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Colorectal cancer screening among first-degree relatives of colorectal cancer patients: benefits and barriers

by

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Abstract

First-degree family history of colorectal carcinoma (CRC) imparts an increased risk of developing CRC. This study assessed CRC screening status, knowledge, and benefits / barriers to CRC screening among first-degree relatives (FDRs) of patients with CRC (stage I-III) in the Calgary Health Region (2001-2003) using a population-based survey. Seventy percent of FDRs had CRC screening, 60% were adherent to guidelines, and 85% were interested in screening. Of those screened, 33.7% had fecal occult blood testing, 19.4% barium enema, 10.7% sigmoidoscopy, and 58.7% colonoscopy. Factor analysis identified 5 constructs of CRC screening behavior: salience/ coherence, cancer worries, social influence, susceptibility, and response efficacy. The main predictor of screening was age ≥ 50 years (OR 3.64: 95% CI 2.001-6.621). Further predictors include full-time employment and positive responses to 4 constructs: cancer worries, social influence, response efficacy, susceptibility. Uniform guidelines and a standardized screening program may further improve screening uptake in this population.

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I. Introduction

Colorectal carcinoma (CRC) is the third most common malignancy and the second leading cause of cancer-related death in Canada.(1) The majority of colorectal cancers develop from within a pre-existing adenoma (benign polyp) via a step-by-step accumulation of genetic alterations known as the adenoma to carcinoma sequence.(2;3)

Screening describes a procedure or procedures used to identify a condition in an asymptomatic individual. There are many options to screen for colorectal cancer or adenomatous polyps including fecal occult blood testing, sigmoidoscopy, barium enema, colonoscopy, CT colonography (virtual colonoscopy) or fecal DNA testing.(4) CRC is an ideal tumor for population-based screening due to its high incidence, long lag time between adenomatous polyp and carcinoma, and increased potential for curative treatment when detected at an earlier stage.(5) The Canadian Task Force on Preventive Care has recommended CRC screening in all average risk individuals, although a standardized screening program has not been adopted in Canada.(6)

At present, widespread screening for CRC is not occurring in Canada and some feel screening of all average risk individuals may not be feasible in the Canadian healthcare environment.(7) An alternate strategy is to focus on potentially higher risk, yet still asymptomatic individuals. Individuals with a first-degree family history (parent, sibling or child related by blood) of CRC are at an increased risk of developing colorectal cancer and may be a reasonable

subgroup of the population for an introductory standardized screening program.(8;9) There are currently limited Canadian data regarding perceived benefits or barriers to screening in this population subgroup.

II. Background

A. Colorectal Cancer

Statistics

Colorectal cancer is the second leading cause of cancer-related death in Canada with an estimated age-standardized incidence rate of 59 per 100000 in males and 38 per 100000 in females in 2001. The corresponding estimated age-standardized mortality rate was 22 per 100000 and 14 per 100000 males and females, respectively. (1) Fortunately, the age standardized incidence and mortality rates have slowly decreased in Canada since 1985. However, because of an aging population, the absolute number of new cases has continually increased among both men and women.

Preclinical Phase

As noted, the majority of colorectal cancers develop from within a pre-existing adenoma (benign polyp) via a step-by-step accumulation of genetic alterations known as the adenoma to carcinoma sequence.(2;3) Further, these accumulating genetic alterations may take up to 10 years or more to develop into colorectal cancer. Symptoms do not occur during this pre-clinical phase of the disease.

B. Screening for Colorectal Cancer

Definitions

Screening describes a procedure or procedures used to identify a condition in an asymptomatic individual. The World Health Organization states that the success of a screening program for a population depends on specific, fundamental principles.(10) First, the target disease (i.e. colorectal cancer) should be a common form of cancer with high morbidity and mortality. Second, effective treatment which is capable of reducing morbidity and mortality should be available. Finally, screening test procedures should be acceptable, safe, accurate and relatively inexpensive.

There are a number of important definitions related to screening.(10;11) Sensitivity is defined as the effectiveness of a test in detecting disease in those who have that disease. Specificity defines the extent to which a test gives negative results in those that are free of disease. Positive predictive value is defined as the extent to which subjects have the disease in those that give a positive test result. Negative predictive value is defined as the extent to which subjects are free of disease in those that give a negative test result. Finally, acceptability is the extent to which those for whom the test is designed agree to be tested.(10) The ideal screening test aims to have as few people as possible with the disease go undetected (high sensitivity) and as few as possible without the disease subject to further diagnostic tests (high specificity).(10) If the test has a high sensitivity and specificity, the likelihood of

a positive screening test giving a correct result (positive predictive value) will depend on the prevalence of the disease within the population.

As noted previously, colorectal cancer is a common cancer in both men and women in Canada with a recognized preclinical phase. Screening of asymptomatic individuals may note benign polyps which can be removed with the goal of cancer prevention. Further, screening may detect colorectal cancer at an earlier, more treatable and more curable stage.(5;12) In general, CRC is a suitable disease for screening as it has a high incidence with significant morbidity and mortality, a long asymptomatic pre-clinical phase, and is relatively curable if detected in its early stages. The most controversial aspect of colorectal cancer screening is the availability of acceptable, safe and relatively inexpensive screening tests.

Colorectal Cancer Screening Tools

Current screening options for colorectal cancer include fecal occult blood testing, sigmoidoscopy, barium enema, colonoscopy, CT colonography (virtual colonoscopy), and fecal DNA testing.(4) Fecal occult blood testing is a non-specific test which detects blood in the stool. Both large adenomas and colorectal carcinomas may bleed leading to a positive test. Hemoglobin in blood will oxidize guiac impregnated stool collection cards to turn the card blue; resulting in a positive result. Flexible sigmoidoscopy examines the sigmoid colon and rectum directly with a 60 cm endoscope. The procedure can be performed by a variety of health care workers including physicians (primary care and specialists), physician assistants, and nurses. Double contrast

barium enema is a procedure performed by a radiologist and technician where both air and contrast material is injected into the colon to inflate the bowel and outline the mucosa. Mucosal abnormalities including moderate to large polyps as well as colorectal cancer can be detected in this manner.(13) Colonoscopy involves the direct examination of the entire colon and rectum with a long, flexible endoscope. It generally requires patient sedation but can directly view and biopsy suspicious lesions. Further, colonoscopy is required for all other positive screening modalities to confirm the diagnosis of polyp or colorectal cancer. Thus, it is the gold standard examination.(13) CT colonography (virtual colonoscopy) is the use of high resolution CT scan to create two and three dimensional images to simulate the images obtained by conventional colonoscopy.(14;15) It still requires bowel cleansing as in conventional colonoscopy. Finally, fecal DNA testing uses assays to detect common DNA mutations of adenomas and CRC that are shed in the stool. Multiple genetic abnormalities occur in the development of colorectal cancer; many of which can be detected by fecal DNA testing.(16;17) The evidence for and limitations of these various screening modalities will be discussed below.

Evidence Supporting Benefits and Limitations of Screening Tools

The overall goal of colorectal cancer screening is to reduce cancer-specific mortality in average risk individuals; which is support by several well-designed randomized controlled trials. Fecal occult blood testing is supported by four randomized controlled trials (and meta-analysis) involving greater than 330000 average risk individuals and improving cancer-specific mortality by

approximately 16% in the screened group (RR=0.84 95%CI=0.77-0.93).(12;18-22) Further, the meta-analysis by Towler *et al.* indicated a 23% reduction in mortality in those who complied with screening.(22) Although a simple, safe, and inexpensive test, there are several potential limitations. To be most effective, fecal occult testing is done on an annual basis with a high compliance rate.(12;22) Further, it has a relatively low sensitivity or chance of detecting an abnormality of approximately 50% and probably much lower.(4;18;20;23) Finally, there is a relatively high false positive rate with this screening test as the presence of dietary animal hemoglobin or vegetables with peroxidase activity such as broccoli or turnip may cause the oxidation of guiac on stool collection cards.(4)The majority of individuals testing positive will not have CRC but will be exposed to further testing and possible unnecessary risk.

Well-designed prospective (non-randomized) trials of flexible sigmoidoscopy do demonstrate colorectal cancer-specific decreases in mortality with this screening modality.(24-27) A relatively large case-control study by Selby *et al.* was conducted.(26) 261 cases with fatal CRC were compared to 868 matched control subjects. The investigators found that 8.8% of cases versus 24.2% of controls had a sigmoidoscopy in the preceding 10 year period. Following adjustments for confounding variables, the authors concluded that there was a 70% relative risk reduction of developing fatal CRC from the distal colon in those screened with sigmoidoscopy compared to control subjects. A smaller, case-control study by Newcomb *et al.* yielded

similar results where the risk of death from CRC was reduced among individuals who had a single examination with screening sigmoidoscopy (odds ratio (OR) of 0.21 (95% CI:0.08-0.52)) compared to those never undergoing the procedure.(25) Further, the largest case control study examined 4411 veterans with fatal CRC and compared to four living and four dead matched controls per case.(27) Those having undergone an endoscopic procedure (sigmoidoscopy or colonoscopy) had a reduced CRC mortality, with an OR of 0.41 (95% CI: 0.33-0.50). A similar yet larger case-control study of veterans by the same group assessed the effect of endoscopic screening on CRC incidence.(28) Those with prior endoscopic procedures had a lower incidence of colorectal carcinoma. Further, the odds ratio of developing CRC in those undergoing prior polypectomy was 0.59 (95% CI: 0.45-0.78) and 0.48 (95% CI: 0.35-0.66) for colon and rectal cancer respectively. They concluded that prior large bowel endoscopy and polypectomy prevents future development of CRC. Further advantages of sigmoidoscopy include its ability to detect quite small polyps (<5 mm), no need for patient sedation, shorter time and lower costs compared to colonoscopic examinations, and low overall life-threatening complication rates of 0.005% of perforation and 0.01% for bleeding.(29) An obvious limitation of this screening method is the ignorance of potential lesions in the more proximal colon.(30) Only 20-30% of CRCs in the proximal colon are associated with a more distal polyp or CRC which would be detected on flexible sigmoidoscopy and lead to full colonoscopy.(31) Approximately 70-80% of all advanced neoplasms should be detected since these lesions are

more common in the distal large bowel and rectum.(32)

Double contrast barium enema (DCBE) as a screening tool has not been assessed by a randomized controlled trial. A population-based case-control trial demonstrated a 33% reduction in CRC mortality although this was not significant statistically.(33) Comparison of DCBE and colonoscopy by Winawer *et al.* notes that DCBE detected 32% of adenomatous polyps <5 mm identified by colonoscopy, 54% of those 5-10 mm, and 48% of those > 10mm.(13) However, a study by Rex *et al.* found an overall sensitivity for CRC of 85.2% for DCBE compared to 95% for colonoscopy.(34). Advantages include lower cost and less time per examination compared to colonoscopy as well as a low complication rate of perforation in 0.004%.(35) Its main limitation is a lower sensitivity than colonoscopy in the detection of adenomatous polyps.(13;34)

Colonoscopy is felt to be the best diagnostic tool for colorectal adenomas or carcinomas in terms of accuracy.(13) Studies by Lieberman *et al.* and Imperiale *et al.* found a 10.5% and 5.6% incidence of advanced neoplasia (1 cm adenomatous polyp, villous adenoma, high grade dysplasia or colorectal cancer) respectively in healthy individuals over age 50; suggesting a potentially high clinical impact.(30;32) However, it still may not be the best screening modality for the general population. Concerns include a lack of randomized control trials confirming improved cancer-specific mortality with colonoscopic screening (no randomized trials have been published), the usual requirement of sedation for the procedure and its potential risks, the need for bowel preparation or cleansing for a high accuracy screening rate, the

possibility of potentially serious complications, as well as costs and resource issues. Recent estimates of serious complications such as bowel perforation or bleeding from screening colonoscopy range from 0.2 to 0.3%.(32;36) However, perforation, albeit relatively uncommon, may have up to a 14% associated mortality rate.(37) Cost and resource concerns may be less worrisome if the ideal frequency of screening for this modality is every 5-10 years.(38) All screening methods appear to be cost-effective with several investigators estimating costs of screening colonoscopy of approximately $10000 to $250000 (U.S.) per year of life saved in year 2000.(39-41) Overall costs should be less in the Canadian health care environment.

CT colonography and fecal DNA testing are relatively new technologies which have not been significantly tested in a population-based setting.

Colorectal Cancer Screening Recommendations

Due to the number of CRC screening modalities and their relative advantages and disadvantages, evidence for the ideal or best screening program is unclear and different guidelines are based on differing levels of evidence and expert opinion. The Canadian Task Force on Preventive Care has recommended CRC screening in all average risk individuals above the age of fifty, supporting screening via fecal occult blood testing or flexible sigmoidoscopy.(6) The U.S. Preventive Services Task Force, the American Society of Colon and Rectal Surgeons, and the American Cancer Society have similar although somewhat variable recommendations including the use of fecal occult blood testing annually, sigmoidoscopy or barium enema every 5

years and colonoscopy every 10 years.(42-44)

Current Canadian Colorectal Screening Data – General Population

Despite controversy regarding the ideal CRC screening method, all organizations do recommend screening in all average risk individuals; individuals greater than 50 years of age. Despite these recommendations, the majority of Canadians currently do not undergo CRC screening. The National Cancer Institute of Canada (NCIC) notes population-based screening is most effective when administered through an organized screening program that incorporates all elements of the screening process: evidence based screening, follow-up, recruitment and retention strategies, comprehensive quality assurance, and information systems in support of program operation, monitoring and evaluation.(45) There are currently no formal CRC screening programs in Canada although Ontario and Alberta have announced implementation of such programs on a provincial level.(46) The NCIC estimates that between 4 and 14% of eligible Canadians have undergone fecal occult blood testing in the last 2 years based on results from the Canadian Community Health Survey.(45) Questions regarding colorectal cancer were administered in British Columbia, Newfoundland and Labrador, as well as portions of Saskatchewan and Ontario. A survey of physicians in a large, Canadian urban centre in Alberta suggests the majority (58%) of physicians recommend CRC screening to all average risk individuals.(47) However, an Alberta survey of primary care physicians notes the majority of physicians do not offer CRC screening to more than 75% of eligible individuals.(7)

Furthermore, physician self-reported recommendations likely overestimate actual screening behavior among patients.(48;49) McGregor *et al.* confirmed this with a random, population-based survey of Albertan residents and found approximately 14% up to date in terms of following recommendations for colorectal cancer screening.(50) Many physicians are uncertain about the cost-effectiveness of CRC screening and have concerns regarding inconsistent recommendations and access to screening resources.(7) Others cite patient acceptance as a potential barrier to CRC screening.(51)

C. Screening for Colorectal Cancer among First-degree Relatives of Colorectal Cancer Patients

Risk among First-degree Relatives of CRC Patients

A prospective study of CRC risk among first-degree relatives of patients with colorectal cancer determined an age-adjusted relative risk of colorectal cancer of 1.72 (95% CI, 1.34-2.19) in this group compared to the general population.(8) The relative risk increased to 2.75 (95% CI, 1.34-5.63) in participants with two or more first-degree relatives affected by CRC. Similarly, a systematic review of case-control and cohort studies estimates that first-degree relatives of colorectal cancer patients have a 2.42 times (95% CI 2.20-2.65) increased risk of developing colorectal carcinoma.(9) Risk increased further with increasing number of first-degree relatives affected and in relatives of patients diagnosed with CRC when less than forty-five years of age.

Recommendations for Screening among First-degree CRC Relatives

As widespread population-based CRC screening is not occurring, an alternate strategy is to focus on potential higher risk groups. These groups include those at very high risk such as hereditary non-polyposis colorectal cancer syndromes which may make up to 3-5% of colorectal cancer patients, as well as those with a first-degree family history of colorectal cancer which are at an increased level of risk but not as strongly as those with a defined genetic syndrome.(9;52;53) There are no Canadian implementation strategies to introduce colorectal cancer screening specifically among first-degree relatives of individuals with CRC. Further, the Canadian Task Force on Preventive Health Care does not recommend more intensive screening in this subgroup compared to all average risk individuals. Other groups including the U.S. Preventive Services Task Force, the American Society of Colon and Rectal Surgeons, and the American Cancer Society do recommend more intensive CRC screening in this population starting at age 40 years or ten years prior to the age at diagnosis of their first-degree relative.(42-44) Screening with colonoscopy is commonly, although not uniformly, recommended by these groups.

Similarly, a physician survey of a large Canadian centre found 96% recommended CRC screening in those with a positive first-degree family history of CRC, generally with colonoscopy (84% of respondents).(47) It is unknown whether the majority of individuals with a first-degree family history are being screened despite this survey. Currently, there is a paucity of data about actual screening rates in this population subgroup. Further, there is little

data from the individual's point of view as to their acceptance, knowledge, perceived needs, beliefs or concerns regarding CRC screening. In order to determine the impact of a colorectal cancer screening program in this population subgroup, the proportion of individuals who would consider CRC screening should be assessed. Furthermore, individual's current knowledge and viewpoints regarding CRC screening and potential influences of these viewpoints are necessary to determine if a screening program is feasible and desirable.

Recent Surveys of First-degree Relatives

Although a general survey of first-degree relatives of CRC patients has not been performed in Canada, Rawl *et al.* developed validated scales to measure benefits of and barriers to colorectal cancer screening including fecal occult blood testing, flexible sigmoidoscopy, and colonoscopy in a U.S. longitudinal study of 225 first-degree relatives of CRC patients.(54) The scales have been tested for construct validity in two study populations, including one study population of first-degree relatives of colorectal cancer patients as well as a population of patients who had undergone prior polypectomy.

Using the scales developed by Rawl *et al.,* Madlensky *et al.* surveyed a specific group of first-degree relatives of CRC patients through the Ontario Familial Colon Cancer Registry.(55) The Registry contained 772 potential first-degree relatives of CRC patients and interviews were completed with 368. Approximately 64% of these relatives had been screened for CRC in the past 6 years. Encouragement from a physician was a strong correlate of actual

screening behavior.

The Registry contained a specific group of patients with up to 34% felt to be of high or intermediate risk. The Registry identified high risk as those with probable hereditary non-polyposis colorectal cancer.(56) Intermediate risk was defined as those with probable hereditary non-polyposis cancers such as endometrial or ovarian cancers, young age (<35 years), multiple primary colon cancers, inflammatory bowel disease, and other pathologic or familial risk factors. Of this group of patients, all first-degree relatives of high and intermediate risk patients as well as 25% of sporadic cases were asked to participate in the Registry.(56) There was an over-sampling strategy of first-degree relatives from high or intermediate risk patients. A publication of the methods and first-year response rates of the Ontario Familial Colon Cancer Registry notes 91% of first-degree relatives were from the intermediate or high risk groups. As noted, approximately 64% of those surveyed had CRC screening in the past 6 years. A similar population-based survey of more average-risk first-degree relatives of CRC patients has not been conducted in Canada.

D. Benefits and barriers of colorectal cancer screening

Concepts / Definitions

Several concepts assist in predicting cancer screening behavior, some of which have been studied in first-degree relatives of colorectal carcinoma patients. Susceptibility or perceived susceptibility is a person’s perceived risk

of developing a particular disease, in this case colorectal carcinoma.(54;57) The higher the perceived risk, the more likely a person is to undergo screening.(55;58) Perceived benefits of colorectal cancer screening include the person's belief regarding test efficacy and the ability to prevent colorectal carcinoma or dying from colorectal carcinoma.(54;57;58) Barriers to colorectal cancer screening among individuals include fear, embarrassment, time limitations, and a lack of physician recommendation for screening.(58;59) Furthermore, the feeling that one does not have symptoms and is healthy or that even if the intervention was performed, it would not change their outcome are commonly cited barriers to CRC screening.(58;59)

The majority of these constructs regarding CRC screening adherence are from the Health Belief Model.(60;61) Vernon *et al.* describe several theoretical constructs which may influence CRC screening behavior in more detail: salience and coherence, perceived susceptibility, response efficacy, social influence, and cancer worries.(57;60) "Salience and coherence" is defined as the perception that performing a health behavior is consistent with other beliefs about how to protect and maintain health.(57) "Perceived susceptibility" is defined as the subjective personal risk of developing CRC or polyps. "Response efficacy" is defined as the belief that adopting a behavior will be effective in reducing the risk from a disease. "Social influence" is defined as the desire to comply with CRC screening due to key influences such as opinions by a physician or family member. Finally, "cancer worries" is defined as concerns about potential negative consequences of completing a behavior

(e.g. screening).(57) These constructs are important in choosing and developing a survey instrument to measure potential benefits and barriers to CRC screening among first-degree relatives of CRC patients.

E. Survey Instrument

Choice of Instrument

A questionnaire was designed to assess the proportion of first-degree relatives of CRC patients who have undergone screening, their screening habits, knowledge base, beliefs, and concerns regarding colorectal cancer screening. Further, information regarding demographics and a personal history of cancer was collected. Although detailed methodology of the survey design and adaptation will be discussed in the methods section, it is worthwhile discussing the advantages and limitations of an instrument of this type.

First, there is no standardized survey instrument or gold standard for collecting adherence to or knowledge of colorectal cancer screening among first-degree relatives of CRC patients. The NCIC has not collected this data although it has collected data regarding screening in the general population for four provinces.(45) Rawl *et al.* have designed six scales to measure benefits and barriers of colorectal cancer screening.(54) These scales assess the benefits and barriers of fecal occult blood testing, sigmoidoscopy, and colonoscopy, respectively. Each scale has individuals filling out the survey mark whether they strongly agree, agree, are neutral or have no opinion, disagree or strongly disagree with each statement. An example from the

benefits of fecal occult blood testing scale is “finding colorectal cancer early will safe your life”.(54) The scales were designed following an extensive review of the literature, the use of focus groups to generate qualitative data regarding CRC screening specifically and cancer screening generally, as well as modifications of a similar set of scales validated in the area of mammography utilization for breast cancer screening.(62)

The scales developed by Rawl *et al.* were initially tested on two populations: 1) 225 individuals with a first degree family history of CRC 2) 190 individuals with proven adenomatous polyps.(54) In addition to the scales, descriptions of each screening test were presented to individuals. Following extensive testing and exploratory analyses, the scales were found to have good internal consistency (Cronbach’s alphas approaching or exceeding 0.70), a measure of reliability, and construct validity.(54) Internal consistency is defined as confirmation that each item in a multiple-item measure correlates with each other or is coherent.(63;64) Construct validity is defined as the instrument actually measures the underlying hypothetical construct or concept.(63;65) Support for internal consistency and construct validity was the unidimensionality of the scales and observed significant differences between health beliefs of screened versus non-screened participants.(54) Further, perceived benefits of screening correlated to self-reported screening behavior and perceived barriers negatively correlated with self-reported screening behavior. Finally, the perceived benefits of screening were different in the two, independent populations studied. As noted, Madlensky *et al.* used the

instrument by Rawl *et al.* when surveying the Ontario Familial Colon Cancer Registry, in addition to other survey items.(55)

Further, several questions regarding the constructs predicting CRC screening as described by Vernon *et al.* with further validation reported by Tiro *et al.* were modified for the current survey.(57;60) These authors performed a telephone survey of 1413 individuals from a urban primary care clinic regarding CRC screening.(57) The study lends support to the construct validity of their survey by confirmatory factor analyses in both African Americans and Caucasians. Therefore, although there is no gold standard survey instrument to measure CRC screening perceived benefits and barriers, the current survey included items from two previously validated questionnaires available in the literature.(54;57)

In addition to the scales reported by Rawl *et al.* as well as further questions modified from Tiro *et al.,* demographic variables as well as questions regarding predictors of being up-to-date on CRC screening were adapted from McGregor *et al.*(50;54;57) As noted previously, McGregor *et al.* performed a population-based random digit telephone survey of 1808 Alberta men and women aged 50-74 years regarding awareness of and self-reported screening rates for CRC. The survey of McGregor *et al.* was felt to be particularly useful in potentially comparing screening rates and opinions among the general Alberta population aged 50-74 years to the current study population of first-degree relatives of CRC patients in the Calgary Health Region (Alberta) 2001-2003 aged 40 years or more.(50)

Despite the strengths of the survey noted above, it is worth noting that the final survey instrument has not been validated in terms of construct validity since it is a modification of the validated scales by Rawl *et al.* plus the addition of some survey elements from Tiro *et al.* and McGregor *et al..*(50;54;57). As noted, there is no standardized survey assessing screening knowledge and habits for CRC screening. Despite this potential limitation, the final survey instrument appears to have face validity and was tested further for construct validity as discussed in the Methods section. Face validity is defined as the instrument reflects the content of the concept; usually when assessed by content experts.(64)

Accuracy of Self-Reporting

A particular issue for this study was how well self-reported colorectal cancer screening by individuals compares with actual screening as documented by medical records. Older publications assessing this concern suggest self-reported data may overestimate the percentage of the population actually screened. Gordon *et al.* found the accuracy of self-reported data obtained by mailed questionnaire or telephone interview regarding fecal occult blood testing was greater than 90% and was nearly 80% for sigmoidoscopy.(66) However, false positive reported results were above 40% for mammograms, Pap smears, clinical breast examination and digital rectal examination; other common screening tests. The survey occurred approximately 2 years following the screening intervention. Self-reports among specific groups may be less accurate. Lipkus *et al.* reported that medical audit

failed to confirm self-reports of digital rectal exams, fecal occult blood tests, and sigmoidoscopy in many African-American individuals in a community health center.(67) Similarly, only 74% of women older than 50 who recalled fecal occult blood testing in the past 5 years could be confirmed by medical records.(68)

Newer publications are more encouraging. Baier *et al.* assessed the reliability of a computer-assisted telephone interview for collecting self-reported CRC screening behavior.(69) Individuals who had specific colorectal cancer screening tests confirmed by insurance records were contacted by telephone (229 cases) in Colorado. Similarly, individuals who had no prior screening were also interviewed (100 controls). Both sensitivity (88.7%-96.2%) and specificity (85.9%-96.8%) of self-reported screening behavior was quite high depending on the screening modality used. The authors concluded that self-reporting of colon cancer screening behavior could be used as a reliable indicator of actual screening behavior. The group studied both average risk participants and those with higher risk due to a family history of colorectal cancer. There was no significant difference in the accuracy of self-reporting by gender, age, ethnicity, or family history of CRC.

A similar, yet more specific study of relatives of CRC patients has been reported by Madlensky *et al.* in Ontario.(70) The study compared telephone self-reports of CRC screening with medical records in a multi-provider health care setting. The accuracy of self-reports of colonoscopy compared to medical records was quite high (k statistic for agreement beyond chance – 0.87).

However, the accuracy of sigmoidoscopy and fecal occult blood testing was less impressive (k=0.29 and 0.32, respectively). Interestingly, the authors felt the main reason for this less accurate result was the difficulty obtaining confirmatory medical records rather than over-reporting of tests by individuals. Physician offices tended to have a poorer response for the request of medical records compared to hospital medical records departments. Records of fecal occult blood testing are primarily kept at physician offices and unfortunately were difficult to track. Approximately 25% of physician offices never responded to requests for test confirmation.

Accuracy of Physician Survey

Although a valid potential concern of self reported screening behavior is the possibility of overestimation of actual screening behavior, physician surveys regarding patient screening behavior appear less accurate. Hawley *et al.* reported that 82% of primary care physicians in Texas self-reported recommending fecal occult blood testing and 87% recommended flexible sigmoidoscopy.(51) However, a 1999 American survey of the general population found that only 20.6% of respondents over 50 had been screened by fecal occult blood within the past year, and 33.6% by sigmoidoscopy or colonoscopy within the last 5 years.(49)

Self Administered Mail-In Design

There are advantages and disadvantages of a self-administered mail-in survey. Definite advantages of self-completion mail-in questionnaires are they are less expensive and quicker to administer than phone or personal interview;

a large quantity can be distributed in a short period of time.(71) Further, since there is no interviewer, there will be an absence of interviewer effect or interviewer variability assuring a more standard response.(71) Particular interviewer characteristics may influence or affect how respondents answer. Interviewer variability occurs when an interviewer asks questions in different ways or different orders which may influence the respondent's answers.(71)

The self-administered mail-in questionnaire also has limitations.(71) There is no one present to prompt the respondent who is having difficulty understanding a particular question and no opportunity for the respondent to elaborate on a particular answer. It is difficult to ask a lot of questions due to respondent fatigue. Finally, there is a greater risk of missing data or lower response rates due to a lack of prompting or supervision. In order to overcome these potential limitations, self-completed surveys need to have mainly closed questions, have easy to follow designs, and be relatively short to minimize respondent fatigue. Fortunately, there are several methods to maximize response rates related to the survey instrument itself as well as overall survey implementation including multiple responses and token financial incentives.(72) These concepts will be discussed further in the Methods subsection; Survey Implementation.

F. Study Population – Explanation of Inclusion/ Exclusion Criteria

The study population is the population of first-degree relatives aged 40 years or older of living colorectal cancer patients (Stage I-III) in the Calgary

Health Region (2001-2003) identified by the Alberta Cancer Registry. The years 2001 to 2003 were chosen to give sufficient time for first degree relatives to be aware of the diagnosis of CRC in their relative and pursue CRC screening if desired. Stage I to III colorectal cancer patients were chosen as those with Stage IV had a 5 year survival of 0-5% and the study required permission by living patients to approach their first-degree relatives.(73-75) Age 40 years and older was stipulated as the study targeted first-degree relatives of 'average risk' rather than younger patients who were more likely to be of a defined genetic CRC cancer entity such as hereditary non-polyposis familial colorectal cancer which are of a greater risk of developing CRC. Finally, the time period 2001-2003 was also chosen to ensure a sufficient sample size for a precise estimate of actual colorectal cancer screening behavior and enough positive responses to explore potential benefits and barriers of screening (see Methods section for details).

III. Specific Aims

This study was designed to assess the current colorectal cancer screening status, knowledge base, beliefs and barriers with regards to colorectal cancer screening among first-degree relatives aged 40 years or older of patients diagnosed with colorectal carcinoma (Stage I-III) in the Calgary Health Region (2001-2003) using a population-based survey. The main study objectives were to:

1. Estimate the overall proportion of first-degree relatives of colorectal cancer patients that are being screened for colorectal cancer.
2. Identify and define differences between individuals screened versus those not screened for colorectal cancer.

IV. Research Design and Methods

A. Study Overview

All living colorectal cancer patients (Stage I-III) in the Calgary Health Region diagnosed between 2001 to 2003 were identified via the Alberta Cancer Registry. Primary colorectal cancer patients were approached with an information letter about the survey (Appendix A) and a data sheet (Appendix B) to obtain addresses of their first-degree relatives. Patients could refuse at this point to have their relatives contacted. Patients were asked whether they had first-degree relatives age 40 or older, the number of these eligible relatives, and whether they would be interested in completing a study questionnaire. Patients permitting contact returned their relatives' addresses on a data form via a postage-paid envelope.

An information letter (Appendix C) and mail-in study questionnaire (Appendix D) was then sent to first-degree relatives of CRC patients. In summary, the eight-page questionnaire was designed to assess the proportion of first-degree relatives of CRC patients who had undergone screening, their screening habits, knowledge base, and possible benefits and barriers

regarding colorectal cancer screening. Further information regarding demographics (age, ethnic background, language, education level, socioeconomic status) and personal history of cancer was collected. Of note, the Likert scale questions in Appendix D are labeled as to which underlying construct the question corresponds; individuals filling in the questionnaire did not have these labels.

The returned questionnaires were entered into a Microsoft Access database (Microsoft Inc., Redmond WA). Data transfer to SPSS occurred for further analysis (SPSS Inc., Chicago IL). Analyses included the proportion of those screened, the proportion of those interested in screening as well as descriptive analyses (proportions) of individual demographics, health knowledge and characteristics, screening knowledge and habits, as well as descriptive analyses of potential benefits and barriers of screening (modes, means, medians, standard deviations). More detailed analyses were completed to identify possible correlations with screening behavior. Study results were then compared with the existing literature on colorectal cancer screening in first-degree relatives of CRC patients.

B. Survey development

A questionnaire was designed by a group of content and design experts using modifications of the prior Alberta general population survey, the scales developed by Rawl *et al.*, as well as some data elements measuring CRC adherence from Tiro *et al.*(50;54;57) Demographic questions related to ethnic

origin, language, level of education, marital status, employment status, age, and income were modified from McGregor *et al.* with intention of possible comparison of survey results from the current survey to the general population survey.(50) General questions regarding self-related health status and access to a family physician were included. More specific questions regarding screening knowledge, sources of screening knowledge, and self-reported screening habits were asked. The major outcome element of the survey was self-reported screening rates.

The scales of Rawl *et al.* were modified to consider attitudes as well as potential benefits and barriers of screening generally.(54) Instead of specific questions regarding benefits and barriers of each screening modality (i.e. fecal occult blood testing, sigmoidoscopy, and colonoscopy), these questions were modified to discuss CRC screening overall. Standardized descriptions of these CRC screening tests were included in the survey as per Rawl *et al.*(54). Questions regarding costs of the screening tests were removed as it was felt not to be relevant to the Canadian health care environment where these costs are covered by the provincial government. Finally, data items which did not overlap with the scales of Rawl *et al.* were added from Tiro *et al.* to address further potential predictors of CRC screening adherence.(57)

The survey was then reviewed by a group of content and design experts and changes made to assess for face validity. The questionnaire was further reviewed by a group with survey design expertise and modifications made for ease of comprehension and survey flow. Finally, the survey was reviewed by

three laypeople for ease of completion and comprehension. Appendix D is the final eight-page, survey questionnaire mailed to identified, first-degree relatives of colorectal cancer patients diagnosed in the Calgary Health Region from 2001 to 2003. A priori advantages and limitations of this survey were previously discussed in the 'Choice of Instrument' subsection of the Background section.

C. Population Identification – First-degree Relatives of Colorectal Cancer Patients

The population of interest is all first-degree relatives over the age of 40 years of living CRC patients (Stage I-III) diagnosed in the Calgary Health Region from 2001-2003. All patients diagnosed with CRC (Stage I-III) within the Calgary Health Region for 2001-2003 and still alive in 2007 were identified by the Alberta Cancer Registry. In total, 640 patients were identified prior to the initiation of the study to ensure a sufficient sample. Patients were sent an information letter (Appendix A) as to the purpose of the study. Patients were asked to voluntarily fill in a datasheet with the number of their first-degree relatives over the age of 40 years and their contact information (Appendix B). Based on overall response rates to mail-in medical surveys, it was estimated that 50-60% of CRC patients sent the initial study information letter and datasheet would allow contact with their first-degree relatives and return the datasheet.(76) Therefore, it was estimated 320 to 384 patients would return their datasheets. It was further estimated that each patient would have 2 living,

eligible first-degree relatives ensuring a potential pool of first degree relatives of at least 600.

To ensure a maximal response to the initial letter sent to CRC patients, many elements of Dillman's tailored design approach for mail-in surveys were used.(72) The cover letter was personalized and was delivered by the Alberta Cancer Registry to ensure it appeared official. Confidentiality was assured, the datasheet had clear instructions and an attractive layout and had a stamped addressed envelope included to return the datasheet. Appreciation for participating was given by the investigators. Further, a token financial incentive was included (draw for $100.00).(77;78) As per Dillman's tailored design approach, a reminder letter to non-respondents was sent out 3 weeks following the initial information and datasheet mail-out.(72) The entire package was sent to continued non-responders 3 weeks later. Patients were informed that the survey was completely voluntary and could be returned blank to ensure no repeat mailings would occur.

D. Survey Implementation

First-degree relatives identified as described above were sent an information letter regarding the purpose of the study (Appendix C) and the mail-in study questionnaire regarding their colorectal cancer screening habits, personal cancer history, as well as their knowledge, beliefs, and concerns regarding colorectal cancer screening (Appendix D). Dillman's methods to ensure a high response were used again for this portion of the study including

a personalized letter from the study authors, recognition by the Alberta Cancer Registry, clear instructions with an attractive lay-out, assurance regarding confidentiality, a stamped addressed envelope for the return of the survey, and another token financial incentive (draw for $100.00).(72) Further, the investigators noted that permission for contact had come from their first-degree relative. A reminder and then repeat mailing of the questionnaire (3 weeks apart) was sent to continued non-responders. Continued non-responders were to be followed up by telephone interview if the a priori sample size of 200 returned surveys had not been achieved.

E. Data Collection

An initial database using Microsoft Excel (Microsoft Inc., Redmond WA) was created to track the number of mail-outs (Appendix A and B) to CRC patients as well as to ensure appropriate reminders were sent to non-respondents. A data coordinator also entered the contact information of first degree relatives as they were returned and ensured mail out of the study information letter and study questionnaire (Appendix C and D) within a week of receiving this information. Study questionnaires were tracked to ensure appropriate reminders were sent to first degree relatives of colorectal cancer patients.

A database using Microsoft Access (Microsoft Inc., Redmond WA) was designed to enter all data from the returned study questionnaires by an experienced data entry clerk. The database was designed to give an error

response for mis-entered, nonsense outcomes. For example, a question with a response requiring an integer from ‘1’ to ’6’ to be entered would give an error response if the number ‘8’ was entered. This allowed immediate feedback and re-entry of obvious non-sense data. A value of ‘0’ could be entered if the respondent left a question blank. Further, 10% of all surveys were re-checked for accuracy by an independent data entry clerk.

F. Data Analysis

Survey Response

The initial response rate from CRC patients and the response rate from first-degree family relatives were calculated. However, the actual total number of first-degree relatives of CRC patients (study population) is unknown as only a proportion of CRC patients provided this information. Therefore, a response rate was calculated by the number of study questionnaires returned compared to the number sent to first-degree relatives (sample); but this does not reflect the actual population. Hence, a minimum sample size returned with a given precision estimate of CRC screening rates may be a more important measure of generalizability.

Estimate of Screening Prevalence- Sample Size Calculation

The primary outcome variable and aim of the study was to estimate the prevalence of colorectal cancer screening in first-degree family members aged 40 years or older of CRC patients (Stage I-III) in the Calgary Health Region diagnosed from 2001-2003. As noted previously, self-reported screening

behavior appears to be a quite reliable indicator of actual screening behavior. Further, actual screening behavior is currently not recorded in Canada by any prospective measure. To ensure a relatively precise estimate of screening prevalence, the required sample size is approximately 200 respondents. One hundred responses are necessary to obtain an estimate of whether a respondent is a screener or non-screener with a precision of ± 10% or better. Using the normal approximation for a binomial function, assuming 100 respondents and 50% being screened and 50% non-screened, a precision of ± 10% is determined with a 95% confidence interval.

Sample size = $(z/\pi)^2 p(1-p)$

where π = the precision interval (i.e.± 10%), p = the proportion being screened for colorectal cancer, and z =1.96 for the z value of the normal distribution of the 95% confidence interval

Increasing the sample size to 200 respondents, the estimate of proportion screened will improve the precision interval to ± 7% if 50% are screened and 50% are not screened. Current general population data suggests that CRC screening may be as low as 10-20% in Alberta.(50) Using the same formula and these estimated proportions, the precision of the estimate of screened relatives would be within ± 4-6% with a 95% confidence interval. Please see Table 1 for a range of precision estimates based on a 95% confidence level and variable sample sizes and proportion being screened.

A sample size of 200 respondents has adequate precision to estimate CRC screening prevalence and is large enough to account for potential

clustering of responses within families. Further inflation of the sample size had diminishing improvements in precision. Finally, a sample size of 200 respondents allowed sufficient positive responses to explore predictors of CRC screening in a logistic regression model.

Descriptive Analysis

The data analysis is largely descriptive; the primary result of most survey designs. The proportion of respondents screened for colorectal cancer as well as the proportion of those interested in pursuing CRC screening are tabulated to assess the potential impact on current screening facilities.

Individual characteristics such as ethnic background, language, education level, marital status, age, employment status and income are described through proportions. Major demographic variables were compared to the prior general population survey by McGregor *et al.*(50) Survey data regarding self-reported health, screening knowledge as well as benefits and barriers of CRC screening are described further (proportions, modes, means, medians, standard deviations as appropriate). Outliers are examined for further insight into screening behavior.

Screening modality and time of last screening test in years are described via proportions. Appropriateness of screening interval was defined as within 1 year of the survey for fecal occult blood testing, within 5 years for barium enema or sigmoidoscopy, or within 10 years for colonoscopy.

Analysis of Important Factors Affecting Screening

Univariate analysis was performed to assess for potential predictors of

screening behavior (chi square tests). Variables assessed included demographic data (age, education level), personal history of cancer, whether one has a regular family doctor, and whether one has a regular annual examination. Variables were determined to be significant if p-values were ≤ 0.05.

An exploratory factor analysis was performed using a principle components analysis with varimax rotation to assess whether the survey instrument separated Likert scale questions and responses (19 benefits and barriers questions) into the constructs for CRC screening adherence as described by Vernon *et al.*(60) Computed scales for each factor were created. Cronbach alpha reliability measures were determined for each scale separately as well as overall.

A multivariate logistic regression model with screening behavior as the dependent variable was first explored using all important demographic and health related variables from the univariate analysis. Responses to the benefits and barriers portion of the survey were separated into their respective constructs via the factor analysis described above. Further modeling used backwards logistic regression for all demographic variables and the factors determined by factor analysis. A final model using all variables found to be significant following multivariate analysis was presented and the model tested for overall fit.

G. Ethical Considerations

The study was approved by the Conjoint Health Research Ethics Board, University of Calgary (Appendix E). Patients were approached via a cover letter and description of the purpose of the study from the Alberta Cancer Board directly to ensure confidentiality. Patients returning contact information of their first-degree relatives gave implied consent. Similarly, first-degree relatives gave consent when mailing in their survey.

All patients and subjects were assured of confidentiality in their demographic information and responses. A limited number of personnel (i.e. principle investigators and a data entry clerk) had access to respondent survey data with personal identifiers. All survey data elements were entered into the Microsoft Access database (Microsoft Inc, Redmond WA) without personal identifiers and analyzed in aggregate form. All data was kept in a double-locked storage area on a password protected computer disc.

H. Funding and Role of Masters Student

The current project was supported by an Alberta Cancer Board Heritage Research Grant through the Clinical Research Unit at the Tom Baker Cancer Centre, Calgary, Alberta.

The Masters Student completed a literature review, developed and designed the research project, developed and designed the survey questionnaire with further input from the committee, wrote funding applications, set up the mail outs which were through the Alberta Cancer Registry and a data coordinator, conducted the analysis with assistance from

a statistician, interpreted all results and wrote the final thesis.

V. Results

A. Survey Response Rates

Six hundred forty (640) living CRC patients (Stage I-III) were identified by the Alberta Cancer Registry as having been diagnosed in the Calgary Health Region from 2001 to 2003. All were sent introductory letters (Appendix A) and datasheets for contact information of first-degree relatives (Appendix B). Three hundred forty-three (343/640 [54%]) returned the package with information regarding 747 first-degree relatives (mean 2.2 relatives per patient). An introductory letter (Appendix C) and the study questionnaire (Appendix D) was sent to all identified first-degree relatives and was returned by 383 (383/747 [51%]). Twenty-seven (27) first-degree relatives returned the surveys completely blank indicating they did not wish to participate.

In total, 356 completed study questionnaires were returned by first-degree relatives of CRC patients, exceeding the a priori sample size of 200 required ensuring an estimate of the prevalence of CRC screening with 95% confidence of a precision estimate within 7%. Double checking 10% of the surveys found approximately a 1% data entry error rate.

B. Demographics

General demographics of respondents are presented in Tables 2 and 3.

The majority of respondents were born in Canada (86%) (Table 2), spoke English at home (94%) (Table 2), and had at least completed a high school education (93%) (Table 3). Approximately 70% (250/356) had obtained some post-secondary school education including a university degree (32%), college diploma (21%) or other post-secondary education (e.g. trade school certificate) (17%).

Most respondents were between the ages of 40 and 60 years (70%), married (73%) and working full-time (55.1%) (Table 3). Although a substantial proportion were retired (22%) (Table 3), the most common annual household income was in the category $100000 or greater (125/356 [35%]).

General demographics of this sample compared closely to the Alberta general population survey by McGregor *et al.*(50) More specifically, differences in proportions for demographic variables including marital status, educational attainment, birth in Canada, employment status, and self-rated health status ranged from <1% to 15% (Table 4). However, the survey by McGregor *et al.* was of Albertans aged 50-74 years of age compared to the current survey of first-degree relatives aged 40 year or older. Fifty percent of the respondents to the survey by McGregor *et al.* were aged 50-59 years and the other 50% were aged 60-74 years. By comparison, the current survey had 38.8% of respondents' age 40-49 years, 31.2% age 50-59 years, 18.5% age 60-74 years and 9.3% age 75 or greater (Table 4).

C. Health Knowledge and Attitudes

Approximately 90% (319/356) of respondents recorded their health in the categories good, very good, or excellent (Table 5). The majority of respondents had a family doctor (93.5%) and had routine examinations at least once a year (74%) (Table 5). Of those not having a routine examination, only eight did not go because of a concern with the costs involved. The most common reason for not going to a routine examination was due to the reported practice of going to the doctor only when there was a specific concern (14.9%) (Table 5). Even if they did not go to a routine examination, approximately 92% had been to a physician at least once in the preceding 12 months. The most common number of visits (mode) to a physician in the last 12 months was two; mean 3.29, median 2.50, standard deviation 3.07.

Overall, 55 respondents (15%) had a prior diagnosis of cancer themselves. Nine (2.5%) had already been diagnosed with colorectal cancer. Other cancer diagnoses among respondents included skin (11 cases), bladder (2), breast (6), cervical (3), kidney (2), ovarian (1), prostate (2), testicular (1), thyroid (2), and uterine carcinomas (2) as well as leukemia (1) and lymphoma (1).

D. Screening Knowledge and Attitudes

Approximately 92% of respondents had heard of the term screening for any condition or disease. Interestingly, many respondents felt the term meant checking or testing for symptoms of a disease (38.8%) but there was a spectrum of answers to the question “what does the term screening mean to

you?" (Table 6). In contrast, approximately three-quarters (76.1%) felt the term "early detection" correctly meant "catching disease at early stage when treatable and not too serious" (Table 6).

Most respondents had heard of common, currently available screening tests; although knowledge appeared test specific (Table 7). More than 90% had heard of colonoscopy as a screening test. Additionally, most respondents (80%) noted their family doctor as a source of knowledge regarding screening (Table 7), although family and friends were also a common source of knowledge (75.8%).

E. Estimate of Screening Prevalence

The major outcome of the study is self-reported colorectal cancer screening prevalence by first-degree relatives aged 40 years or older of living CRC patients (Stage I-III) diagnosed in the Calgary Health Region 2001-2003. Seventy percent reported having *ever* had any CRC screening test (precision estimate ± 5%; 95% confidence) (Table 8). Appropriateness of the CRC screening for the entire group of respondents is more difficult to interpret but is presented in the next subsection.

F. Description of Screening Behavior

For the entire sample of 356 respondents, approximately 34% and 59% reported ever having fecal occult blood testing or colonoscopy, respectively. Of 250 respondents who reported *ever* having one or more CRC screening

test, fecal occult blood testing was used in 120, barium enema in 69, sigmoidoscopy in 38, and colonoscopy in 209 (Table 8). Reported CRC screening tests do not add to 250 as some respondents had more than one screening test. Overall, of those ever having been screened, nearly half had fecal occult blood testing (120/250 [48%]) and the majority had a colonoscopy (209/250 [84%]).

Of those respondents having *ever* been screened, the majority had been screened within the past 5 years (88.8%). Sixty (60/250 [24%]), eighteen (18/250 [7.2%]), and 10 (10/250 [2.5%]) respondents had been screened within the past year, within 6-10 years, and greater than ten years respectively (Table 8). However, using the overall sample as the denominator, approximately 17% had screening with the last year, 46% had screening within 1-5 years, 5% had screening within 6-10 years, 2.8% had screening more than 10 years ago, and 30% had never undergone screening. There appeared to be an appropriate screening interval (within 1 year for fecal occult blood testing, within 5 years for barium enema or sigmoidoscopy, or within 10 years for colonoscopy) in 60% of the entire sample. Eighty-five percent of respondents stated they were interested in pursuing a screening test for bowel cancer.

G. Benefits and Barriers to Screening

The answers to questions regarding possible benefits and barriers to CRC screening are described in detail by Tables 9 and 10 and Figures 1-3. Two to

six (0.6-1.7%) respondents failed to respond to particular questions in this series. The most common answer (mode) on the Likert scale as well as the mean, median, and standard deviation for each question are given (Table 9). For these calculations, the data was treated as a continuous variable rather than categorical as the internal consistency of these questions was previously been demonstrated by Rawl *et al.* and Tiro *et al.*(54;57) For all questions except 37 “when bowel cancer is found early it can be removed” where the range was 4, the range of responses was 5; from strongly agree to strongly disagree. However, standard deviations were relatively small, from 0.305 to 1.308, suggesting a fairly tight distribution around the most common answer. Table 10 presents the distribution of responses to each question on the Likert scale: strongly agree, agree, uncertain, disagree, and strongly disagree with their frequencies and proportions.

Some uncertainty was expressed by respondents in response to particular questions. For example, a substantial number (218/356 [61.3%]) were either uncertain or agreed with the statement “I am afraid of having an abnormal bowel cancer screening result” (Figure 1). Similarly, the distribution of respondents answering from strongly agree to strongly disagree was relatively equal for the question “I am worried that bowel cancer screening will show that I have bowel cancer or polyps (Figure 2). Many respondents (176/356 [49%]) did not know their risk of developing colorectal cancer in a relative sense (i.e. compared to other high risk individuals) or were incorrect about their risk compared to others their age (181/356 [50.8%]) (Figure 3 and

Table 9). A large number (129/356 [36.2%]) were uncertain or disagreed as to whether the removal of polyps could prevent colorectal cancer (Table 10).

As noted in the descriptive analysis, approximately 80% of respondent listed their family doctor as a significant source of awareness of CRC screening. Despite this, ninety-seven (27.2%) respondents were uncertain whether their doctor thought they should undergo CRC screening. Forty respondents (11.2%) felt their doctor did not think they should undergo CRC screening. Further, the vast majority (296/356 [83%]) of respondents did want to do what they thought their physician recommended in terms of CRC screening.

Exploratory factor analysis demonstrates that these Likert scale survey questions fall into five separate constructs. More specifically, a principal component analysis with varimax rotation found approximately 63% of the variance is explained by 5 separate components or themes of questions (Table 11). Cronbach's alpha scores are also reported for the five factors, ranging from high (e.g. 0.843 for Factor 1) to moderate (e.g. 0.570 for Factor 5). The overall Cronbach alpha reliability measure for the 5 factors combined is 0.813.

The raw data of the rotated component matrix is presented in Table 12. Four of five questions loaded on factor one, four of four questions loaded on factor two, three of three questions loaded on factor three, two of four questions loaded on factor four, and one of three questions loaded on factor five. Since similar questions were modified from Rawl *et al.* as well as Tiro *et*

al., it follows that similar concepts or constructs are being tested in the current study survey.(54;57) Tiro *et al.* describe 5 major constructs of CRC screening adherence including “salience and coherence”, “cancer worries”, “social influence”, “susceptibility”, and “response efficacy”, correlating with factors 1 to 5 in this analysis.(57;60) Exploratory factor analysis could not identify further concepts which adequately explained further variance. Therefore, approximately 37% of respondent variance is not explained by the above concepts or constructs.

H. Analysis of Important Factors Predicting Screening

Demographic data including level of education (high school diploma or less vs. more than high school), age (40-49 years vs. 50 years or older), having a family doctor (yes / no), having an annual routine checkup (yes /no), and having a personal history of cancer (yes / no) were assessed with chi-square tests in relation to having ever been screened for CRC (Table 13). Older age ($p<0.0001$), having a family physician (0.05), having a regular annual checkup ($p=0.002$), and a personal history of cancer ($p=0.007$) was associated with ever having been screened. Education level was not significantly associated with having been screened on univariate analysis. The 19 Likert scale questions assessing perceived benefits and barriers were analyzed via the 5 major constructs as noted in the proceeding section.

Further analysis combined demographic factors and health questions with the five constructs from the benefits and barriers survey. A backwards logistic

regression model was developed using colorectal cancer screening behavior as the dependent variable. Specific variables included in the model include education level, marital status, employment status, age greater than or equal to 50 years, self-reported health rating, having a family physician, having an annual examination, having a personal history of cancer, knowledge of the term ‘screening’, as well as the five constructs determined by the factor analysis. The backwards selection continued through nine iterations until all remaining variables had a significance level of <0.06. The final model including age, employment status, and four constructs (cancer worries, social influence, susceptibility and response efficacy) is presented in Table 14. Age is the strongest predictor, with age greater than 50 years positively associated with having undergone colorectal cancer screening (odds ratio [OR] 3.64 – 95% confidence interval [CI] 2.001-6.621; p<0.0001).

Three constructs from the factor analysis; social influence, cancer worries, and response efficacy, were associated with CRC screening, although their effect was more modest than age. The original Likert scale was from 1-5 corresponding with strongly agree to strongly disagree but were reverse coded for ease of interpretation. Following reverse coding, higher scores reflect a higher level of agreement and were associated with CRC screening. Social influence is the strongest predictor of CRC screening among these constructs with an OR of 1.48 (95% CI 1.281-1.701). Respondents agreeing with statements regarding physician and family members wanting or recommending them to have screening appeared to be positively influenced

to do so. Similarly, agreement with statements among the response efficacy questions was also positively associated with actual CRC screening (OR 1.20: 95% CI 1.008-1.416). In this case, the confidence interval is just over 1.0 suggesting borderline significance. For the construct cancer worries, no reverse coding was necessary due to the manner in which statements were arranged; a higher score corresponded to disagreement with the somewhat off-putting statements. More specifically, disagreement with statements regarding concerns of CRC screening tests being painful, dangerous, embarrassing, and messy or disagreement with statements concerning fear of abnormal screening results, was associated with having undergone CRC screening (OR 1.12: 95% CI 1.009-1.234). Again, this finding is of borderline significance.

A fourth construct, susceptibility, as well as employment status were marginally significant with p-values of 0.058 and 0.053 respectively (Table 14). Reverse coding was used for the construct susceptibility and higher scores correspond to agreement with susceptibility survey questions. Agreement with statements suggesting a relatively high risk of developing colorectal polyps or cancer was associated with actual CRC screening (OR 1.18: 95% CI 0.998-1.399). Similarly, full-time employment was associated with actual CRC screening behavior (OR 1.19: 95% CI 0.994-1.430).

The final model fit the data well (Hosmer and Lemeshow Test χ^2 3.625 [p=0.0.889]) with approximately 0.412 of the variance in responses was explained. A classification table (Table 15) notes the model is correct in

predicting ‘no screening’ in 51.5% of respondents, correct in predicting ‘screening’ in 90.2% of respondents, and the overall accuracy rate is 79.1%.

VI. Discussion

A. Colorectal Cancer Screening Prevalence

The primary objective of the current study was to determine the prevalence of colorectal cancer screening in first-degree relatives aged 40 years or older of living colorectal cancer patients (Stage I-III) diagnosed in the Calgary Health Region 2001 to 2003. The self-reported CRC screening prevalence was 70% of those having *ever* been screened. These results were sampled from a specific population with a response exceeding the a priori calculated minimum sample size ensuring a good estimate of CRC screening prevalence. Further, the sample appears similar to the prior general population survey by McGregor *et al.* for major demographic variables; allowing for differences in age considering the current survey was of first-degree relatives aged 40 years or older and the general population survey was of Albertans aged 50 to 74 years.(50) It may be reasonable to generalize to the larger population of Alberta and make inferences about the prevalence of CRC screening among first-degree relatives aged 40 years or older. As noted in the limitations section of the discussion, some responses appear non-representative of the population in general. Therefore, further generalization to Canadians of the same age group and with a first-degree

family history of CRC should be made with caution.

Although direct comparison of different screening prevalences is difficult due to different time frames of ascertainment and different inclusion criteria, it is clear CRC screening prevalence in this population is much higher than reported CRC screening behavior in the general population. The NCIC estimates that between 4 and 14% of eligible Canadians have undergone fecal occult blood testing in the last 2 years based on results from the Canadian Community Health Survey administered to British Columbia, Newfoundland and Labrador, as well as portions of Saskatchewan and Ontario.(45) McGregor *et al.* found 14% of respondents in a random, population-based survey of Albertan residents were up to date for recommendations of colorectal cancer screening.(50) Ramji *et al.* found 23% of those older than 50 years had reported ever undergoing CRC screening in Ontario.(79) More specifically, 17% reported having a fecal occult blood test, 6% sigmoidoscopy, and 4% colonoscopy. CRC screening prevalence in the study population also appears higher than general population CRC screening behavior in the U.S., where many studies report a larger proportion have undergone screening (range 43-54%).(49;80;81)

A few studies have assessed CRC screening prevalence among first-degree relatives of CRC patients specifically. One hundred thirty-four respondents to the 2004 general population survey by McGregor *et al.* were categorized as elevated risk, defined as having ≥ 1 first-degree relative with a diagnosis of CRC.(50) Among this group, CRC screening prevalence was

42.9% (34.5-51.4 95% CI). The general population survey of Ramji *et al.* notes 228 individuals with a positive first-degree family history of CRC.(79) Having a first-degree family history of CRC was the strongest correlate of having CRC screening (OR=2.5 95% CI, 1.7-3.8). A survey specifically of first-degree relatives in the Ontario Familial Colon Cancer Registry reported 64% of respondents had been screened for CRC in the past 6 years.(55) As noted previously, the OFCCR has over-sampled first-degree relatives of particularly high risk families including those with hereditary non-polyposis colorectal cancer and may not be directly comparable to the current study.(56) A U.S. survey of first-degree family members of CRC patients who were part of the Johns Hopkins Colorectal Cancer Registry had a self-reported CRC endoscopic screening rate of 59.7%.(58) Finally, a U.S. survey of siblings of CRC patients found approximately 57% were compliant with CRC screening 5 years after the diagnosis.(82)

The current survey results report a higher than anticipated proportion of first-degree relatives having undergone screening. A potential explanation is that the current survey is the most recent; allowing sufficient time for recommendations to diffuse and resources to develop to support the current screening prevalence. Other explanations include possible overestimation of CRC screening behavior due to self-reporting of respondents or a difference in screening rates between those responding to the survey and those not responding. Madlensky *et al.* did note a significant difference in screening status among participants and non-participants of the survey of the Ontario

Familial Colon Cancer Registry (OFCCR) at 61% and 34%, respectively.(55) Unfortunately, the current study cannot compare participants and non-participants in this manner since no information was gathered on non-participants. A registry similar to the OFCCR does not exist in Alberta and all information from the current sample was collected by the current survey from voluntary participants.

It is also important to note that 70% of the current sample had *ever* undergone CRC screening but this does not necessarily mean respondents were up to date with current screening recommendations. Some had not undergone screening in more than 10 years (2.5%) and others had not been screened in an appropriate time interval (7.5%). Approximately 60% of respondents overall were up to date for screening as defined by fecal occult testing within 1 year, barium enema or sigmoidoscopy within 5 years, or colonoscopy within 10 years. Therefore, a 60% up to date CRC screening prevalence may be a better comparison value depending on the study being compared to (i.e. whether other studies report CRC screening prevalence in terms of *ever* having been screened or in terms of being up to date with screening recommendations).

As for CRC screening methods, of those screened, the majority (84%) had been screened via colonoscopy (i.e. 59% of the entire sample). Current guidelines of CRC screening in individuals with a first-degree family history of CRC are inconsistent. The Canadian Task Force on Preventive Health does not currently recommend more intensive screening in this group compared to

the general population.(6) However, particular provinces have developed guidelines recommending colonoscopy as the preferred screening tool in this group; starting at age 40 years or ten years prior to the index case.(83) North American guidelines for CRC screening for first-degree relatives are also variable. Some recommend following general population screening guidelines but at an earlier age, and others specifically recommend colonoscopy, starting at an age dependent on the specific family history.(42-44;84) A survey of physicians in the same geographic area as the current study found colonoscopy is usually recommended in this risk group and usually starting at age 40.(47) Further, most physicians would choose colonoscopy if they themselves were to undergo CRC screening.(7) A clear, evidence-based guideline consistent amongst all professional groups should be developed for individuals with a first-degree family history of CRC as inconsistent recommendations are a known barrier to CRC screening.(7;85;86) The current study found significant differences in screening prevalence depending on age of the respondent; inconsistent guidelines as to the initiation of CRC screening may be partially responsible for this difference.(85;86)

B. Predictors of CRC Screening Behavior

Age

Few studies have examined correlates of screening behavior specifically in relatives of CRC patients. Age is a consistent correlate in the literature; older age correlates with having undergone CRC screening.(55;58) The

current survey was limited to those age 40 years or older; the age where most physicians recommend CRC screening for this population, although there is significant variation in guidelines.(6;42-44;47;83;84) The current study found approximately 51% of respondents aged 40 to 49 years had undergone CRC screening compared to 83.8% of those age 50 years or older ($p<0.0001$). Age remained statistically significant following multivariate analysis with an odds ratio of 3.64 (95% CI 2.001-6.621) in favor of being screened in the older age group. Similarly, Codori *et al.* found for every 10-year advance in age, the odds of endoscopy screening among first-degree relatives of CRC patients increased by 2.4.(58)

As noted, inconsistencies in guidelines may be a major barrier to CRC screening in younger individuals. The Canadian Task Force on Preventive Health does not recommend more intensive screening in this group than the general population where it is recommended to start at age 50 years.(6) Recently, the Alberta Cancer Board published guidelines for colorectal cancer screening of moderate risk individuals.(87) An individual with one first-degree relative with colorectal cancer diagnosed at age 60 years or older is recommended to have the same screening as average risk individuals but commencing at age 40 years. For those with a first degree relative diagnosed less than 60 years or with two or more first-degree relatives diagnosed with colorectal cancer, a colonoscopy is recommended every 5 years starting at age 40 or ten years younger than the earliest case in the family.

A systematic review of case-control and cohort studies estimates that

first-degree relatives of colorectal cancer patients have a 2.42 times (95% CI 2.20-2.65) increased risk of developing colon carcinoma.(9) Risk increased further with increasing number of first-degree relatives affected and in relatives of patients diagnosed with CRC when less than forty-five years of age. A physician survey reports most recommend initiating CRC screening 10 years prior to the index case (45%) or by age 40 years (40%).(47) A consistent guideline with regards to age of initiating CRC screening for first-degree relatives of CRC patients may be beneficial in promoting appropriate screening in this group of people.

Physician Recommendation

Several portions of the survey related to physicians appear to predict screening behavior. On univariate analysis, those with a family physician as well as those having an annual routine examination predicted higher screening prevalence. This was also found by Codori *et al.* as well as Manne *et al.* in surveys of first-degree relatives identified by U.S. cancer registries.(58;82) Further, those feeling that their physician wanted them to undergo screening and those more likely to listen to their physicians recommendations reported having undergone CRC screening more frequently.

Although access to a family physician or annual examination was no longer predictive of colorectal cancer screening following multivariate analysis, the underlying construct of social influence did predict screening behaviour (odds ratio 1.48: 95% CI 1.281-1.701). Two questions of three for

the construct social influence dealt directly with the role of physicians in influencing CRC screening: Question 30 “My doctor thinks I should have bowel cancer screening” and question 31 “I want to do what my doctor thinks I should do about colorectal cancer screening”. Similarly, Madlensky *et al.* found physician recommendation was the strongest correlate of CRC screening behavior in their survey of the Ontario Familial Colon Cancer Registry.(55)

Rawl *et al.* cite lack of physician recommendation as a barrier to CRC screening in qualitative research with focus groups of first-degree relatives.(86) Similarly, Madlensky *et al.* found a significant number of first-degree relatives of CRC patients were non-screeners as their physician had not endorsed screening.(59) Ninety-one percent of participants said they would have an endoscopic screening exam if advised to do so by a physician in a U.S. survey.(58) Doctor recommendation was the most important factor predicting CRC screening behavior in a multivariate model developed by Manne *et al.* in a survey of siblings of CRC patients.(82)

Specific guidelines for first-degree relatives of CRC patients and dissemination of guidelines to family physicians may improve the consistency of recommendations for CRC screening. However, guidelines themselves may not change clinical practice significantly.(50;88) Most provinces in Canada have a cancer registry; perhaps a duty of these registries would be to contact first-degree relatives of CRC patients so they know they are at higher risk. Guidelines for CRC screening could be given to first-degree relatives

directly. The ethical issues of privacy of information for CRC patients would have to be debated for this to occur and there may be significant logistical issues; however, this may be an idealistic option considering CRC patients substantially underreport CRC arising in first and second-degree relatives.(89)

Family Interactions

A desire to agree with family about undergoing CRC screening was related to actual screening behavior in the current survey; again via the construct of social influence but also related to the construct of perceived susceptibility.(57;60) Various interactions may help to explain this phenomenon. First, many individuals perceive a higher overall risk of developing CRC if a first-degree relative has been affected and this may correlate with screening behavior.(58;82;90;91) Interestingly, many respondents (49%) in the current survey did not know their risk of developing colorectal cancer in a relative sense (i.e. compared to other high risk individuals) or were incorrect about their risk compared to others their age (50.8%). Further, a significant number were uncertain whether CRC cancer could be prevented by removal of polyps. Despite this uncertainty, there may be a correlation between screening behavior and the construct of perceived susceptibility; although of marginal significance in this survey (p=0.053).(58) Education regarding actual risk may improve CRC screening uptake further as demonstrated by Glanz *et al.* These investigators evaluated a colon cancer risk counseling intervention specifically for relatives of CRC patients and

report increased CRC screening participation in this group.(92)

It is clear those with a positive family history are more likely to have undergone CRC screening than the general population. The CRC screening prevalence of 70% in the current study is consistent with higher screening prevalence reported by others for this type of study population.(50;55;58;79;82) Further, closeness of a sibling relationship correlated with screening compliance in a specific survey of siblings of CRC patients.(82) Similarly, Madlensky *et al.* found family encouragement positively correlated with CRC screening.(55) The current survey did not ask for specifics of first-degree relatives diagnosed with CRC and did not assess closeness of the family relationship; however, the survey question 28 “Members of my immediate family think I should have bowel cancer screening” was related to actual screening behavior via the construct of social influence.

Absence of Symptoms

Absence of symptoms is another commonly found barrier of CRC screening among first-degree relatives of CRC patients.(59) While many in the current survey erroneously thought screening meant to be tested at the first sign of symptoms, this did not statistically correlate with non-screening status. Only one Likert scale item specifically addressed this concept: question 39 “Screening tests for bowel cancer are not necessary as I do not have any problems” which is a part of the construct response efficacy. Although the construct overall did appear to influence screening behavior,

only one of three questions appropriately loaded on this construct making further interpretation difficult.

Cancer Worries

Four Likert scale items addressed the construct of cancer worries and did correlate with CRC screening behavior following multivariate analysis (OR 1.12: 95% CI 1.009-1.234) However, disagreeing with question items appeared to correlate with screening behavior. For example, in survey question 29 “I am worried that bowel cancer screening will show that I have bowel cancer or polyps”, those disagreeing with this statement were more likely to have been screened. Fear of positive results as well as fear of embarrassment and messiness of tests are common barriers found in qualitative analysis using focus groups of first-degree relatives.(85;86) Again, specific education regarding actual risks of CRC and the overall process of CRC screening may improve CRC screening uptake.(92) In the general population, individuals more concerned about the invasiveness of a test than its accuracy still consider CRC screening but prefer fecal occult blood testing.(93) Preference for type of CRC screening test was not specifically addressed in this survey.

Education Level

Education level was not associated with screening activity in the current survey. However, this was a fairly highly educated population where the majority of respondents (93.5%) had at least received a high school diploma. Manne *et al.* did correlate CRC screening with education level in a survey of

siblings of CRC patients but most studies do not find a significant relationship either in the general population or first-degree relatives.(50;55;58;79)

Personal Cancer History

A personal cancer history did correlate with CRC screening on univariate analysis although it was not important in creating the multivariate logistic regression model. Approximately 15% of respondents had a personal history of cancer and 85% of these had undergone CRC screening; a higher prevalence than the overall sample. Few studies of first-degree relatives address this factor although Madlensky *et al.* found no correlation between a personal cancer history and screening behavior in their survey.(58) CRC screening promotion may be less important in this group of people who have already been diagnosed with cancer.

Employment Status

Although of borderline significance following multivariate analysis (p=0.053), most studies suggest no relationship between screening behavior and employment; or did not specifically address this as a demographic variable.(50;55) Similar yet different than employment status, Madlensky et al. did not find a difference in screening behavior dependent on income among first-degree relatives of CRC patients.(55) This may be more of an issue in the U.S. where medical insurance status does appear to influence CRC screening behavior.(58)

Barriers to Colorectal Cancer Screening

Potential reasons for first-degree relatives to not undergo screening have

been explored by others. Madlensky *et al.* were able to categorize non-screeners into four discrete types: a group who felt healthy and therefore did not think screening was necessary, a group whose physicians had not endorsed screening, a younger group that were told to wait to be screened, and a group who were concerned about possible discomfort and pain with screening.(59) All of the same themes were found in the current survey as discussed above.

Some further barriers have been found for CRC screening among first-degree relatives of CRC patients by other authors. Those never having had an endoscopic screening exam were more likely to say they would avoid an exam due to embarrassment.(58) Qualitative research using focus groups of first-degree relatives also found embarrassment as a common barrier to undergoing screening.(86) One survey item 38 “Screening tests for bowel cancer are embarrassing and messy” had a large range of responses and correlated with screening behavior through the construct cancer worries. Its effect was modest; nearly one-third agreed with the above item but the majority still underwent CRC screening. Further, a survey of physicians’ and patients’ perceptions of CRC screening tests in an internal medicine practice found a discrepancy between opinions; patients were more concerned about accuracy than discomfort of CRC screening tests compared to the perception of their physician.(93)

Several other barriers found by focus groups with first-degree relatives of CRC patients and their physicians were not specifically examined in the

current survey. A lack of health insurance was another barrier listed by respondents to a U.S. survey; although less likely to be a barrier in the Canadian health care system.(58) Further barriers identified by focus groups include a lack of public awareness, concerns regarding test efficacy, as well as fear of potential positive results; the last two barriers may fall under the constructs of response efficacy and cancer worries.(57;60;86) Primary care physicians note an effective follow-up or recall system for patients requiring surveillance is often lacking.(85) The current survey notes 70% of respondents have undergone CRC screening but 85% would be interested in pursuing such screening. The difference in actual behavior and interest may be due to some of the above barriers. A true population-based screening program where individuals are contacted directly without the need for physician referral may capitalize on the interest in CRC screening and improve actual screening behavior.

C. Potential Limitations of Study

Potential limitations of the study include the cross-sectional design which prevents attributing causal interpretation of predictors of CRC screening. The estimates of screening prevalence are based on self-reported data and may be subject to error. More specifically, respondents may tend to overestimate actual screening behavior.(67;68) However, most studies comparing self-reported to actual screening prevalence by confirming with medical records have recorded about 80-95% sensitivity and specificity for self-reported

screening behavior.(66;69) Khoja *et al.* found self-reported CRC screening history had a sensitivity of 76% and specificity of 89.6% when compared to medical records.(94) High specificity was observed for self-reporting of individual tests but low sensitivity was recorded for fecal occult blood testing. Madlensky *et al.* point out the reason medical record confirmation is often not achieved is due to an inability to obtain these records from busy medical offices.(70) In their study, up to 25% of family physician offices did not respond to requests for confirmatory medical records. Until screening activity is collected in a prospective database which occurs with implementation of population-based screening programs, self-reported screening prevalence is the best estimate of actual screening behavior. Physician estimates are less reliable and tend to overestimate actual screening behavior more than self-reported data.(48;49;51;95;96)

The study response rate for CRC patients was 54% and the study questionnaire response rate of identified first-degree relatives of CRC patients was 51%. These response rates are fairly low and raise concern over the representativeness of the sample. However, most medical mail-in surveys have a mean response rate of approximately 60%.(76) A U.S. survey of CRC patients had only a 18% participation rate.(97) Further, a general population telephone survey of Alberta CRC assessing screening adherence had a response rate of 47.5%.(50) The overall response rates may have been lower if a physician had to give consent to contact patients first; which has been the case in prior similar surveys.(56) This step was eliminated as the Conjoint

Health Research Ethics Board felt it was not ethical to potentially deny patients the ability to participate in research due to issues obtaining physician consent. Most importantly, response rates may not be the most appropriate measure of representativeness or generalizability in this study. The target population is first-degree relatives age 40 or older of living CRC patients (Stage I-III) diagnosed in the Calgary Health Region 2001 to 2003. The actual population size is unknown as many patients did not want to participate in the study and population size cannot be directly measured. Therefore, a more appropriate measure was to ensure a precise estimate (±7%) of self-reported screening prevalence by having a minimum of 200 completed study questionnaires. Because 356 study surveys were completed, the self-reported screening prevalence is estimated with very good precision.

Despite the above assurances, the representativeness of the sample and the ability to generalize to this population should be done with forethought. Specific concerns include the relatively high annual household income (35% >$100000) and high proportion (93.5%) of those with access to a family physician; suggesting the sample may not be representative. Further, the survey specifically tried to avoid over-sampling of hereditary non-polyposis colorectal cancer (HNPCC) patients by limiting the survey to those aged 40 years or older. While the number of these patients in this survey is likely low, we cannot confirm this based on the study design. The age restriction may have also biased our sample towards first-degree family members with a sibling or older parent with CRC and away from those with a relatively young

parent affected.

Finally, it is important not to over-interpret the survey results and multivariate analysis as the principle component factor analysis accounts for 63% of the variance in responses and the overall logistic regression model accounts for approximately 40% of the variance in respondents' screener vs. non-screener status. The factor analysis accounting for 63% of variance, although significant, suggests that major demographic variables (e.g. age) are also very important in predicting screening status. Further demographic variables or societal values may also predict CRC screening beyond the ones included in the current survey. There is more to be learned about differences in first-degree relatives who have undergone screening versus those who have not; using the known underlying constructs influencing CRC screening behavior as a guide. More importantly, although the current study notes a fairly high CRC screening prevalence among first-degree relatives of CRC patients, there is still opportunity for improvement in this higher-than-average risk group.

D. Implications and Future Directions

The incidence and mortality rates of colorectal cancer in Canada are among the highest in the world.(1) It is the leading cause of cancer related death in men and women that is unrelated to the use of tobacco. There is level one, prospective, randomized trial data in hundreds of thousands of individuals confirming screening for CRC is effective in reducing cancer

related mortality.(22) Unfortunately, there is no organized national general population CRC screening program in Canada.

First-degree relatives of CRC patients are at an even higher risk of developing CRC.(8;9;98;99) The current survey was designed to determine the current prevalence of CRC screening among this group. Self reported CRC screening estimates found 70% had *ever* undergone colorectal cancer screening, 60% were up to date with screening recommendations, yet 85% were interested in pursuing CRC screening. Although more individuals appear to be screened in this higher-than-average risk group compared to the general population, it is clear that there is a significant gap between CRC screening recommendations, screening prevalence, and interest in undergoing CRC screening.

The current survey infers several areas of potential improvements in CRC screening among this higher-than-average risk group. The most significant predictor of CRC screening behavior in the current survey is age. An older age group (greater than 50 years or age) and underlying constructs of colorectal cancer screening behavior including social influence, cancer worries, response efficacy and susceptibility appear to predict CRC screening in this population. One of the major implications of differences in screening rates between those aged 40 to 49 years versus those aged 50 years or older is the role of their physician. Inconsistency in guidelines for this population may be a significant barrier to physicians providing uniform CRC screening advice. Most physicians in the Calgary Health Region felt initiation of CRC

screening should begin at age 40 or 10 years prior to the index case in a prior survey.(47) However, the Canadian Task Force on Preventive Health does not recommend starting CRC screening until age 50 years in this age group citing a lack of specific evidence that CRC screening alters outcome in this group.(6) The increased risk of first-degree relatives of CRC patients and the opinions of physicians suggest there is a lack of clinical equipoise to justify a specific trial in this higher-than-average risk group.(9;47)

In order to consolidate a guideline for this population, the best currently available CRC screening tool should be recommended rather than an option of several choices. Again, the Canadian Task Force on Preventive Health states there is insufficient evidence to recommend for or against the use of colonoscopy for this higher-than-average risk group.(6) However, level I randomized trials supporting fecal occult blood testing in the general population relied on follow-up colonoscopy for positive fecal occult blood tests.(22) Colonoscopy is considered the gold standard diagnostic test for CRC and screening colonoscopy has been shown to prevent the development of CRC by 76-90% with the removal of benign adenomas.(4;5) Further, few (9.4%) physicians in an Alberta survey rate fecal occult blood testing as an “excellent or very good” test and most would choose colonoscopy if they themselves were screened.(7) Most physicians recommend colonoscopy for individuals with a positive first-degree family history of CRC in a survey in the same centre as the current survey.(47)

It seems reasonable to consolidate guidelines to recommend CRC

screening to first-degree family members of CRC patients starting at age 40 years or 10 years prior to the index case and with colonoscopy. Randomized trials assessing fecal occult blood testing versus colonoscopy in this specific higher-than-average risk group will likely never occur. Lack of this evidence is not a valid reason to halt progress in making sound recommendations to this specific higher risk population. Particular provinces and professional groups have already recommended this specific CRC screening guideline.(43;83;87) One consistent guideline may improve CRC screening prevalence further in those with a first-degree family history of CRC.(7;85;86)

Realistically, consistency of guidelines is not the only area for improvement considering many physicians may still not adhere to them.(100) An organized, colorectal cancer screening program is required in Canada. Ontario and Alberta have recently announced the future implementation of such programs.(46;87) Individuals with a first-degree family history of CRC should be specifically addressed with a consistent guideline within a population based screening program. Patients identified with CRC by provincial cancer registries should have information regarding their first-degree family members collected and these family members should be part of an ongoing database within these provincial initiatives. Individuals could be sent the specific CRC screening guideline for their risk group, provided information as to the rationale for CRC screening and given access as desired with local screening facilities. This assumes appropriate screening facilities exist; however, both provinces will already have to make such

investments to go ahead with general population CRC screening.(46) The NCIC notes population-based screening is most effective when administered through an organized screening program that incorporates all elements of the screening process: evidence based screening, follow-up, recruitment and retention strategies, comprehensive quality assurance, and information systems in support of program operation, monitoring and evaluation.(45) As noted by this study, there is still more to be learned from differences between screeners and non-screeners, but the most important way to improve CRC screening rates among this higher-than-average risk population is to accelerate the implementation of an organized CRC screening program.

VII. Summary

A survey of first-degree relatives aged 40 years or older of living colorectal cancer patients (Stage I-III) diagnosed in the Calgary Health Region from 2001-2003 was conducted. Greater than 200 surveys were returned ensuring a relatively precise estimate of colorectal cancer screening prevalence in this population. Seventy percent of respondents had undergone CRC screening at some point. Sixty percent of respondents were up to date with CRC screening recommendations. These values are higher than CRC screening prevalence in the general population. Further, they appear similar to other estimates of CRC screening prevalence among first-degree relatives of CRC patients.

Important predictors of CRC screening behavior following univariate

analysis included increased age (≥50 years of age compared to 40-49 years of age), having a family physician, having an annual routine examination, and having a personal history of cancer. Multivariate modeling identified age as well as four underlying constructs influencing colorectal cancer screening: cancer worries, social influence, susceptibility and response efficacy. Full-time employment also predicted CRC screening although its significance was marginal.

Colorectal cancer incidence and mortality rates are among the highest in the world.(1) Individuals with a first-degree family member diagnosed with CRC have an elevated risk of developing this disease.(9) Further improvements in CRC screening prevalence among this population are required including the development of a consistent guideline for this higher-than-average risk group as well as the development of an organized screening program which specifically addresses this population.

Table 1. Survey Sample Sizes and Precision Estimate of Self-Reported Screening Prevalence

Sample Size (n)	Proportion Being Screened (%)	Precision Estimate (±%)
96	50	10
61	20	10
150	50	8
96	20	8
170	20	6
200	50	7
200	20	5

Table 2. Description of General Demographics: Ethnic Origin and Language

Variable	Frequency (356 Respondents)	Proportion (%)
Born in Canada	306	86
Born Elsewhere	50	14
England (UK)	6	1.7
Philippines	5	1.4
Netherlands	5	1.4
China	4	1.1
Germany	4	1.1
USA	4	1.1
Hong Kong	4	1.1
Ireland	3	0.8
Italy	3	0.8
South Africa	3	0.8
Northern Ireland	2	0.6
Poland	2	0.6
Russia	2	0.6
Trinidad	1	0.3
Vietnam	1	0.3
Emigrated to Canada		
1996-2000	1	0.3
Before 1996	48	13.5
Language Spoken at Home		
English	335	94.1
Chinese	8	2.2
German	4	1.1
Philipino	3	0.8
French	2	0.6
Italian	1	0.3
Dutch	1	0.3
Polish	1	0.3

Table 3. Description of Age and Socioeconomic Factors: Marital Status, Level of Education, Household Income

Variable	Frequency (n=356)	Proportion (%)
Educational Level		
Elementary	3	0.8
Junior High	14	3.9
High School/ post- Secondary	333	93.5
High School Only	83	23.3
Trade Certificate	37	10.4
College Diploma	74	20.8
University Degree	115	32.3
Other	24	6.7
Marital Status		
Single	18	5.1
Married	261	73.3
Common-law	20	5.6
Separated	7	2.0
Divorced	25	7.0
Widowed	23	6.5
Employment Status		
Full-time	196	55.1
Part-time	35	9.8
Retired	79	22.2
Other	46	13.1
Age Group		
40-44	70	19.7
45-49	68	19.1
50-54	57	16.0
55-59	54	15.2
60-64	35	9.8
65-69	19	5.3
70-74	12	3.4
75 or greater	33	9.3
Annual Household Income		
<$24,999 per year	32	9.0
$25,000-$49,900	55	15.5
$50,000-$74,999	57	16.0
$75,000-$99,000	45	12.6
$100,000 or greater	125	35.1

Table 4 Comparison of Current Survey to General Population Survey (McGregor *et al.)*(50)

Variable	Current Study (356 Respondents) **(%)**	Population Survey (1808 Respondents) **(%)**
Age Group (yrs)		
40-49	38.8	NA
50-59	31.2	50.0
60-74	18.5	50.0
75 or greater	9.3	NA
Marital Status		
Single	5.1	5.0
Married	73.0	67.0
Common-law	5.6	3.6
Separated	2.0	2.6
Divorced	7.0	12.5
Widowed	6.5	9.3
Education		
High school	20.5	31.0
Trade/ diploma	31.0	23.0
University	32.3	23.0
Employment Status		
Full-time	55.0	40.0
Part-time/ other	14.8	14.0
Retired/ at home	30.2	46.0
Self-rated Health Status		
Fair/ poor	9.6	14.4
Good	26.7	30.9
Very good	40.4	35.6
Excellent	22.5	18.8

Table 5. Self-reported Health Status and Access to Healthcare

Variable	Frequency (n=356)	Proportion (%)
Self-reported health		
Excellent	80	22.5
Very good	144	40.4
Good	95	26.7
Fair	27	7.6
Poor	7	2.0
Regular Family MD		
Yes	333	93.5
No	23	6.5
Routine Physical Exam		
Yes	262	73.6
No	94	26.4
Reasons if No		
Only go when concerned	53	14.9
Don't go for every ache	20	5.6
Being followed for specific Problem	13	3.7
Don't want to waste MD's time	11	3.1
Don't have regular MD	9	2.5
Costs	8	2.2
Want to avoid bad news	5	1.4
No time	5	1.4
Don't know / other	22	6.2
Personal Diagnosis of Cancer		
Yes	55	15.4
No	301	84.6
Colon Cancer	9	2.5

Table 6. Screening Knowledge

Variable	Frequency (356 Respondents)	Proportion (%)
Heard of Screening		
Yes	328	92.1
No	28	7.9
Meaning of Screening		
Checking for Symptoms	138	38.8
Eliminating Problems	37	10.4
To Diagnose a Problem	12	3.4
Test such as Pap, mammogram, prostate check	131	36.8
Take part in research	6	1.7
Other or blank	32	9.0
Meaning of Early Detection		
Catching disease at early stage when treatable	271	76.1
Catching disease when develop symptoms	61	17.1
Prevention of disease	11	3.1
Extending your life	3	0.8
Regular visits to MD	2	0.6
Other or blank	7	2.0

Table 7. Specific Screening Knowledge and Source(s) of Knowledge

Variable	Frequency (356 Respondents)	Proportion (%)
Heard of Specific Screening Test		
Mammogram	328	92.1
Clinical breast exam	244	68.5
Prostate specific antigen (PSA)	245	68.8
Stool blood test Fecal occult blood test	239	67.1
Sigmoidoscopy	112	31.5
Colonoscopy	324	91.0
Testicular self exam	165	46.3
Skin self exam	176	49.4
Chest X-ray	241	67.7
Breast self exam	297	83.4
Pap test	300	84.3
Digital rectal exam	211	59.3
Other	16	4.5
Source(s) of Screening Awareness		
Your doctor	284	79.8
Friends/ family	270	75.8
Magazine/ newspaper	219	61.5
Television/ radio	180	50.6
Pamphlet/ poster	133	37.4
Internet	61	17.1
Other	13	3.7

Table 8 Self-reported Screening Behavior

Variable	Frequency (356 Respondents)	Proportion (%)
Ever had a Screening Test		
Yes	250	70.2
No	106	29.8
Type of Test 250 Respondents[a]		
Fecal Occult Blood Testing	120	33.7
Barium Enema	69	19.4
Sigmoidoscopy	38	10.7
Colonoscopy	209	58.7
Other	2	0.6
Time Interval		
Within the past year	60	16.9
Within 1-5 years	162	45.5
Within 6-10 years	18	5.1
More than 10 years ago	10	2.8
Up to date Screening		
Yes	214	60
No	142	40

[a] Respondents could choose more than one screening test.

Table 9. Benefits and Barriers of CRC Screening: Distribution of Scores on Likert Scale

Survey Question	Mean	Median	Mode	Stand Dev
22. CRC screening makes sense to me	1.30	1	1	.553
23. I want to do what my family thinks about CRC screening	1.76	2	1	.976
24. CRC screening is important For me to do	1.47	1	1	.744
25. CRC screening can protect My health	1.37	1	1	.640
26. I am afraid of abnormal CRC screening result	2.92	3	2	1.31
27. I will be as health if I avoid CRC Screening	4.02	4	4	.984
28. Members of my family think I should have CRC screening	1.97	2	2	.981
29. Worried CRC screening will show cancer or polyps	3.31	4	4	1.24
30. My doctor thinks I should have CRC screening	2.14	2	1	1.11
31. I want to do what my doctor thinks For CRC screening	1.77	2	2	0.847
32. The chance I may develop CRC is High	2.66	3	3	.888
33. Compared to others my age, I am at a lower risk of CRC	3.42	3	3	.883
34. CRC screening tests are painful/dangerous	3.62	4	4	.973
35. It is likely I will develop polyps or CRC	2.95	3	3	.906
36. When polyps are removed, CRC can be prevented	2.24	2	2	.810
37. When CRC is found early, it can be Cured	1.96	2	2	.699
38. CRC screening tests are messy/embarrassing	3.28	4	4	1.21
39. CRC screening tests are not needed As I have no problems	4.08	4	4	.962
40. CRC screening test are worth the potential risks of the test	1.72	2	2	.494

Table 10. Benefits and Barriers of CRC Screening: Scores on Likert Scale

Survey Question	[a]SA n (%)[b]	A n (%)	U n (%)	D n (%)	SD n (%)
22. CRC screening makes sense to me	255 (71.6)	89 (25.0)	8 (2.2)	0	1 (0.3)
23. I want to do what my family thinks about CRC screening	163 (45.8)	134 (37.6)	27 (7.6)	19 (5.3)	8 (2.2)
24. CRC screening is important For me to do	225 (63.2)	95 (26.7)	27 (7.6)	4 (1.1)	2 (0.6)
25. CRC screening can protect My health	238 (66.9)	99 (27.8)	13 (3.7)	1 (0.3)	2 (0.6)
26. I am afraid of abnormal CRC screening result	50 (14.0)	103 (28.9)	65 (18.3)	86 (24.2)	48 (13.5)
27. I will be as healthy if I avoid CRC screening	6 (1.7)	12 (3.4)	67 (18.8)	141 (39.6)	127 (35.7)
28. Members of my family think I should have CRC screening	128 (36.0)	129 (36.2)	69 (19.4)	21 (5.9)	5 (1.4)
29. Worried CRC screening will show cancer or polyps	28 (7.9)	72 (20.2)	65 (18.3)	128 (36.0)	60 (16.9)
30. My doctor thinks I should have CRC screening	123 (34.6)	90 (25.3)	97 (27.2)	32 (9.0)	8 (2.2)
31. I want to do what my doctor thinks for CRC screening	145 (40.7)	151 (42.4)	44 (12.4)	8 (2.2)	4 (1.1)
32. The chance I may develop CRC is high	35 (9.8)	94 (26.4)	176 (49.4)	44 (12.4)	4 (1.1)
33. Compared to others my age, I am at a lower risk of CRC	6 (1.7)	30 (8.4)	145 (40.7)	143 (40.2)	29 (8.1)
34. CRC screening tests are painful/dangerous	5 (1.4)	41 (11.5)	79 (22.2)	176 (49.4)	52 (14.6)
35. It is likely I will develop polyps Or CRC	20 (5.6)	63 (17.7)	180 (50.6)	81 (22.8)	8 (2.2)
36. When polyps are removed, CRC can be prevented	56 (15.7)	168 (47.2)	112 (31.5)	16 (4.5)	1 (0.3)
37. When CRC is found early, it Can be cured	78 (21.9)	212 (59.6)	56 (15.7)	7 (2.0)	0
38. CRC screening tests are messy/embarrassing	16 (4.5)	101 (28.4)	48 (13.5)	134 (37.6)	54 (15.2)
39. CRC screening tests are not needed as I have no problems	5 (1.4)	15 (4.2)	36 (10.1)	170 (47.8)	126 (35.4)
40. CRC screening test are worth the potential risks of the test	135 (37.9)	182 (51.1)	31 (8.7)	4 (1.1)	3 (0.3)

[a]SA=Strongly Agree, A=Agree, U=Uncertain, D=Disagree, SD=Strongly Disagree

[b]Percentages may not add up to 100% as some questions left blank

Table 11. Exploratory Factor Analysis of Survey Questions

Total Variance Explained

Component	Initial Eigenvalues Total	% of Variance	Cumulative %	Rotation Sums of Squared Loadings Total	% of Variance	Cumulative %	Cronbach's alpha
1 Salience & Coherence	5.34	28.11	28.11	3.66	19.29	19.29	0.843
2 Cancer Worries	2.76	14.52	42.63	2.58	13.60	32.89	0.707
3 Social Influence	1.55	8.17	50.80	2.02	10.61	43.51	0.768
4 Susceptibility	1.35	7.13	57.93	1.93	10.16	53.67	0.647
5 Response Efficacy	1.02	5.34	63.28	1.83	9.63	**63.27**	0.570
					All five factors		0.813

Table 12. Rotated Component Matrix

	Component				
Survey Question	1	2	3	4	5
22	**.832**[a]	-.050	.139	.136	-.104
23	**.598**	.042	.378	.027	.041
24	**.868**	-.011	.181	.156	-.171
25	**.859**	.023	.133	.163	-.136
26	**.213**	**.784**	-.063	-.096	-.038
27	-.203	.360	-.074	.125	**.566**
28	.479	.170	**.552**	.112	-.140
29	.154	**.812**	-.023	.073	.066
30	.333	-.071	**.784**	.146	-.107
31	.214	-.087	**.842**	.089	.011
32	.111	.302	.201	**.581**	-.481
33	-.039	.58	.012	-.056	**.788**
34	-.192	**.638**	.052	.082	.208
35	.093	.252	.000	**.709**	-.246
36	.277	-.118	.064	**.663**	.188
37	.173	1.176	.202	**.661**	.235
38	-.143	**.648**	-.021	-.022	.100
39	-.361	.318	-.141	.103	**.583**
40	**.557**	-.054	.238	.228	-.114

[a]Bold values indicate these questions correlate with corresponding factor.

Table 13. Comparison of CRC Screeners and Non-screeners by Predictor

Variable	Screener (n=250)		Non-screener (n=106)		χ^2	p value
	No.	%	No.	%		
Age (%)						
40-49 yrs	71	27.7	67	63.2	42.33	<0.0001
>50 yrs	176	68.8	34	32.1		
Missing (8)[a]						
Education (%)						
High school	52	20.3	21	19.8	0.212	0.645
More than high School	171	68.4	79	74.5		
Less than high school or missing (33)[a]						
Family physician (%)						
Yes	238	95.2	95	89.6	3.832	0.05
No	12	4.8	11	10.4		
Annual checkup (%)						
Yes	196	78.4	66	62.3	9.974	0.002
No	54	21.6	40	37.7		
Personal Cancer History (%)						
Yes	47	18.8	8	7.5	7.216	0.007
No	203	91.2	98	92.5		

[a]Not included in analysis of high school versus more than high school or in multivariate analysis.

Table 14. Final Regression Model of Predictors of CRC Screening

Predictor	Odds Ratio	(95% CI)	(p-value)
Age (40-49 vs. >50)	3.64	(2.001-6.621)	<0.0001
Employment Status	1.19	(0.994-1.430)	0.058
Factor 2. Cancer worries	1.12	(1.009-1.234)	0.033
Factor 3. Social influence	1.48	(1.281-1.701)	<0.0001
Factor 4. Susceptibility	1.18	(0.998-1.399)	0.053
Factor 5. Response Efficacy	1.20	(1.008-1.416)	0.041

Model Summary:
Nagelkerke R squared value – 0.412
Omnibus Tests of Coefficients – χ^2 116.771, p<0.0001

Table 15. Classification Table: Accuracy of Model Predicting CRC Screening Status

Observed		Predicted		% Correct
Screened		Screened		
		Yes	No	
	Yes	221	24	**90.2**
	No	48	51	**51.5**
	Overall %			**79.1**

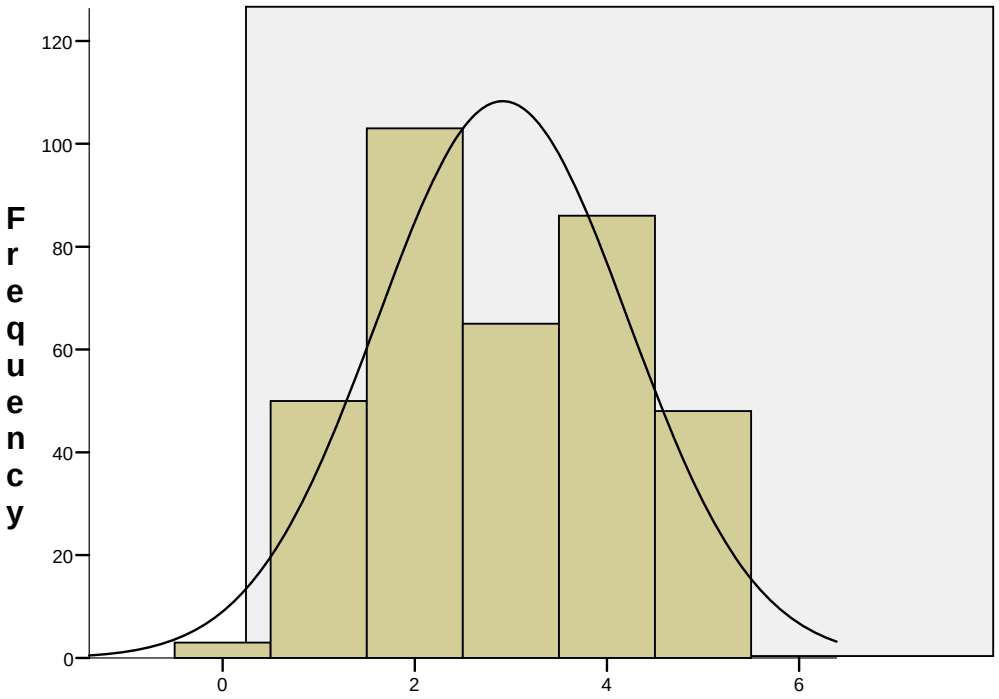


Figure 1. Distribution of 'Afraid of Abnormal Result' Answers

Legend: 0 = blank 1 = strongly agree 2 = agree
3 = uncertain 4 = disagree 5 = strongly disagree

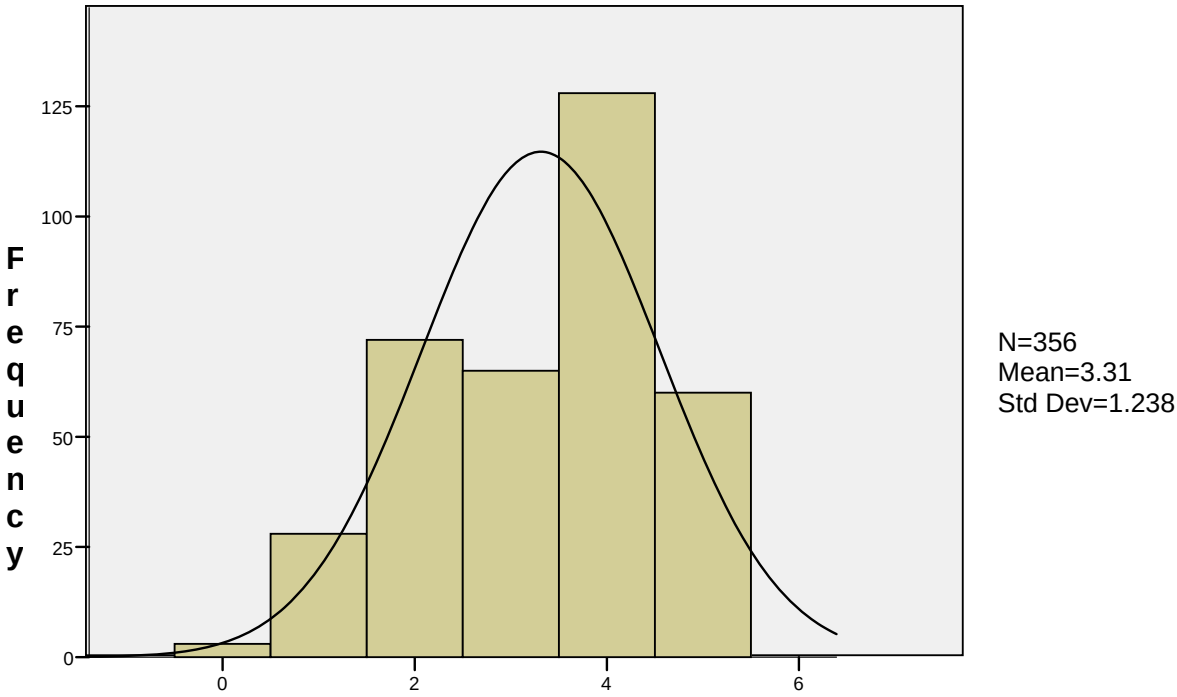
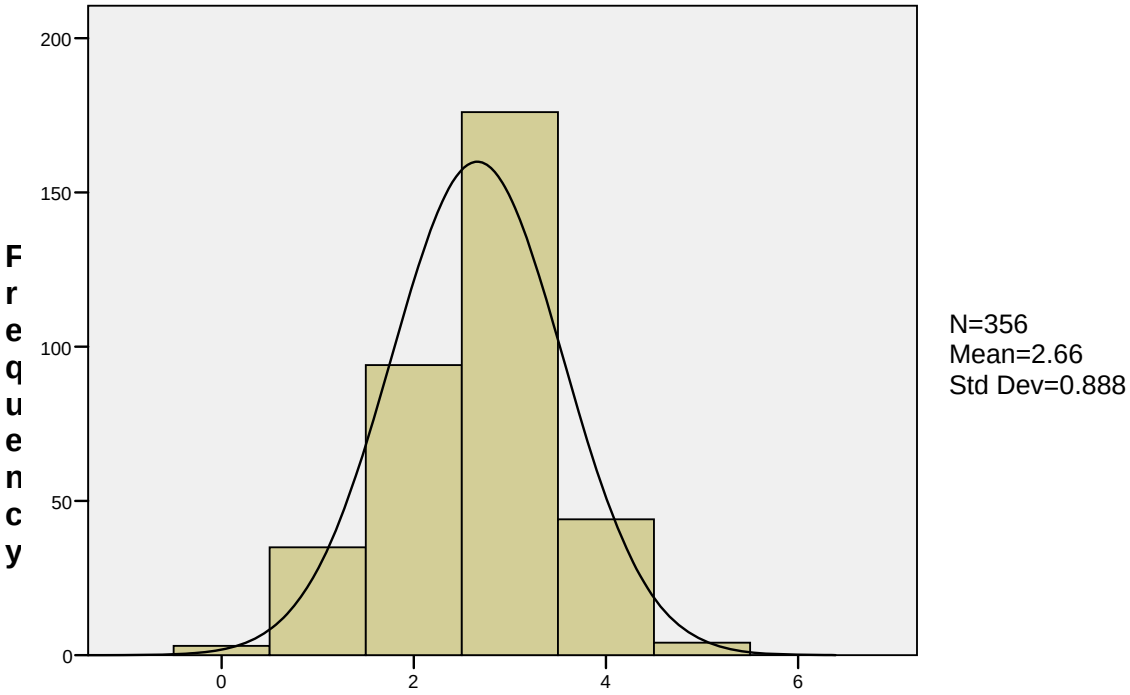


Figure 2. Distribution of 'Worried that CRC Screening will show Cancer or Polyps' Answers.

Legend: 0 = blank 1 = strongly agree 2 = agree
3 = uncertain 4 = disagree 5 = strongly disagree



Firgure 3. Distribution of 'Chance of CRC is High' Answers

Legend: 0 = blank 1 = strongly agree 2 = agree
3 = uncertain 4 = disagree 5 = strongly disagree

References

(1) National Cancer Institute of Canada. Canadian Cancer Statistics. 2001. Toronto, ON.

(2) Vogelstein B, Fearon ER, Hamilton SR, Kern SE, Preisinger AC, Leppert M et al. Genetic alterations during colorectal-tumor development. *N Engl J Med* 1988; 319(9):525-532.

(3) Jass JR. Pathogenesis of colorectal cancer. *Surg Clin N Am* 2002; 82:891-904.

(4) Huang CS, Lal SK, Farraye FA. Colorectal cancer screening in average risk individuals. *Cancer Causes Control* 2005; 16:171-188.

(5) Winawer SJ, Zauber AG, Ho MN, O'Brien MJ, Gottlieb LS, Sternberg SS et al. Prevention of colorectal cancer by colonoscopic polypectomy. *N Engl J Med* 1993; 329(27):1977-1981.

(6) McLeod RS, Canadian Task Force on Preventive Health Care. Screening strategies for colorectal cancer: a systematic review of the evidence. *Can J Gastroenterol* 2001; 15(10):647-660.

(7) McGregor SE, Hilsden RJ, Murray A, Bryant HE. Colorectal cancer screening: practices and opinions of primary care physicians. *Prev Med* 2004; 39:279-285.

(8) Fuchs CS, Giovannucci EL, Colditz GA, Hunter DJ, Speizer FE, Willett WC. A prospective study of family history and the risk of colorectal cancer. *N Engl J Med* 1994; 331:1669-1674.

(9) Johns LE, Houlston RS. A systematic review and meta-analysis of familial colorectal cancer risk. *Am J Gastroenterol* 2001; 96(10):2992-3003.

(10) Wilson J, Junger G. Principles and practices of screening for diease: public health paper 34. 34, 26-39. 1968. Geneva, World Health Organization.

(11) Jaeschke R, Guyatt G, Sackett DL. Users' guide to the medical literature. III. How to use and article about a diagnostic test. A. Are the results of the study valid? *JAMA* 1994; 271(5):389-391.

(12) Mandel JS, Church TR, Ederer F, Bond JH. Colorectal cancer mortality: effectiveness of biennial screening for fecal occult blood. *J Natl Cancer Inst* 1999; 91(5):434-437.

(13) Winawer SJ, Stewart ET, Zauber AG, Bond JH, Ansel H, Waye JD et al. A comparison of colonoscopy and double-contrast barium enema for surveillance after polypectomy. *N Engl J Med* 2000; 342(24):1766-1772.

(14) Kim DH, Pickhardt PJ, Taylor AJ, Leung WK, Winter TC, Hinshaw JL et al. CT colonography versus colonoscopy for the detection of advanced neoplasia. *N Engl J Med* 2007; 357(14):1403-1412.

(15) Fenlon HM, Nunes DP, Schroy III PC, Barish MA, Clarke PD, Ferrucci JT. A comparison of virtual and conventional colonoscpy for the detection of colorectal polyps. *N Engl J Med* 1999; 341:1496-1503.

(16) Ahlquist DA, Skoletsky JE, Boynton KA, Harrrington JJ, Mahoney DW, Pierceall WE et al. Colorectal cancer screening by detection of altered human DNA in stool: feasibility of a multitarget assay panel. *Gastroenterology* 2000; 119:1219-1227.

(17) Tagore KS, Levin TR, Lawson MJ. The evolution to stool DNA testing for colorectal cancer. *Aliment Pharmacol Ther* 2004; 19:1225-1233.

(18) Hardcastle JD, Thomas WM, Chamberlain J, Pye G, Sheffield J, James PD et al. Randomised, controlled trial of faecal occult blood screening for colorectal cancer. Results for first 107,349 subjects. *Lancet* 1989; 1(8648):1160-1164.

(19) Kewenter J, Bjork S, Haglin E, Smith L, Svanvik J, Ahren C. Screening and rescreening for colorectal cancer. A controlled trial of fecal occult blood testing in 27,700 subjects. *Cancer* 1988; 62(3):645-651.

(20) Kronborg O, Fenger C, Olsen J, Jorgensen OD, Sondergaard O. Randomised study of screening for colorectal cancer with faecal-occult-blood test. *Lancet* 1996; 348(9040):1467-1471.

(21) Towler BP, Irwig L, Glasziou P, Weller D, Kewenter J. Screening for colorectal cancer using faecal occult blood test. *Cochrane Database Syst Rev 2* 2000; 91:CD001216.

(22) Towler B, Irwig L, Glasziou P, Kewenter J, Weller D, Silagy C. A systematic review of the effects of screening for colorectal cancer using the faecal occult blood test, Hemoccult. *BMJ* 1998; 317:559-565.

(23) Imperiale TF, Ransohoff DF, Itzkowitz SH, Turnbull BA, Ross ME, for the Colorectal Cancer Study Group. Fecal DNA versus fecal occult blood for colorectal-cancer screening in an average-risk population. *N Engl J Med* 2004; 351:2704-2714.

(24) Friedman GD, Collen MF, Fireman BH. Multiphasic health checkup evaluation: a 16 year follow up. *J Chronic Dis* 1986; 39:453-463.

(25) Newcomb PA, Norfleet RG, Storer BE, Surawicz TS, Marcus PM. Screening sigmoidoscopy and colorectal cancer mortality. *J Natl Cancer Inst* 1992; 84:1572-1575.

(26) Selby JV, Friedman GD, Quesenbery CP, Weiss NS. A case-control study of screening sigmoidoscopy and mortality from colorectal cancer. *N Engl J Med* 1992; 326:653-657.

(27) Muller AD, Sonnenberg A. Protection by endoscopy against death from colorectal cancer. A case-control study among veterans. *Arch Int Med* 1995; 155:1741-1748.

(28) Muller AD, Sonnenberg A. Prevention of colorectal cancer by flexible endoscopy and polypectomy. *Ann Intern Med* 1995; 123:904-910.

(29) Atkin WS. Flexible sigmoidoscopy as a mass screening tool. *Eur J Gastroenterol Hepatol* 1998; 10:219-223.

(30) Imperiale TF, Wagner DR, Lin CY, Larkin GN, Rogge GN, Ransohoff DF. Risk of advanced proximal neoplasms in asymptomatic adults according to the distal colorectal findings. *N Engl J Med* 2000; 343:169-174.

(31) Lemmel GT, Haseman JH, Rex DK, Rahmani E. Neoplasia distal to the splenic flexure in patients with proximal colon cancer. *Gastrointest Endosc* 2000; 44:109-111.

(32) Leiberman DA, Weiss DG, Bond JH, Ahnen DJ, Garewal H, Chejfec G. Use of colonoscopy to screen asymptomatic adults for colorectal cancer. *N Engl J Med* 2000; 343:162-168.

(33) Scheitel SM, Ahlquist DA, Wollan PC, Hagen PT, Silverstein MD. Colorectal cancer screening: a community case-control study of proctosigmoidoscopy, barium enema radiography, and fecal occult blood test efficacy. *Mayo Clin Proc* 1999; 74:1207-1213.

(34) Rex DK, Rahmani EY, Haseman JH, Lemmel GT, Kaster S, Buckley JS. Relative sensitivity of colonoscopy and barium enema for detection of colorectal cancer in clinical practice. *Gastroenterology* 1997; 112:17-23.

(35) Blakeborough A, Sheridan MD, Chapman AH. Complications of barium enema examinations: a survey of UK consultant radiologists 1992 to 1994. *Clin Radiol* 1997; 52:142-148.

(36) Nelson DB, McQuaid KR, Bond JH, Lieberman DA, Weiss DG, Johnston TK. Procedural success and complications of large-scale screening colonoscopy. *Gastrointest Endosc* 2002; 55:307-314.

(37) Garbay JR, Suc B, Rotman N, Fourtanier G, Escat J. Multicentre study of surgical complications of colonoscopy. *Br J Surg* 1996; 83:42-44.

(38) Lieberman DA, Weiss DG, Harford WV, Ahnen DJ, Provenzale D, Sontag SJ et al. Five-year colon surveillance after screening colonoscopy. *Gastroenterology* 2007; 133:1077-1085.

(39) Frazier AL, Colditz GA, Fuchs CS, Kuntz KM. Cost-effectiveness of screening for colorectal cancer in the general population. *JAMA* 2000; 284:1954-1961.

(40) Khandker RK, Dulski JD, Kilpatrick JB, Ellis RP, Mitchell JB, Baine WB. A decision model and cost-effectiveness analysis of colorectal cancer screening and surveillance guidelines for average-risk adults. *Int J Technol Assess Health Care* 2000; 16:799-810.

(41) Sonnenberg A, Delco F, Inadomi JM. Cost-effectiveness of colonoscopy in screening for colorectal cancer. *Ann Intern Med* 2000; 137:129-131.

(42) U.S.Preventive Services Task Force. Screening for colorectal cancer: recommendation and rationale. *Ann Intern Med* 2002; 133:573-584.

(43) Simmang CL, Senatore P, Lowry A, Hicks T, Burnstein M, Dentsman F et al. Practice parameters for detection of colorectal neoplasms. The Standards Committee, The American Society of Colon and Rectal Surgeons. *Dis Colon Rectum* 1999; 42(9):1123-1129.

(44) Smith RA, Cokkinides V, Eyre HJ. American Cancer Society guidelines for the early detection of cancer, 2004. *CA Cancer J Clin* 2004; 54:41-52.

(45) Bancej C, Nichol M, Jones-McLean E, Mai V. Prevalence and correlates of colorectal cancer screening among adults aged 50 to 74 in four Canadian provinces. 2006.

(46) Institute of Cancer Research. Colorectal cancer screening workshop report. 2006. 2-2-2008.

(47) Mack LA, Stuart H, Temple WJ. Survey of colorectal cacer screening practices in a large Canadian urban centre. *Can J Surg* 2004; 47(3):189-194.

(48) Ruffin IV MT, Gorenflo DW, Woodman B. Predictors of screening for breast, cervical, colorectal, and prostatic cnacer among community-based primary care practices. *J Am Board Fam Pract* 2000; 13:1-10.

(49) Center for Disease Control. Trends in screening for colorectal cancer-United States 1997 and 1999. *MMWR* 2001; 50:162-166.

(50) McGregor SE, Hilsden RJ, Li FX, Bryant HE, Murray A. Low uptake of colorectal cancer screening 3 yr after release of national recommendations for screening. *Am J Gastroenterol* 2007; 102:1727-1735.

(51) Hawley ST, Levin B, Vernon SW. Colorectal cancer screening by primary care physicians in two medical care organizations. *Cancer Detect Prev* 2001; 25(3):309-318.

(52) Kwak EL, Churg DC. Hereditary colorectal cancer syndromes: an overview. *Clin Colorectal Cancer* 2007; 6(5):340-344.

(53) Ricciardiell L, Boland CR. Lynch syndrome (hereditary non-polyposis colorectal cancer): current concepts and approaches to management. *Curr Gastroenterol Rep* 2005; 7(5):412-420.

(54) Rawl S, Champion V, Menon U, Loehrer FJ, Vance GH, Skinner CS. Validation of scales to measure benefits and barriers to colorectal cancer screening. *J Psychosoc Oncol* 2001; 19(47):63.

(55) Madlensky L, Esplen MJ, Gallinger S, McLaughlin JR, Goel V. Relatives of colorectal cancer patients: factors associated with screening behavior. *Am J Prev Med* 2003; 25(3):187-194.

(56) Cotterchio M, McKeown-Eyssen G, Sutherland H, Buchan G, Aronson M, Easson AM et al. Ontario Familial Colon Cancer Registry: methods and first-year response rates. *Chron Dis Can* 2000; 21(2):81-86.

(57) Tiro JA, Vernon SW, Hyslop T, Myers RE. Facorial validity and invariance of a survey measureing psychosocial correlates of colorectal cancer screening among African Americans and Caucasians. *Cancer Epidemiol Biomarkers Prev* 2005; 14(12):2855-2861.

(58) Codori AM, Petersen GM, Miglioretti DL, Boyd P. Health beliefs and endoscopic screening for colorectal cancer: potential for cancer prevention. *Prev Med* 2001; 33:128-136.

(59) Madlensky L, Esplen MJ, Goel V. Reasons given by relatives of colorectal cancer patients for not undergoing screening. *Prev Med* 2004; 39:643-648.

(60) Vernon SW, Myers RE, Tilley BC. Development and validation of an instrument to measure factors related to colorectal cancer screening adherence. *Cancer Epidemiol Biomarkers Prev* 1997; 6:825-832.

(61) Maiman LA, Becker MH. The health belief model: orignis and correlates in psychlogical theory. *Health Educ Monogr* 1974; 2:9-26.

(62) Champion VL. Development of a benefits and barriers scale for mammography utilization. *Cancer Nurs* 1995; 18(1):53-59.

(63) Cook DA, Beckman TJ. Current concepts in validity and reliability for psychometric instruments: theory and application. *Am J Med* 2006; 119(2):166.e7-166.e16.

(64) Bryman A. The nature of quantitative research. In: Bryman A, editor. Social Research Methods. New York: Oxford University Press, 2001: 61-82.

(65) Creswell JW. Quantitative methods. 2003: 153-178.

(66) Gordon NP, Hiatt RA, Lampert DI. Concordance of self-reported data and medical record audit for six cancer screening procedures. *J Natl Cancer Inst* 1993; 85(7):566-570.

(67) Lipkus IM, Rimer BK, Lyna PR, Pradhan AA, Conaway M, Woods-Powell CT. Colorectal screening patterns and perceptions of risk among African-American users of a community health center. *J Community Health* 1996; 21(6):409-427.

(68) Mandelson MT, Curry SJ, Anderson LA, Nadel MR, Lee NC, Rutter CM et al. Colorectal cancer screening participation by older women. *Am J Prev Med* 2000; 19(3):149-154.

(69) Baier M, Calonge N, Cutter G, McClatchey M, Schoentgen S, Hines S et al. Validity of self-reported colorectal cancer screening behavior. *Cancer Epidemiol Biomarkers Prev* 2000; 9:229-232.

(70) Madlensky L, McLaughlin J, Goel V. A comparison of self-reported colorectal cancer screening with medical records. *Cancer Epidemiol Biomarkers Prev* 2003; 12:656-659.

(71) Bryman A. Self-completion questionnaires. In: Bryman A, editor. Social Research Methods. New York: Oxford University Press, 2001: 127-140.

(72) Dillman DA. Survey implementation. In: Dillman DA, editor. Mail and Internet Surveys: The Tailored Design Method. New York: John Wiley & Sons, Inc., 2000: 149-193.

(73) American Joint Committee on Cancer. Colon and Rectum. In: Greene FL, Page DL, Fleming ID, Fritz AG, Balch CS, Haller DG et al., editors. Cancer Staging Manual. New York: Springer, 2002: 113-119.

(74) Kang H, O'Connell JB, Maggard MA, Sack J, Ko CY. A 10-year outcomes evaluation of mucinjous and signet-ring cell carcinoma of the colon and rectum. *Dis Colon Rectum* 2005; 48(6):1161-1168.

(75) Cook AD, Single R, McCahill LE. Surgical resetion of primary tumors in patients who present with stage IV colorectal cancer: an analysis of surveillance, epidemiology, and end results data, 1988 to 2000. *Ann Surg Oncol* 2005; 12(8):637-645.

(76) Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. *J Clin Epidemiol* 1997; 50(10):1129-1136.

(77) Kalantar JS, Talley NJ. The effects of lottery incentive and length of questionnaire on health survey response rates: a randomized study. *J Clin Epidemiol* 1999; 52(11):1117-1122.

(78) Roberts LM, Wilson S, Roalfe A, Bridge P. A randomised controlled trial to determine the effect on response of including a lottery incentive in health surveys. *BMC Health Serv Res* 2004.

(79) Ramji F, Cotterchio M, Manno M, Rabeneck L, Gallinger S. Association between subject factors and colorectal cancer screening participation in Ontario, Canada. *Cancer Detect Prev* 2005; 29:221-226.

(80) Etzioni DA, Ponce NA, Babey SH, Spencer BA, Brown ER, Ko CY et al. A population-based study of colorectal cancer test use: results from the 2001 California Health Interview Survey. *Cancer* 2004; 101:2523-2532.

(81) Ioannou GN, Chapko MK, Dominitz JA. Predictors of colorectal cancer screening participation in the United States. *Am J Gastroenterol* 2003; 89(9):2082-2091.

(82) Manne S, Markowitz A, Winawer S, Meropol NJ, Haller D, Rakowski W et al. Correlates of colorectal cancer screening compliance and stage of adoption among siblings of individuals with early onset colorectal cancer. *Health Psychol* 2002; 21(1):3-15.

(83) Guidelines & Protocols Advisory Committee. Detection of colorectal neoplasms in asymptomatic patients. 2004. British Columbia, BC Health Services.

(84) Read TE, Kodner IJ. Colorectal cancer: risk factors and recommendations for early detection. *Am Fam Physician* 1999; 59(11):3083-3092.

(85) Stermer T, Hodgson S, Kavalier F, Watts S, Jones R. Patients' and professionals' opinions of services for people at an increased risk of colorectal cancer: an exploratory qualitative study. *Fam Cancer* 2004; 3:49-53.

(86) Rawl SM, Menon U, Champion VL, Foster JL, Skinner CS. Colorectal cancer screening beliefs: focus groups with first-degree relatives. *Cancer Pract* 2000; 8(1):32-37.

(87) Alberta Cancer Board Cancer Screennng Programs. Alberta Colorectal Cancer Screening Program. 2008. Alberta, Alberta Cancer Board.

(88) Taylor ML, Anderson R. Colorectal cancer screening: physician attitudes and practices. *WMJ* 2002; 101:39-43.

(89) Mitchell RJ, Brewster D, Campbell H, Porteous MEM, Wyllie AH, Bird CC et al. Accuracy of reporting of family history of colorectal cancer. *Gut* 2004; 53:291-295.

(90) Montgomery GH, Erblich J, Dilorenzo T, Bovbjerg DH. Family and friends with disease: their impact on perceived risk. *Prev Med* 2003; 37:242-249.

(91) Blalock SJ, Devellis B, Afifi RA, Sandler R. Risk perceptions and paticipation in colorectal cancer screening. *Health Psychol* 1990; 9:792-806.

(92) Glanz K, Steffen AD, Taglialatela LA. Effects of colon cancer risk counseling for first-degree relatives. *Cancer Epidemiol Biomarkers Prev* 2007; 16(7):1485-1491.

(93) Ling BS, Moskowitz MA, Wachs D, Pearson B, Schroy III PC. Attitudes towards colorectal cancer screening tests. A survey of patients and physicians. *J Gen Intern Med* 2001; 16:822-830.

(94) Khoja S, McGregor SE, Hilsden RJ. Validation of self-reported history of colorectal cancer screening. *Can Fam Physician* 2007; 53:1192-1197.

(95) Montano DE, Phillips WR. Cancer screening by primary care physicians: a comparison of rates obatined from physician self-report, patient survey, and chart audit. *Am J Pub Health* 1995; 85(6):795-800.

(96) Hawley ST, Vernon SW, Levin B, Vallejo B. Prevalence of colorectal cancer screening in a large medical organization. *Cancer Epidemiol Biomarkers Prev* 2007; 13:314-319.

(97) Jacobs LA. Health beliefs of first-degree relatives of individuals with colorectal cancer and participation in health maintenance visits: a population-based survey. *Cancer Nurs* 2002; 25(4):251-265.

(98) Lynch KL, Ahnen DJ, Byers T, Weiss DG, Lieberman DA. First-degree relatives of patients with advanced colorectal adenomas have an increased prevalence of colorectal cancer. *Clin Gastroenterol Hepatol* 2003; 1(2):96-102.

(99) St.John DJB, McDermott FT, Hopper JL, Debney EA, Johnson WR, Hughes ESR. Cancer risk in relatives of patients with common colorectal cancer. *Ann Intern Med* 1993; 118:785-790.

(100) Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud P-AC et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA* 1999; 282:1458-1465.

Appendix A. Personalized Study Information Letter Inviting Colorectal Cancer Patients to Participate.

Date

Dear

We are conducting a survey of close blood relatives of patients with bowel cancer (colorectal cancer). The short survey will focus on screening tests for the early diagnosis or prevention of bowel cancer.

You were identified as a patient who has received a diagnosis of bowel cancer by the Alberta Cancer Registry.

The study, described in detail below, is a survey of first-degree relatives (parent, child, brother or sister) of patients with bowel cancer. We would be interested in obtaining your relatives views on possible screening tests but would only approach your relatives with your permission.

TITLE: PERCEIVED BENEFITS AND BARRIERS OF COLORECTAL CANCER SCREENING AMONG FIRST DEGREE RELATIVES OF COLORECTAL CANCER PATIENTS

INVESTIGATORS: Drs. Lloyd Mack, Linda Cook, Linda Carlson, Walley Temple, Robert Hilsden

SPONSOR: None

This information sheet is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more details about something mentioned here, or information not included here, please ask. Take the time to read this carefully and to understand any accompanying information.

BACKGROUND

Bowel cancer (Colorectal carcinoma) is a common cancer in Canada and is a leading cause of cancer-related death. People with a first-degree relative (parent, brother or sister, or child) diagnosed with bowel cancer may be at a higher risk of developing this

problem. However, bowel cancer may be detected at an early stage or even prevented with the use of cancer screening methods such as home stool blood testing, barium enema, sigmoidoscopy or colonoscopy.

Very little information is known about how often bowel cancer screening is recommended or occurring in first degree relatives of those with bowel cancer. Also, little information is known about family member's attitudes about screening tests.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of the study is to determine the thoughts and experiences of first-degree relatives of patients with bowel cancer. As well, the study hopes to determine how people feel about the possibility of bowel cancer screening.

WHAT WOULD I HAVE TO DO?

If you agree to participate, simply fill in the number of first-degree relatives (parent, brother or sister, or child) you have and their contact information in the attached data form and return in the postage paid envelope. You only need to provide information about your relatives aged 40 or greater. Your relative will receive a short, seven-page questionnaire to fill out and return. The questionnaire should take approximately 10-15 minutes. No further questionnaires or activities are required by your relative. If you do not wish your relatives to be contacted or participate, simply return the data sheet blank in the postage-paid envelope.

WHAT ARE THE RISKS?

There are no appreciable risks to taking part in this questionnaire.

WILL I BENEFIT IF I TAKE PART?

The chances of benefiting directly by completing this questionnaire are minimal although it may encourage your relatives to approach their physician or one of the investigators for further information about bowel cancer screening and prevention. The broader benefit is that their answers to the survey may guide future bowel screening policies in Alberta.

DO I HAVE TO PARTICIPATE?

Completion of your relatives' information is completely voluntary. If you do not wish to participate, please return the data form blank in the postage-paid envelope and we will not contact you further and will not contact your relatives.

WHAT HAPPENS NEXT?

Please return the data form in the postage-paid envelope if you wish to participate. A reminder letter will be sent to you in three weeks if we have not heard from you. A repeat mailing of this information will be sent to you three weeks later if we still have not heard from you. Finally, a follow-up phone call will be made if we have not heard from you to see if your relative(s) would be interested in the survey or not.

WILL I BE PAID FOR PARTICIPATING, OR DO I HAVE TO PAY FOR ANYTHING?

There should be no costs to you for completing this survey other than your time. If you do return your survey, you will be entered into a draw for $100.00.

WILL MY RECORDS BE KEPT PRIVATE?

All confidential information about your relative(s) will be kept at the Tom Baker Cancer Centre by Dr. Lloyd Mack in a secure / confidential area until your relative has been given the survey and returned (either filled out or blank) and then all confidential information will be destroyed.

AGREEMENT TO PARTICIPATE

Your decision to complete and return the information about your relative(s) questionnaire will be interpreted as an indication of your agreement to participate. In no way does this waive your legal rights nor release the investigators, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time.

If you have further questions concerning matters related to this research, please contact:

Dr. Lloyd Mack (403) 521-3169
Or
Dr. Linda Cook (403) 220-4285

If you have any questions concerning your rights as a possible participant in this research, please contact the Ethics Resource Officer, Internal Awards, Research Services, University of Calgary, at 220-3782.

The University of Calgary Conjoint Health Research Ethics Board has approved this research study.

Appendix B. Dataform Collecting Contact Information of First-degree Relatives.

DATAFORM #

How many first-degree relatives (brother or sister, parent, child) age 40 or older do you have? _____

Please fill in the contact information of the relatives above who may be interested in a survey about bowel cancer. Your relative will have the option of refusing if they are not interested. Remember, all information collected will be kept confidential.

Relative #1
Surname _____
First name _____
Street address _____
_____
City _____Province_____
Postal Code _____

Relative #2
Surname _____
First name _____
Street address _____
_____
City _____Province_____
Postal Code _____

Relative #3
Surname _____
First name _____
Street address _____
_____
City _____Province_____
Postal Code _____

Relative #4
Surname _____
First name _____
Street address _____

_____
City _____Province_____
Postal Code _____

Relative #5
Surname _____
First name _____
Street address _____
_____
City _____Province_____
Postal Code _____

Relative #6
Surname _____
First name _____
Street address _____
_____
City _____Province_____
Postal Code _____

Please attach additional names, addresses if you have more than six first degree relatives age 40 or more who may be interested in this survey.

Sincerely

Dr. Lloyd A. Mack
Phone (403) 521-3169

Or

Dr. Linda Cook
Phone (403) 220-4285

Appendix C. Personalized Study Information Letter Inviting First-degree Relatives to Participate.

Date

Dear

Your relative thought you may be interested in participating in the following questionnaire / survey for scientific research from the University of Calgary and the Alberta Cancer Board. Please read carefully.

TITLE: PERCEIVED BENEFITS AND BARRIERS OF COLORECTAL CANCER SCREENING AMONG FIRST DEGREE RELATIVES OF COLORECTAL CANCER PATIENTS

INVESTIGATORS: Drs. Lloyd Mack, Linda Cook, Linda Carlson, Walley Temple, Robert Hilsden

SPONSOR: None

This information sheet is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more details about something mentioned here, or information not included here, please ask. Take the time to read this carefully and to understand any accompanying information.

BACKGROUND

Bowel cancer (Colorectal carcinoma) is a common cancer in Canada and is a leading cause of cancer-related death. People with a first-degree relative (parent, brother or sister, or child) diagnosed with bowel cancer may be at a higher risk of developing this problem. However, bowel cancer may be detected at an early stage or even prevented with the use of cancer screening methods such as home stool blood testing, barium enema, sigmoidoscopy or colonoscopy.

Very little information is known about how often bowel cancer screening is recommended or occurring in first degree relatives of those with bowel cancer. Also,

little information is known about family members' attitudes about screening tests.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of the study is to determine the thoughts and experiences of first-degree relatives of patients with bowel cancer with respect to screening. As well, the study hopes to determine how people feel about the possibility of bowel cancer screening.

WHAT WOULD I HAVE TO DO?

If you agree to participate, there is a short, seven-page questionnaire to fill out and return in the postage-paid envelope. The questionnaire should take approximately 10-15 minutes. No further questionnaires or activities are required. If you do not wish to participate, simply return the questionnaire blank in the postage-paid envelope.

WHAT ARE THE RISKS?

There are no appreciable risks to taking part in this questionnaire.

WILL I BENEFIT IF I TAKE PART?

The chances of benefiting directly by completing this questionnaire are minimal although it may encourage you to approach your family physician or one of the investigators for further information about bowel cancer screening and prevention. The broader benefit is that your answers to this survey may guide future bowel screening policies in Alberta.

DO I HAVE TO PARTICIPATE?

Completion of the questionnaire is completely voluntary. If you do not wish to participate, please return the questionnaire blank in the postage-paid envelope and we will not contact you further.

WHAT HAPPENS NEXT?

Please return the questionnaire in the postage-paid envelope. A reminder letter will be sent to you in three weeks if we have not heard from you. An additional survey will be sent to you three weeks later if we still have not heard from you. Finally, a follow-up phone call will be made if the survey is not returned to see if you are interested in the survey or not.

WILL I BE PAID FOR PARTICIPATING, OR DO I HAVE TO PAY FOR ANYTHING?

There should be no costs to you for completing this survey other than your time. If you do return your survey, you will be entered into a draw for $100.00.

WILL MY RECORDS BE KEPT PRIVATE?

All responses to the questionnaire will be collected and kept anonymously. Your name and address was provided by a first-degree relative who thought you may be interested in the questionnaire/ survey. All private information (name and address) will be kept at the Tom Baker Cancer Centre by Dr. Lloyd Mack in a secure / confidential area until the survey has been returned (either filled out or blank) and then all confidential information will be destroyed.

AGREEMENT TO PARTICIPATE

Your decision to complete and return this questionnaire will be interpreted as an indication of your agreement to participate. In no way does this waive your legal rights nor release the investigators, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time.

If you have further questions concerning matters related to this research, please contact:

Dr. Lloyd Mack (403) 521-3169
Or
Dr. Linda Cook (403) 220-4285

If you have any questions concerning your rights as a possible participant in this research, please contact the Ethics Resource Officer, Internal Awards, Research Services, University of Calgary, at 220-3782.

The University of Calgary Conjoint Health Research Ethics Board has approved this research study.

Appendix D. Final Study Questionnaire Sent to First-degree Relatives.

Study #

BOWEL CANCER SCREENING QUESTIONNAIRE

1. Were you born in Canada? **(please circle one response)**
   1. Yes **if yes, skip to question 2**
   2. No

   1.a. **If no**, in what country were you born?_____

   1.b. **If no**, when did you come to Canada? **(please circle one response)**
      1. Within the past five years (includes 2001 until present)
      2. Five to ten years ago (includes 1996-2000)
      3. More than ten years ago (includes 1995 or earlier)

2. To which ethnic or cultural group(s) did your grandparents belong?
   (Select all that apply)

1. Canadian	11. Irish
2. French	12. Italian
3. English	13. Ukrainian
4. German	14. Scandinavian
5. Scottish	15. Dutch (Netherlands)
6. Chinese	16. North American Indian
7. Jewish	17. Métis
8. Polish	18. Inuit/ Eskimo
9. Portuguese	19. Other (Specify)
10. South Asian	20. Don't know

3. What language do you speak **MOST** often at home? **(please circle one response)**
   1. English
   2. French
   3. German
   4. Italian
   5. Chinese
   6. Other (Specify) _____.

Study #

4. What level of education you have completed? **(please circle one response)**
    1. elementary
    2. junior high
    3. high school

5. Have you obtained any diplomas, certificates, or degrees?
    (please circle one response)
    1. No
    2. High school diploma
    3. Trade certificate
    4. Diploma (e.g. technical school, community college, etc)
    5. University Degree (e.g. Bachelor's, Masters, or PhD)
    6. Other education or training (Specify) _____

6. What is your current marital status? **(please circle one response)**
    1. Married
    2. Living common-law or with partner
    3. Separated
    4. Divorced
    5. Widowed
    6. Single (never married)

7. What is your current employment status? **(please circle one response)**
    1. Working full-time (more than 15 hours per week)
    2. Working part-time (15 or less hours per week)
    3. Not employed, but looking for work
    4. Homemaker
    5. Retired
    6. Student
    7. Other (Specify) _____

8. Please tell me what age group you are in: **(please circle one response)**
    1. 40-44 years of age?
    2. 45-49
    3. 50-54
    4. 55-59
    5. 60-64
    6. 65-69
    7. 70-74
    8. 75 or greater

Study #

9. What is your annual household income before taxes? (remember all answers are confidential or you may leave blank if desired) **(please circle one response)**

1. less than $24,999 per year
2. $25,000-49,999
3. $50,000-74,999
4. $75,000-99,999
5. $100,000 or greater

10. In general, compared to others your age, how would you rate your health?
(please circle one response)

1. Excellent
2. Very good
3. Good
4. Fair
5. Poor

11. Do you have a regular family doctor? (general practitioner)
(please circle one response)

1. Yes
2. No

12. How many times did you visit a medical doctor in the past 12 months?
_____ times

13. Do you go to the doctor for a **routine** checkup or physical exam at least once every year?
(please circle one response)

1. Yes **if yes, skip to question 14**
2. No

If no, can you tell me why you do not go to the doctor for a routine checkup?
(please select as many answers as needed)

1. Not necessary
2. Only go to the doctor when I'm concerned about something in particular
3. Costs involved (wastes health care money)
4. I don't want to take doctor's time away from people who are sick
5. I don't want to find out "bad news"
6. I wasn't brought up to go to the doctor for every little ache and pain
7. I am being followed for a specific problem (e.g.– high blood pressure)
8. I don't know
9. I don't have a regular family doctor
10. I don’t have time.
11. I don’t have transportation
12. Other (Specify) _____

Study #

14. Have you had a diagnosis of cancer yourself? **(please circle one response)**
    1. Yes (Specify) _____
    2. No

15. Have you heard of the term **screening** for any condition or disease?
    (please circle one response)
    1. Yes
    2. No **if no, skip to question 17**

16. What does the term **screening** mean to you? **(please circle one response)**
    1. Checking/ testing for symptoms
    2. Eliminating/ ruling out problems
    3. To diagnose a problem
    4. To have a test given such as Pap smear, mammogram, prostate check
    5. To take part in a research study
    6. Other (Specify) _____

17. What does the term **early detection** mean to you? **(please circle one response)**
    1. Catching disease at early stage when treatable and not too serious
    2. Catching disease at first symptoms
    3. Prevention of disease
    4. Extending your life
    5. Making regular visits to the doctor
    6. Other (Specify) _____

18. Have you heard about any of the following screening tests or early detection tests for cancer? **(you may select as many answers as apply)**
    1. Mammogram
    2. Clinical breast exam
    3. Prostate specific antigen (PSA) blood test
    4. Stool blood test (fecal occult blood test or FOB test)
    5. Sigmoidoscopy
    6. Colonoscopy
    7. Testicular self examination
    8. Skin self examination
    9. Chest X-ray
    10. Breast self examination
    11. Pap test
    12. Digital rectal examination (finger test)
    13. Other (Specify) _____
    14. None

Study #

19. How do you usually become aware of any tests that can be used to screen people for cancer? **(you may select as many answers as apply)**
    1. From your doctor
    2. Magazines or newspaper articles
    3. Pamphlets or posters
    4. Internet
    5. Television or radio
    6. From friends or family
    7. Other (Specify) _____

The rest of the questions are specifically about bowel cancer screening. Four short paragraphs describe tests commonly used for bowel cancer screening. Please read the descriptions and then finish the questions afterward.

The **home stool blood test** or occult blood test or fecal occult blood test is a test that uses a special test kit at home to see whether the stool contains blood. A spatula is used to take stool samples from three consecutive bowel movements. Samples are smeared onto a special card, sealed and returned to a lab for testing. Patients are often advised not to consume raw fruits or vegetables, red meat, iron supplements, Vitamin C, or Aspirin for two days prior to having a home stool blood test.

A **barium enema** or lower GI exam is a test that uses X-ray examination to view the entire colon or large bowel. Before the X-ray pictures are taken, barium and air are inserted into the rectum with a tube.

A flexible **sigmoidoscopy** is an examination in which a doctor inserts a thin, hollow tube with a light on the end, into the rectum and lower part of the bowel, to look for signs of cancer or other problems. It is done in a doctor's office or clinic. Before having this test, you use an enema to clean out the lower part of the bowel. There are no diet or medication restrictions before the procedure.

A **colonoscopy** is an examination that uses a long tube with a lighted video camera on the end. This camera displays to a video-monitor that allows the doctor to look closely at the entire colon or large bowel. It is done by a specialist doctor at a hospital or clinic. You follow a clear liquid diet for 24 hours before the exam and also clean out the bowel using powerful laxatives. Before the test, you sign a special "consent" form. You are usually sedated with a needle into a vein in your hand or arm.

Study #

20. Have you ever had any of these screening tests for bowel cancer? (home stool blood test, barium enema, sigmoidoscopy, or colonoscopy) **(please circle one response)**

1. Yes
2. No **– if no, skip to question 22**

21.a. **If yes**, which screening test for bowel cancer did you have? **(select all that apply)**

1. Home stool blood test
2. Barium enema
3. Sigmoidoscopy
4. Colonoscopy
5. Other: (Specify) _____

21.b. **If yes**, when did you last have a screening test for bowel cancer?
(please circle one response)

1. Within the last year.
2. Within the past 1-5 years.
3. Within the past 6-10 years.
4. More than 10 years ago.

The rest of the questions regarding bowel cancer screening have the same format with an answer from strongly agree to strongly disagree.

Please circle only one answer per question.

22. Bowel cancer screening makes sense to me. (Salience and coherence)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

23. I want to do what my family thinks I should do about bowel cancer screening. (Salience and coherence)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

24. Having bowel cancer screening is an important thing for me to do. (Salience and coherence)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

25. Having bowel cancer screening can help to protect my health. (Salience and coherence)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

Study #

Please circle only one answer per question.

26. I am afraid of having an abnormal bowel cancer screening test result. (Cancer worries)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

27. I will be just as healthy if I avoid having bowel cancer screening. (Response efficacy)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

28. Members of my immediate family think I should have bowel cancer screening. (Social influence)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

29. I am worried that bowel cancer screening will show that I have bowel cancer or polyps. (Cancer worries)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

30. My doctor thinks I should have bowel cancer screening. (Social influence)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

31. I want to do what my doctor thinks I should do about colorectal cancer screening. (Social influence)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

32. The chance that I might develop bowel cancer is high. (Susceptibility)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

33. Compared to other persons my age, I am at lower risk for bowel cancer. (Response efficacy)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

34. Screening tests for bowel cancer may be painful and dangerous. (Cancer worries)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

Study #

Please circle only one answer per question.

35. It is very likely that I will develop bowel cancer or pre-cancerous polyps. (Susceptibility)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

36. When polyps are found and removed, bowel cancer can be prevented. (Susceptibility)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

37. When bowel cancer is found early, it can be cured. (Susceptibilty)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

38. Screening tests for bowel cancer are embarrassing and messy. (Cancer worries)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

39. Screening tests for bowel cancer are not necessary as I do not have any problems. (Response efficacy)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

40. Screening tests for bowel cancer are worth the potential risk of the test. (Salience and coherence)

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

41. I would be interested in pursuing a screening test for bowel cancer.

(please select only one answer)

1. Yes
2. No

Thank you for your time. Please place the survey in the posted envelope provided and place in the mail.

Appendix E. Ethics Approval

FACULTY OF MEDICINE | UNIVERSITY OF CALGARY

February 1, 2007

OFFICE OF MEDICAL BIOETHICS
Room 93, Heritage Medical Research Bldg
3330 Hospital Drive NW
Calgary, AB, Canada T2N 4N1
Telephone: (403) 220-7990
Fax: (403) 283-8524
Email: omb@ucalgary.ca

Dr. L. Cook
Department of Community Health Sciences
University of Calgary
Calgary, Alberta

Dear Dr. Cook:

Re: Colorectal Cancer Screening Among First Degree Relatives of Colorectal Cancer Patients: Benefits and Barriers

Grant ID: 20453

Your request to modify the above-named research protocol has been reviewed and approved.

I am pleased to advise you that it is permissible for you to use the revised protocol based on the information contained in your correspondence of December 6, 2006.

A progress report concerning this study is required annually, from the date of the original approval 2006-10-19. The report should contain information concerning:

(i) the number of subjects recruited;
(ii) a description of any protocol modification;
(iii) any unusual and/or severe complications, adverse events or unanticipated problems involving risks to subjects or others, withdrawal of subjects from the research, or complaints about the research;
(iv) a summary of any recent literature, finding, or other relevant information, especially information about risks associated with the research;
(v) a copy of the current informed consent form;
(vi) the expected date of termination of this project;

Thank you for the attention which I know you will bring to these matters.

Yours sincerely,

Glenys Godlovitch, BA(Hons) LLB, PhD.
Chair, Conjoint Health Research Ethics Board
GG/eb

c.c. Adult Research Committee Dr. Lloyd Mack