CCSS Analysis Concept Proposal

May 7, 2012

STUDY TITLE: Predictors of Colorectal Cancer Surveillance Practices of Survivors of Childhood Cancer at Risk for Secondary Colorectal Malignancies

WORKING GROUPS AND INVESTIGATORS

Working groups: Cancer Control, Secondary Malignancy, Psychology

Investigators:

Connie Kohler, DrPH	ckohler@uab.edu	(205) 934-6020
Paul Nathan, MD, MSc	paul.nathan@sickkids.ca	(416) 813-8795
Wendy Leisenring, ScD	wleisenr@fhcrc.org	(206) 667-4374
Casey Daniel, MPH	cdaniel@uab.edu	(205) 934-6020
Greg Armstrong, MD	greg.armstrong@stjude.org	(901) 595-5892
David Hodgson, MD, MPH	david.hodgson@rmp.uhn.on.ca	(416) 946-4501 (ext.2126)
Alfred Bartolucci, PhD	albartol@uab.edu	(205) 934-4906
Kevin Krull, PhD	kevin.krull@stjude.org	(901) 595-5891
John Waterbor, DrPH, MD	h2obor@uab.edu	(205) 934-7146
Tara Henderson, MD, MPH	thenderson@peds.bsd.uchicago.edu	(773) 702-2501
Kim Whelan, MD, MSPH	kwhelan@peds.uab.edu	(205) 934-5263
Kevin C. Oeffinger, MD	oeffingk@mskcc.org	(646) 888-4730
Les L. Robison, PhD	Les.Robison@stjude.org	(901) 595-5817

BACKGROUND AND RATIONALE

Risk for Colorectal Cancer in Childhood Cancer Survivors

According to the National Cancer Institute (NCI), cancer is the leading cause of disease-related death among children ages 0-15 years in the United States. Although there has been some increase in the overall incidence of childhood cancer in the past thirty years, mortality rates for many of these cancers have decreased over 50 percent (NCI, 2010). Advancements in treatment have contributed to a current five year survival rate of approximately 80 percent. As the population of childhood cancer survivors continues to grow, there is an increasing need for continued follow-up care to meet the specific needs of childhood cancer survivors.

The various therapies used to treat childhood cancers can lead to late effects in these patients. Late effects refer to medical or psychosocial conditions that present or persist 5 years post-diagnosis (NCI, 2009). These late effects can include organ dysfunction (including endocrine abnormalities and cardiopulmonary dysfunction), musculoskeletal sequelae, neurocognitive problems, and secondary neoplasms (Kadan-Lottick et al., 2011; Landier & Bhatia, 2008). Among these late effects, secondary neoplasms are one of the greatest concerns, as almost 10 percent of survivors will develop a second malignancy within 30 years of their initial diagnosis (Meadows et al., 2009).

Studies of childhood cancer survivors have demonstrated that these individuals may have up to six times the risk of developing a second cancer compared to the risk of developing cancer in the general population, and this risk continues to increase with age (Bhatia, 2005; Oeffinger et al., 2006). Secondary cancers in this cohort vary based on primary diagnosis, previous treatment details, and individual genetic predispositions (Landier & Bhatia, 2008). There has been great attention in the literature to second malignancies of the breast and thyroid, as well as skin cancer, three of the most common secondary neoplasms of childhood cancer survivors. However, much less emphasis has been placed on the risk of secondary colorectal cancer in this population.

Childhood cancer survivors who received radiation doses equal to or greater than 30 Gy to the abdomen, pelvis, or spine are at a significantly higher risk of developing a secondary colorectal cancer compared to the general population, up to 3.9 to 4.7 times the risk observed in the general population (Bhatia et al., 2003; Jenkinson et al., 2004; Hodgson et al., 2007; Inskip & Curtis, 2007; Landier & Bhatia, 2008; Meadows et al., 2009). In a recent study using data from the British Childhood Cancer Survivor Study (BCCSS), investigators found that individuals whose initial treatment included direct abdominopelvic irradiation had 3.3 times the relative risk of developing a subsequent digestive primary neoplasm compared with survivors whose initial treatment did not include radiation (Reulen et al., 2011). This study concluded that survivors of childhood cancer who were treated with direct abdominopelvic radiation have a risk of developing a subsequent colorectal cancer similar to the risk of individuals with a strong family history of colorectal cancer (Reulen et al., 2011). 30 Gy is considered to be a moderately high dose of abdominal radiation. Pelvic, spinal, and/or abdominal radiation is typically used in conjunction with surgery and/or chemotherapy to treat many types of childhood cancer. These cancers include rhabdomyosarcomas in the abdomen or pelvis, neuroblastomas, Wilms tumors, and pearapinal Ewing sarcomas (NCI, 2010). In the work by Reulen et al., there were higher standardized incidence ratios (SIRs) for developing a subsequent digestive primary neoplasm in survivors of childhood Wilms tumors and heritable retinoblastoma (2011). Children and adolescents who were treated with these doses of radiation begin to have an increased risk of colorectal cancer about ten years after radiation treatment (Bhatia et al., 2003; Oeffinger, 2008). A recent study of the CCSS cohort by Henderson et al. found that the gastrointestinal malignancy risk was almost 5 times greater in survivors of childhood cancer than in the general population (Henderson et al., In press). Childhood cancer survivors who were treated with abdominal radiation, the risk increased 11-fold. Eighty percent of these malignancies occurred more than 24 years post-diagnosis of childhood cancer.

Surveillance for Colorectal Cancer in Childhood Cancer Survivors

The increased risk of secondary colorectal malignancies in this cohort emphasizes the importance of follow-up care and ongoing surveillance targeted at specific risks in survivors (Henderson, Friedman, & Meadows, 2010). By adhering to recommended screening guidelines, childhood cancer survivors may detect secondary colorectal cancer earlier. With earlier detection, treatment can be administered most effectively and thus may potentially reduce morbidity or mortality related to these neoplasms (Nathan et al., 2010; Skinner, Hamish, Wallace, & Levitt, 2007; Nathan et al., 2008; COG, 2008).

Colonoscopy is a commonly recommended cancer screening test for colorectal cancer. Colonoscopies are used to screen the rectum and colon for cancer, polyps, nonpolypoid lesions, and other conditions (Salz et al., 2009; “Colorectal Cancer Screening”, 2008). There are other tests that can be used to screen for these issues, such as sigmoidoscopy, fecal occult blood testing, and double contrast barium enemas. However, colonoscopy is currently considered the gold standard of colorectal cancer screening tests (USPSTF, 2008; “Colorectal Cancer Screening”, 2008). Colonoscopies use an instrument called a colonoscope to view the entire colon and check for abnormalities as well as to remove or biopsy abnormal growths. There is current evidence that colonoscopy screening detects cancer in early stages (USPSTF, 2008). For the general population, colonoscopies have been recommended every 10 years for men and women beginning at age 50 (Salz et al., 2009; “Colorectal Cancer and Polyps”, 2011). More recent recommendations for individuals at average risk for colorectal cancer include: fecal occult blood testing, sigmoidoscopy, or colonoscopy every five years beginning at age 50 (USPSTF, 2008; ACS 2011). For those with a personal or family history of colorectal cancer or polyps, as well as those who have been exposed to radiation to the spine, pelvis, or abdomen (particularly in childhood), there are recommendations for more frequent screening. There is currently limited information detailing colorectal cancer screening practices of childhood cancer survivors at high risk.

The Children’s Oncology Group (COG) has developed comprehensive surveillance guidelines for the long-term follow-up care of childhood cancer survivors based on risk and exposures. For children and adolescents who were treated with radiation therapy to the abdomen, pelvis, or spine at doses of 30 Gy or more, COG recommends a colonoscopy every five years, beginning at age 35 or 10 years after completion of radiation (whichever occurs last) (Oeffinger, 2008). This is a marked difference from the recommended colorectal screening guidelines for the general population: fecal occult blood testing, sigmoidoscopy, or colonoscopy every five years beginning at age 50 (USPSTF, 2008; ACS 2011). However, there is currently limited information detailing colorectal cancer screening practices of childhood cancer survivors at high risk.

A study by the CCSS found that among survivors at increased risk for developing colorectal cancer, only 91/794 (11.5%) patients reported undergoing a colonoscopy within the recommended period (Nathan et al., 2010). While some literature suggests that adult survivors of childhood cancer demonstrate greater cancer screening adherence than the general population (Trask et al., 2005), the screening rates among these survivors vary and are often less than desired, with researchers finding in one recent study that “less than half of survivors at increased risk of breast, colorectal, or skin cancer reported compliance with recommended surveillance” (Nathan et al., 2010). Given that early detection of colorectal malignancies through participation in screening can lead to vastly improved long-term health outcomes, understanding variables that predict and influence screening participation is extremely important in promoting this health behavior among high-risk individuals. In the 2010 study by Nathan et al., investigators explored various predictors of colorectal cancer surveillance. They determined that older age at interview, survivor possession of a treatment summary, and a medical visit related to their childhood cancer within the previous two years were associated with increased likelihood of reporting colonoscopy.

In this study, we propose to build on previous CCSS studies examining secondary colorectal cancer surveillance behaviors, measured by questionnaire items C3 and C4 from the 2007 follow up survey (FU2007) which respectively ask the last time that the subject took a blood stool test and the last time that he / she had a sigmoidoscopy or colonoscopy. We will analyze these two items separately to account for factors that may contribute to participation in one type of screening or the other. For instance, because a blood stool test does not require the thorough bowel cleansing and preparation that a colonoscopy does, participants might be more likely to perform a blood stool test rather than the much more invasive colonoscopy. In research exploring the screening methods of patients, Cai et al. (2009) determined that financial issues, fear of pain and bowel preparation, lack of time, and poor awareness of risk factors and importance were associated with lower colonoscopy attendance. Authors concluded that blood stool testing is less expensive and more convenient than colonoscopy or sigmoidoscopy and thus that it is generally more acceptable than the other, more invasive screenings (Cai et al., 2009). In a different study examining community-based preferences for colorectal cancer screening, DeBourcy et al. found that when patients who did not receive a recommendation for one test over the other and were given detailed information about each test, at least 40% of participants preferred blood stool testing over colonoscopy (2007). The COG recommends colonoscopy but not blood stool testing for CRC screening which may incline survivors of childhood cancer to follow the guideline explicitly, participating only in colonoscopy. Thus, certain factors may be associated differentially with each method of testing and these associations will be explored separately for each method of screening.

Based on prior evidence, we hypothesize that several factors will be associated with colorectal cancer screening in this population. We propose that individuals in this population with “negative health perceptions” will be less likely to adhere to colorectal cancer screening. These negative health perceptions are estimated by individuals’ responses to survey questions that indicate: low fear and anxiety related to their cancer diagnosis, low concern for future health, low concern about developing a future cancer, report of physical impairment, and high levels of self-reported general health. Low fear and anxiety related to previous diagnosis is likely associated with decreased screening participation because survivors’ do not express particular concern about the occurrence of a subsequent cancer. Reporting low concern for future health, low concern about developing a future cancer, and high self-reported general health likely indicate that the participant is unaware of or does not feel susceptible to subsequent negative outcomes resulting from his/her initial cancer, and therefore is less likely to participate in ongoing screening (because it does not seem necessary or relevant to the individual). Self-reported physical impairment is also likely associated with decreased adherence to screening because of perceived and/or actual physical limitations that serve as barriers to attending follow-up screening.

We also hypothesize that “insufficient personal health care practices” will be associated with decreased colorectal cancer screening in this population. Insufficient personal health care practices will be reflected by individuals’ responses to survey questions indicating: no recent follow-up care related to childhood cancer diagnosis/treatment, infrequent follow-up care visits, not attending recent follow-up care at a cancer center, and not having a follow-up care visit planned in the near future. Each of these factors indicates that the survivor is not engaged in the health care system to the desired extent regarding his/her childhood cancer diagnosis and/or treatment. Therefore, if the survivor is disconnected from relevant follow-up care, he/she is less likely to adhere to recommended follow-up screening.

An additional hypothesis is that survivors who “lack prompts for screening” for ongoing surveillance will be less likely to participate in colorectal cancer screening. These will be determined by survivors’ survey responses indicating: not having discussed subsequent cancer risk with health care providers, hot have screening tests recommended or ordered by health care providers, and being told by health care providers that he/she had nothing to worry about. Cues to screening, such as receiving a physician recommendation, are the most significant positive influence on individuals' screening practices, often due to considerable trust in health care providers. Therefore, survivors who have not received cues are less likely to think such ongoing surveillance is necessary (because, if it was, their physician would have told them so).

The primary aim of this study is to determine potential predictors of colorectal cancer screening among high risk members of this population. The findings of this study can guide future interventions to increase colorectal cancer screening participation in this population. Knowing and understanding what factors are most influential in colorectal cancer screening for high risk survivors will greatly assist in structuring more targeted, and thus more effective, interventions, leading to improved long-term outcomes for these individuals.

AIMS AND HYPOTHESES

Primary Aims and Objectives:

1. Determine the **prevalence of colorectal cancer surveillance** by self-reported colonoscopy, sigmoidoscopy, or home blood stool test of adult survivors of childhood cancer at high risk for secondary colorectal cancer (i.e. were treated with 30 or more Gy radiation to the abdomen, pelvis, and/or spine).

2. Identify **predictors of colorectal cancer surveillance** (as measured in FU2007 as **performing a home blood stool test**) in adult survivors of childhood cancer at high risk for secondary colorectal cancer.

3. Identify **predictors of colorectal cancer screening** (as measured in FU2007 as **receiving a colonoscopy *or* sigmoidoscopy**) in adult survivors of childhood cancer at high risk for secondary colorectal cancer.

Secondary Aim:

1. Based on the significant predictors found for each of the two outcomes from Aim 2 and Aim 3, compare and contrast predictors of colorectal cancer screening by colonoscopy/sigmoidoscopy with predictors of colorectal cancer screening by home stool testing.

Hypotheses:

1. The self-reported prevalence of colorectal cancer screening by colonoscopy, sigmoidoscopy, or home blood stool test of adult survivors of childhood cancer at high risk for secondary colorectal cancer (i.e. were treated with ≥30 Gy radiation to the abdomen, pelvis, and/or spine) will not exceed the prevalence of colorectal cancer screening in the general population.

2. Negative personal health perceptions (including: low self-reported fear and anxiety related to cancer diagnosis, low concern for future health, low concern about developing a future cancer, self-report of physical impairment, and low levels of self-reported general health) will be negatively associated with subsequent colorectal cancer screening

in adult survivors of childhood cancer at high risk of developing a subsequent colorectal cancer.

3. Insufficient personal health care practices (including: not attending recent follow-up care related to childhood cancer diagnosis/treatment, infrequent follow-up care visits, not attending recent follow-up care at a cancer center, and not planning a follow-up care visit in the near future) will be negatively associated with subsequent colorectal cancer screening in adult survivors of childhood cancer at high risk of developing a subsequent colorectal cancer.

4. Lack prompts for screening such as: discussing subsequent cancer risk with health care providers, physicians not ordering/recommending screening tests for high-risk survivors, and being told by a physician that the survivor had nothing to worry about will be negatively associated with subsequent colorectal cancer screening in adult survivors of childhood cancer at high risk of developing a subsequent colorectal cancer.

5. Adult survivors of childhood cancer at high risk for developing a subsequent colorectal cancer will be more likely to participate in fecal occult blood testing than in colonoscopy/sigmoidoscopy to screen for subsequent colorectal cancer.

ANALYSIS FRAMEWORK

Subject Population and Inclusion Criteria:

Adult survivors of childhood cancer who completed the 2007 CCSS follow-up survey, and at the time of completion, met the COG colorectal screening criteria for high risk survivors: survivors who received ≥30 Gy of radiation therapy to the abdomen, pelvis or spine and were 36 years old or older at the time of the questionnaire (allowing for a full year for eligible participants to have screening after reaching age 35).

Outcomes of Interest (FU2007)

1. Last time had blood stool test using home kit (C3)
    a. Never
    b. Less than 1 year ago
    c. 1-2 years ago
    d. More than 2 years but less than 5 years ago
    e. Don’t know
2. Last time had colonoscopy or sigmoidoscopy (C4)
    a. Never
    b. Less than 1 year ago
    c. 1-2 years ago
    d. More than 2 years but less than 5 years ago
    e. Don’t know

The distributions of each of the above outcomes will be presented as frequencies for all five response options. For the univariate and multivariable analyses, response options for each outcome measure will be collapsed to form dichotomous outcomes (described in more detail below).

Exposures of Interest (FU2007):

1. Survivors' personal health perceptions:
    a. Self-reported general health status (Excellent/very good, Good/fair, Poor—L19 FU2007)
    b. Current anxieties/fears related to childhood cancer or treatment (No/small amount of anxiety/fears, Medium amount of anxiety/fears, A lot of/very many anxiety/fears—L20 FU2007)
    c. Concern about future health (Not at all/not very concerned, Somewhat concerned/Concerned, Very concerned—O1 FU2007)
    d. Concern about developing subsequent cancer (Not at all/not very concerned, Somewhat concerned/Concerned, Very concerned—O3 FU2007)

2. Survivors' health care practices:
    a. Where survivor received health care in two years prior to survey (Oncology center or clinic/long-term follow-up clinic, Other (doctor's office/other type of clinic/hospital/emergency room or urgent care/no care)—B2 FU2007)
    b. Number of times survivor saw a physician in two years prior to survey (None, 1-10 times, 11-20 times, >20 times—B3 FU2007)
    c. Number of physician visits related to childhood cancer/treatment in two years prior to survey (None, 1-10 visits, 11-20 visits, >20 visits—B4 FU2007)
    d. Most recent routine check-up related to childhood cancer/treatment (Never, Within past 2 years, 2-5 years ago, ≥ 5 years ago—B6 FU2007)
    e. Next planned visit to doctor related to childhood cancer/treatment (Never, Within next 2 years, Within next 3-4 years, ≥ 5 years—B8 FU2007)

3. Prompts for screening:
    a. Discussion with health care provider about risk of developing cancer at any follow-up visit(s) in two years prior to survey (Yes/No—B5c FU2007)
    b. Health care provider discussed/ordered medical screening tests at most recent follow-up visit (Yes/No—B7b FU2007)
    c. Health care provider told survivor that he/she had nothing to worry about based on findings at the most recent follow-up visit (Yes/No—B7e FU2007)

Potential Covariates

1. Date of birth (A1 Baseline)
2. Sex (A2 Baseline)
3. Race/ethnicity (White/Non-white—A4 Baseline, White/Non-white)
4. Age at cancer diagnosis (0-4 years, 5-9 years, 10-14 years, 15 years and older—calculated by subtracting date of birth from date of diagnosis from medical record abstraction)
5. Cancer diagnosis (Leukemia, Central Nervous System, Hodgkin's, Non-Hodgkin's lymphoma, Wilm's tumor, Neuroblastoma, Soft tissue sarcoma, Bone cancer—medical record abstraction)
6. Part of body irradiated (Abdomen (Y/N), Pelvis (Y/N), Spine (Y/N), Total body irradiation (Y/N)—medical record abstraction)
7. Maximum radiation dosage to any of the above organs (30-40 Gy, 41-50 Gy, 51-60 Gy, ≥ 61 Gy—medical record abstraction)
8. Highest level of educational attainment (Did not graduate high school, High school graduate/equivalent, College graduate—A3 FU2007)
9. Employment status (Working full-time, Working part-time, Caring for home or family, Unemployed, Unable to work, Student—A4 FU2007)
10. Annual household income (< $40000, $40000 - $80000, >$80,000, Unknown—A6 FU2007)
11. Insurance coverage (Yes or Canadian resident/No—B9 FU2007)
12. Marital status (Single, Married/living as married, Separated/Divorced/Widowed—M2 FU 2007)
13. Driver's license (Yes/No—N25 FU 2007)
14. Physical impairment impeding routine needs (Yes/No—N23 FU2007)

Statistics:

The unit of measurement for this study will be self-report of participation in (1) colonoscopy/sigmoidoscopy and (2) home blood stool test. For data analysis, the response options for each outcome measure will be collapsed to create dichotomous items according to the criteria below.

The national blood stool testing recommendation for the general population is to perform it annually. Therefore, the response options of survey item C3, inquiring about the most recent blood stool test the participant performed, will be dichotomized into: (1) Survivor **reports** performing/engaging in blood stool testing in the past year, or (2) Survivor **does not report** performing/engaging in blood stool testing in the past year.

The second outcome of interest is drawn from survey item C4, inquiring about the participant's most recent colonoscopy or sigmoidoscopy. Even for individuals at high risk of developing colorectal cancer (such as the study population), recommendations for colonoscopy and sigmoidoscopy screening are less frequent than those for blood stool testing. For survey participants who report engaging in this form of screening, there is not a way to distinguish *which* screening method participants underwent from the available data. Therefore, this outcome measure will be dichotomized into the following categories: (1) Survivor reports undergoing sigmoidoscopy or colonoscopy within the past five years, or (2) Survivor does not report undergoing sigmoidoscopy or colonoscopy within the past five years.

Although, for the multivariable analyses, survivors will be dichotomized into two categories, we recognize that there are potentially significant differences between survivors' who have never engaged in recommended surveillance and those who have not participated in surveillance recently. However, for the purpose of this project as a preliminary study we will analyze individuals in the dichotomized groups detailed above. We will also include information regarding survivors who underwent surveillance but outside of the designated time frame. Future research is intended to focus on more detailed analyses of each category of survivor colorectal cancer surveillance.

Descriptive Statistics:

The distribution of demographic and medical characteristics (listed above under "Potential Covariates") of the study population as reported in FU2007 will be presented as descriptive statistics (Table 1). Continuous variables will potentially be categorized based on their distributions, clinical relevance, and fit of the model.

Univariate Analysis:

We will perform univariate logistic regression to determine the strength of association between the dichotomized outcome variables:

(1) Self-reported blood stool testing and

- Demographic and medical factors
- *Survivors' personal health perceptions*
- *Survivors' health care practices*
- *Cues to screening*

(2) Self-reported sigmoidoscopy or colonoscopy and

- Demographic and medical factors
- *Survivors' personal health perceptions*
- *Survivors' health care practices*
- *Cues to screening*

These analyses, will estimate odds ratios (OR), corresponding 95% confidence intervals (CI), and p-values for each potential covariate.

Multivariable Analysis:

For each outcome, an initial model will be constructed containing those factors that demonstrate statistically significant univariable associations with the outcome variables (determined by a p-value < 0.10). Factors will be removed from the full multivariable model if their p-value is > 0.10 and if their exclusion does not markedly modify other important factors in the model. We will assess three different multivariable models for each of the two outcome variables:

- Significant *Survivors' personal health perceptions* and significant demographic and clinical cofactors
- Significant *Survivors' health care practices* and significant demographic and clinical cofactors
- Significant *Cues to screening* and significant demographic and clinical cofactors

These models will estimate adjusted odds ratios (OR), corresponding 95% confidence intervals (CI), and p-values (Tables 3+).

Examples of Tables and Figures

Figure 1 will be a flow chart depicting individuals at each stage of CCSS cohort development.

Table1. Demographic and medical data from the 2007 Follow-Up Survey of participants in the Childhood Cancer Survivor Study who received ≥30 Gy radiation to the abdomen, pelvis, and/or spine

	Survivors (n=)	
Characteristic	**N**	**%**
Sex		
Male		
Female		
Current age		
< 18 years		
18-24 years		
25-34 years		
35+ years		
Race		
White, Non-Hispanic		
Non-white		
Childhood cancer diagnosis		
Leukemia		
CNS tumor		
Hodgkin’s lymphoma		
Non-Hodgkin’s lymphoma		
Wilm’s tumor		
Neuroblastoma		
Soft tissue sarcoma		
Bone cancer		
Age at diagnosis		
0-4 years		
5-9 years		
10-14 years		
15 years or older		
Radiation site		
Abdomen		
Pelvis		
Spine		
Total Body Irradiation		
Maximum radiation dosage to any of the above organs		
30-40 Gy		
41-50 Gy		
51-60 Gy		
≥ 61 Gy		
Highest level of schooling completed (A3)		
Did not graduate high school		
Graduated high school/equivalent		
Graduated college		

Current employment status (A4)
Working full-time
Working part-time
Caring for home or family
Unemployed
Unable to work
Student

Household income for last year (A6)
< $40,000
$40,000 - $80,000
> $80,000
Unknown

Marital status (M2)
Single
Married/Living as married
Separated/Divorced/Widowed

Health insurance coverage (B9)
Yes/Canadian resident
No

Has driver's license (N25)
Yes
No

Physical impairments impeding routine needs (N23)
Yes
No

*****will indicate a statistically significant association of $p \leq 0.05$*

Table 2. Counts and percentages of receiving either form of colorectal cancer screening versus neither form and of performing blood stool test versus sigmoidoscopy/colonoscopy by demographic and outcome variables

	No screening (n=) *v* **Either type of screening (n=)**		**Blood stool testing (n=)** *v* **Sigmoidoscopy or colonoscopy (n=)**	
	N	**(%)**	**N**	**(%)**
Characteristic				
Sex				
Male				
Female				
Current age				
< 18 years				
18-24 years				
25-34 years				
35+ years				
Race				
White, Non-Hispanic				
Non-white				
Childhood cancer diagnosis				
Leukemia				
CNS tumor				
Hodgkin’s lymphoma				
Non-Hodgkin’s lymphoma				
Wilm’s tumor				
Neuroblastoma				
Soft tissue sarcoma				
Bone cancer				
Age at diagnosis				
0-4 years				
5-9 years				
10-14 years				
15 years or older				
Radiation site				
Abdomen				
Pelvis				
Spine				
Total Body Irradiation				
Maximum radiation dosage to any above organ				
30-40 Gy				
41-50 Gy				
51-60 Gy				
≥ 61 Gy				
Highest level of schooling completed (A3)				
Did not graduate high school				
Graduated high school/equivalent				
Graduated college				

Current employment status (A4)
Working full-time
Working part-time
Caring for home or family
Unemployed
Unable to work
Student

Household income for last year (A6)
< $40,000
$40,000 - $80,000
> $80,000
Unknown

Marital status (M2)
Single
Married/Living as married
Separated/Divorced/Widowed

Health insurance coverage (B9)
Yes/Canadian resident
No

Has driver's license (N25)
Yes
No

Physical impairments impeding routine needs (N23)
Yes
No

*****_will indicate a statistically significant association of_ $p \leq 0.05$

Example Table 3. Personal health perceptions, health care practices, and cues to screening as predictors of colorectal cancer screening by **blood stool testing** or **sigmoidoscopy/colonoscopy** of participants in the Childhood Cancer Survivor Study (by sigmoidoscopy or colonoscopy) who received ≥30 Gy radiation to the abdomen, pelvis, and/or spine

	No screening (n=) *v* Either type of screening (n=)		**Blood stool testing (n=) *v* Sigmoidoscopy or colonoscopy (n=)**	
	OR	**95% CI**	**OR**	**95% CI**
Characteristic				
Where participant received health care in past 2 years (B2)				
Oncology/Long-term follow-up clinic				
Other				
Number of times saw a physician in past 2 years (B3)				
None				
1-10 times				
11-20 times				
> 20 times				
Number of these visits related to childhood cancer (B4)				
None				
1-10 visits				
11-20 visits				
> 20 visits				
Discussed risk of developing cancer with physician at any visits related to primary diagnosis/treatment (B5c)				
Yes				
No				
Most recent routine check-up where doctor tested for health problems from initial cancer or treatment (B6)				
Never				
In past 2 years				
2-5 years ago				
≥ 5 years ago				
Doctor discussed or ordered medical screening tests at most recent routine visit (B7b)				
Yes				
No				
At most recent routine visit, survivor told by physician he/she hse nothing to worry about based on findings at the check-up (B7e)				
Yes				
No				

When survivor plans to have next cancer follow-up visit (B8)
- Never
- Within next 2 years
- Within next 3-4 years
- ≥ 5 years

Survivor currently has health insurance (B9)
- Yes/Canadian resident
- No

Self-reported general health status (L19)
- Excellent/Very good
- Good/Fair
- Poor

Current anxieties/fears resulting from cancer or treatment (L20)
- No/Small amount of anxiety/fears
- Medium amount of anxiety/fears
- A lot of/Many anxiety/fears

Current marital status (M2)
- Single
- Married/Living with partner as married
- Separated, Divorced, or Widowed

Participant needs help with routine activities due to physical impairment (N23)
- Yes
- No

Currently has driver's license (N25)
- Yes
- No

Concern about future health (O1)
- Not at all/Not very concerned
- Somewhat concerned/Concerned
- Very concerned

Concern about developing a cancer (O3)
- Not at all/Not very concerned
- Somewhat concerned/Concerned
- Very concerned

*****_will indicate a statistically significant association of_ $p \leq 0.05$

Special Consideration: None.

Literature Cited

American Cancer Society (2011). Colorectal cancer early detection. Retrieved from http://www.cancer.org/Cancer/ColonandRectumCancer/MoreInformation/ColonandRectumCancerEarlyDetection/colorectal-cancer-early-detection-toc

Bhatia, S. (2005). Cancer survivorship—pediatric issues. *Hematology*.

Bhatia, S., Yasui, Y., Robison, L. L., Birch, J. M., Bogue, M. K., Diller, L., et al. (2003). High risk of subsequent neoplasms continues with extended follow-up of childhood Hodgkin's disease: report from the Late Effects Study Group. *Journal of Clinical Oncology, 21*(23), 4386-4394.

Cai, S., Zhang, S., Zhu, H., & Zheng, S. (2009). Barriers to colorectal cancer screening: A case-control study. *World Journal of Gastroenterology, 15*(20), 2531-2536.

Castellino, S. M., Casillas, J., Hudson, M. M., Mertens, A. C., Whitton, J., Brooks, S. L., … & Oeffinger, K. C. (2005). Minority adult survivors of childhood cancer: A comparison of long-term outcomes, health care utilization, and health-related behaviors from the Childhood Cancer Survivor Study. *Journal of Clinical Oncology, 23*(27), 6499-6507.

Childhood Cancer Survivor Study. (2011). About the Childhood Cancer Survivor Study. Retrieved from http://ccss.stjude.org/about/learn-more

Cox, C. C. (2003). A model of health behavior to guide studies of childhood cancer survivors. *Oncology Nursing Forum, 30*(5), E92-E99.

Cox, C. C., Hudson, M. M., Mertens, A., Oeffinger, K., Whitton, J., Montgomery, M., & Robison, L. L. (2009a). Medical screening participation among childhood cancer survivors. *Archives of Internal Medicine, 169*(5), 454-462.

Cox, C. L., Oeffinger, K., Montgomery, M., Hudson, M. M., Leisenring, W., Whitton, J., & Robison, L. L. (2009b). Determinants of mammography screening participation in adult childhood cancer survivors: Results from the Childhood Cancer Survivor Study. *Oncology Nursing Forum, 36*(3), 335-344.

DeBourcy, A. C., Lichtenberger, S., Felton, S., Butterfield, K. T., Ahnen, D. J., & Denberg, T. D. (2007). Community-based preferences for stool cards versus colonoscopy in colorectal cancer screening. *Journal of General Internal Medicine, 23*(2), 169-174.

Henderson, T. O., Hlublocky, F. J., Wroblewski, K. E., Diller, L., & Daugherty, C. K. (2009). Physician preferences and knowledge gaps regarding the care of childhood cancer survivors: A mailed survey of pediatric oncologists. *Journal of Clinical Oncology, 28*(5), 878-883.

Henderson, T. O., Friedman, D. L., & Meadows, A. T. (2010). Childhood cancer survivors: Transition to adult-focused risk-based care. *Pediatrics, 126*(1), 129-136.

Henderson, T. O., Oeffinger, K. C., Whitton, J., Leisenring, W., Neglia, J., Meadows, A., …& Nathan, P. …. (in press). Secondary gastrointestinal malignancies in childhood cancer survivors: A cohort study. *Annals of Internal Medicine*.

Hodgson, D. C., Gilbert, E. S., Dores, G. M., Schonfeld, S. J., Lynch, C. F., Storm, H. et al. (2007). Long-term solid cancer risk among 5-year survivors of Hodgkin's lymphoma. *Journal of Clinical Oncology, 25*(12), 1489-1497.

Inskip, P. D. & Curtis, R. E. (2007). New malignancies following childhood cancer in the United States, 1973-2002. *International Journal of Cancer, 121*(10), 2233-2240.

Jenkinson, H. C., Hawkins, M. M., Stiller, C. A., Winter, D. L., Marsden, H. B., & Stevens, M. C. (2004). Long-term population-based risks of second malignant neoplasms after childhood cancer in Britain. *British Journal of Cancer, 91*(11), 1905-1910.

Kadan-Lottick, N., Robison, L., Gurney, J., Neglia, J., Yasuri, Y., Hayashi, R. et al. (2002). Childhood cancer survivors' knowledge about their past diagnosis and treatment. *JAMA, 287*(14), 1832-1839.

Klosky, J. L., Cash, D. K., Buscemi, J., Lensing, S., Garces-Webb, D. M., Zhao, W., Wiard, S., & Hudson, M. M. (2008). Factors influencing long-term follow-up clinic attendance among survivors of childhood cancer. *Journal of Cancer Survivorship, 2*(4), 225-232.

Landier, W. & Bhatia, S. (2008). Cancer survivorship: A pediatric perspective. *Oncologist, 13*(11), 1181-1192.

Meadows, A. T., Friedman, D. L., Neglia, J. P., Mertens, A. C., Donaldson, S. S., Stovall, M., et al. (2009). Second neoplasms in survivors of childhood cancer: Findings from the Childhood Cancer Survivor Study cohort. *Journal of Clinical Oncology, 7*(14), 2356-2362.

Nathan, P., Greenberg, M., Ness, K., Hudson, M., Mertens, A., Mahoney, M. et al. (2008). Medical care in long-term survivors of childhood cancer: A report from the Childhood Cancer Survivor Study. *Journal of Clinical Oncology, 26*(27), 4401-4409.

Nathan, P., Ness, K., Mahoney, C., Li, Z., Hudson, M., Ford, J. (2010). Screening and surveillance for second malignant neoplasms in adult survivors of childhood cancer: A report from the Childhood Cancer Survivor Study. *Annals of Internal Medicine, 153*(7), 442-451.

National Cancer Institute. (August 2009). General information about late effects. Retrieved from http://www.cancer.gov/cancertopics/pdq/treatment/lateeffects/patient

National Cancer Institute (September 2010). A snapshot of pediatric cancers. Retrieved from http://www.cancer.gov/aboutnci/servingpeople/snapshots/pediatric.pdf

Oeffinger, K. C., Mertens, A. C., Hudson, M. M., Gurney, J. G., Casillas, J., Chen, H., Whitton, J., Yeazel, M., Yasui, Y., & Robison, L. L. (2004). Health care of young adult survivors of childhood cancer: A report from the Childhood Cancer Survivor Study. *Annals of Family Medicine, 2*(1), 61-70.

Oeffinger, K. C., Mertens, A. C., Sklar, C. A., et al. (2006). Chronic health conditions in adult survivors of childhood cancer. *New England Journal of Medicine, 355*, 1572-1582.

Oeffinger, K. (October 2008). Colorectal cancer following treatment for childhood cancer: Are you at risk? Retrieved from http://www.survivorshipguidelines.org/pdf/ColorectalCancer.pdf

Oeffinger, K. C., Ford, J. S., Moskowitz, C. S., Diller, L. R., Hudson, M. M., Chou, J. F., Smith, S. M., Mertens, A. C., Henderson, T. O., Friedman, D. L., Leisenring, W. M., & Robison, L. L. (2009). Breast cancer surveillance practices among women previously treated with chest radiation for a childhood cancer. *JAMA, 301*(4), 404-414.

Park, E. R., Frederick, P. L., Liu, Y., Emmons, K. M., Ablin, A., Robison, L. L., & Mertens, A. C. (2005). Health insurance coverage in survivors of childhood cancer: The Childhood Cancer Survivor Study. *Journal of Clinical Oncology, 23*(36), 9187-9197.

Sheen, V., Tucker, M. A., Abramson, D. H., Seddon, J. M., & Kleinerman, R. A. (2008). Cancer screening practices of adult survivors of retinoblastoma at risk of second cancers. *Cancer, 113*(2), 434-441.

Skinner, R., Hamish, W., Wallace, B., & Levitt, G. (2007). Long-term follow-up of children treated for cancer: Why is it necessary, by whom, where and how? *Arch Dis Child, 92*, 257-260.

Smith, S. M., Ford, J. S., Rakowski, W., Moskowitz, C. S., Diller, L., Hudson, M. M., … & Oeffinger, K. C. (2010). Inconsistent mammography perceptions and practices among women at risk of breast cancer following a pediatric malignancy: A report from the Childhood Cancer Survivor Study. *Cancer Causes and Control, 21*(10), 1585-1595.

Trask, P. C., Rabin, C., Rogers, M. L., Whiteley, J., Nash, J., Frierson, G. et al. (2006). Cancer screening practices among cancer survivors. *American Journal of Preventive Medicine, 28*(4), 351-356.

Yeazel, M. W., Oeffinger, K. C., Gurney, J. G., Mertens, A. C., Hudson, M. M., Emmons, K. M., Chen, H., & Robison, L. L. (2003). The cancer screening practices of adult survivors of childhood cancer: A report from the Childhood Cancer Survivor Study. *Cancer, 100*(3), 631-640.