, which affects program participation in the provinces. Results of the 2011 survey indicate that 32% of Canadians 50–74 years of age had undergone a FT in the preceding 2 years, with jurisdictional rates ranging from 7% to as high as 66%. Including those people in programmatic screening would allow them to benefit from the quality assurance activities, population-based invitation and recall, and facilitated referral for follow-up that are part of the programs and would also permit the collection and evaluation of screening information at a population level. There is a need to identify opportunistically screened individuals and, if they are eligible, to recruit them into programs, which provide benefits such as safety nets,

TABLE IV Summary of colorectal cancer (CRC) outcomes for first-round screening between January 1, 2009, and December 31, 2011, reported by type of fecal test and overall in four provinces of Canada

Outcome	Test group		
	FTi	FTg	Overall
Tested (n)	16,223	32,515	48,738
Follow-up colonoscopy (n)	1,068	882	1,950
CRC (n)	46	40	86
PPV CRC (%)	4.3	4.5	4.4
CRC detected <sup>a</sup>	2.8	1.2	1.8
Stage I or II invasive CRC (%)	76.1	55.6	64.6

<sup>a</sup> Per 1000 screened.

FTi = immunochemical fecal occult blood test; FTg = guaiac fecal occult blood test; PPV = positive predictive value.

quality assurance activities, and promotion of regular screening, and thereby also to increase program participation rates.

In 2013, the Canadian Partnership Against Cancer initiated a project to quantify the opportunistic screening taking place in Canada outside of CRC, breast cancer, and cervical cancer screening programs, a project that will inform the development of feasible strategies to increase participation in CRC screening programs. Another factor affecting the results of first-round screening in the 5 provincial programs might be that some people have undergone an earlier CRC screening with any modality before entering their local program (data not shown).

In comparing results by type of FT, positivity and PPV for adenoma were higher for FTi than for FTg. Canadian targets for PPV for adenoma are 35% or better for FTg (same as the target used by the U.K. National Health Service<sup>11</sup>) and 50% or better for FTi. Both targets were achieved. Compared with the FTg, the FTi leads to higher identification rates for adenomas and early-stage invasive CRCs. However, the cancer detection rate per 1000 people screened almost achieves the Canadian target of 2 or more per 1000 screened (same as the target used by the U.K. National Health Service<sup>11</sup>). A significant variation between the FTg and the FTi is recognized.

A comparison of Canadian results with those published by international programs shows that Canadian FTg results are similar to those in France<sup>6</sup>, which reported a positivity rate of 3.7% and a cancer detection rate of 2.3 per 1000 people screened, and similar to those in a U.K. report of a 35.0% PPV for adenoma, but with a lower positivity of 1.9% and a higher PPV for cancer (10.9%)<sup>5</sup>. Results from Finland<sup>8</sup> suggest better performance for some of the key indicators in the early stage of their program—PPVs of 43.2% and 8.6% for adenoma and cancer respectively,

and a lower positivity rate of 2.1%—than were seen in Canada. The Canadian FTI result of a 4.3% PPV for cancer is slightly lower than that in Australia<sup>4</sup> (5.2%), but the Australian positivity rate of 9% is almost double the Canadian rate of 4.8%. The variation in immunochemical tests and in threshold cut-offs may explain the differences in results across programs.

The timely availability of follow-up for screening participants with an abnormal FT result is a key component of a successful program. Overall, colonoscopy uptake within 180 days of an abnormal FT was below target at 80.2%, but uptake varied widely in the reporting provinces (Canadian target:  $\geq 85\%$  within 180 days). To achieve their maximum potential, organized CRC screening programs have to make every effort to encourage all individuals with an abnormal FT to proceed to a follow-up colonoscopy. Colonoscopy uptake may improve as capacity is increased with program expansion and with implementation of follow-up strategies such as nurse- or client-navigators or a coordinated referral and scheduling process for colonoscopy.

The wait time for follow-up colonoscopy also varied considerably across the 5 reporting provinces, and except in 1 province, it was much longer than the target of a 90th percentile of 60 days.

Monitoring the effect of follow-up strategies is important so that any inadvertent negative effect on access for symptomatic patients requiring colonoscopy can be recognized and so that those invited to participate in screening receive timely access to necessary follow-up.

Because provincial screening programs are delivered by provincial health authorities, the effort and commitment to collaborative information sharing and reporting is crucial in building organized CRC screening in Canada. All provinces and territories have representatives at the national network level to plan future reporting.

## 5. CONCLUSIONS

In Canada, the provinces and territories are responsible for delivering health care. Considering the diversity across the country in the planning and implementation of CRC screening, and the variation in the characteristics of each provincial program, the collaboration by the provinces leading to this report on the early performance of programmatic CRC screening in Canada is a major milestone. Targets are met or nearly met for significant indicators such as PPV adenoma and cancer detection rates.

The availability of CRC screening through organized programs is steadily increasing in Canada, and as programs mature, more comprehensive reporting on Canadian performance indicators and achievement of targets will be available. It is expected that participation in screening will increase as programs are fully implemented in the provinces and territories.

Additional efforts may be needed to improve timely access to follow-up colonoscopy.

New, updated national quality indicator results should be available within 2 years, with the data being more complete and comprehensive because more provinces will be able to provide information from their newly implemented screening programs.

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## 7. CONFLICT OF INTEREST DISCLOSURES

The authors have no financial conflicts of interest to declare.

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