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Preferences for Outcomes Associated with Decisions to Undergo or Forego Genetic Testing for Lynch Syndrome

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Abstract

Background—Current guidelines recommend offering genetic testing for Lynch syndrome to individuals whose tumors suggest this condition and to relatives of affected individuals. Little is known, however, regarding how patients view the prospect of such testing. In addition, data on preferences (utilities) for the potential outcomes of testing decisions for use in cost-effectiveness analyses are lacking.

Methods—We elicited time tradeoff utilities for ten potential outcomes of Lynch syndrome testing decisions and three associated cancers from 70 participants representing a range of knowledge about and experiences with Lynch syndrome.

Results—Highest mean utilities were assigned to scenarios in which only the assessor's sibling had Lynch-associated colorectal cancer (ranging from 0.669±0.231 to 0.760±0.220). Utilities assigned to scenarios in which the assessor had Lynch-associated colorectal cancer ranged from 0.605±0.252 to 0.682±0.246, while the lowest mean utilities were assigned to 2 of the general cancer states (0.601±0.238 and 0.593±0.272 for colorectal and ovarian cancer respectively). Only 43% of the sample assigned higher values to undergoing Lynch testing and receiving negative results versus foregoing Lynch testing, while 50% assigned higher values to undergoing rather than foregoing surgery to prevent a subsequent cancer.

Conclusions—Genetic testing for Lynch syndrome, regardless of results, can have profound effects on quality of life; the utilities we collected can be used to incorporate these effects into cost-effectiveness analyses. Importantly, preferences for the potential outcomes of testing vary substantially, calling into question the extent to which patients would avail themselves of such testing if it were offered to them.

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Keywords

Lynch syndrome; hereditary nonpolyposis colorectal cancer; genetic testing; quality of life; utilities; decision making

Introduction

Lynch syndrome, previously known as hereditary nonpolyposis colorectal cancer (HNPCC), is an inherited condition that is associated with an increased risk for colorectal, endometrial, ovarian, and numerous other cancers.[1] Mutations in the mismatch repair genes *MLH1*, *MSH2*, *MSH6*, and *PMS2* are the molecular basis of Lynch syndrome, and genetic testing can identify cancer risk-conferring mutations in them.[2] Current guidelines recommend offering genetic testing for Lynch syndrome to individuals who fulfill specific clinical criteria, whose tumors show features suggestive of Lynch syndrome, or who have relatives with Lynch syndrome.[3] These guidelines further recommend that all individuals who test positive should undergo increased surveillance with colonoscopy every 1-2 years starting at age 20 to 25, and that women should be offered annual endometrial biopsy and transvaginal ultrasound starting at age 30 to 35 to screen for cancers of the uterus and ovary, respectively.[4, 5] In addition, women with Lynch syndrome, regardless of whether they have had colorectal cancer, may consider undergoing risk-reducing total abdominal hysterectomy and bilateral salpingo-oopherectomy (TAH/BSO).[6] Among both men and women with Lynch syndrome who are diagnosed with colon cancer, subtotal colectomy is an option to reduce their risk of a subsequent colon cancer.[7]

Deciding whether to undergo genetic testing for Lynch syndrome can be complicated for individuals who have a cancer that is suspected to be a manifestation of Lynch syndrome. Identifying a mutation in a mismatch repair gene can lead to preventive interventions, for example, but also can be associated with increased anxiety about developing other cancers and the need to make difficult decisions regarding whether to undergo risk-reducing surgeries. Moreover, cancer patients who test positive for Lynch syndrome (probands) face decisions regarding whether and how to inform blood relatives about their test results so that these relatives also can consider whether or not to undergo Lynch syndrome testing. So in addition to the clinical benefits that can accrue as a result of knowing one has, or does not have, Lynch syndrome, the outcomes of decisions to undergo – or forego – testing can have profound impacts on health-related quality of life.[8-12]

While cost-effectiveness analyses of genetic testing for Lynch syndrome have assessed its potential impact on the incidence of, and mortality associated with, colorectal and other Lynch-related cancers,[13-15] the health-related quality-of-life consequences of decisions to undergo or forego testing and risk-reducing surgeries have not been incorporated into these analyses. To do so requires quantifying how people value the potential outcomes of accepting or declining these interventions. We sought to measure patient preferences (utilities) for scenarios entailing differing decisions regarding test use and risk-reducing surgeries and their associated outcomes among a group of individuals with a wide range of familiarity and experience with Lynch syndrome testing. Our objectives were to gain an

understanding of how preferences vary in this context, and to provide utility measurements for use in cost-utility analyses.

Methods

Participant recruitment

Study participants were recruited from two UCSF clinics: the General Medical Clinic (our source of patients who were not particularly knowledgeable about or at high risk for Lynch syndrome), and the Gastrointestinal Cancer Prevention Program (our source of patients who were knowledgeable about and at high risk for Lynch syndrome). To recruit general medical patients, we sent letters to primary care physicians with “opt in” cards for them to mail back if they were willing to have their appointment schedules reviewed to identify potentially eligible participants. These lists were given to the physicians who returned the cards to enable them to remove individuals whom they did not feel should be contacted. The study interviewer (SW) then sent letters and stamped opt-in/opt-out postcards to all of the remaining individuals on the list. The letters informed the patients that they should return the postcard indicating whether or not they were interested in being contacted about the study, and that if they did not return the postcard, they might be called by a UCSF research associate to elicit their interest in participating in the study. The study interviewer first called all the individuals who returned cards with “opt in” checked off, and then proceeded to contact those who did not return the cards. The study interviewer then arranged face-to-face interviews with all interested participants.

To recruit participants from the Gastrointestinal Cancer Prevention Program, one of two genetic counselors (AB or PC) contacted individuals who had undergone genetic risk assessment and counseling for Lynch syndrome as part of routine clinical care, and had previously consented to be contacted about opportunities to participate in research. These patients were telephoned and provided with basic information about the study. Patients who agreed to be contacted were then called by the study interviewer (SW), who described the study in more detail and arranged a face-to-face interview at one of several mutually convenient locations (e.g., one of several UCSF office locations, the person's home or workplace or a café) if the patient agreed to participate.

Study participants were recruited between June 2010 and February 2011. All provided informed consent and received a $40 gift card as remuneration at the conclusion of the face-to-face interview. The UCSF Committee on Human Research (CHR# H8937-34562) provided approval for this study.

Questionnaire

The interview began with the administration of a questionnaire that included items related to the participant's sociodemographic characteristics, the number and genders of first degree blood relatives (i.e., parents, siblings, including half brothers and sisters and children), general health, personal and family histories of cancer, and medical procedures they had undergone to detect and diagnose cancer (including genetic testing). The questionnaire also included three questions adapted from the Cancer Worry Scale,[16] asking how often, during

the past month, the participant had thought about their own chances of developing cancer, had thoughts about getting cancer had affected their mood, and had been bothered by thoughts or worry about their chances of getting cancer, with response options ranging from 1= not at all, to 5 = all of the time.

Utility measurement

Each participant completed a series of preference-elicitation exercises using "ELICIT," an interviewer-guided computer program our group had previously developed.[17] Utilities were measured using the time tradeoff metric,[18] which has been used widely for evaluating the quality-of-life effects of clinical conditions for use in cost-effectiveness analyses. The time tradeoff preference elicitation exercise asks participants to choose between living their full life expectancy with a hypothetical disability or health condition (e.g., being blind in both eyes) or living a shorter time without that disability or condition (i.e., having normal vision). Time spent without the disability or condition is varied until the subject is indifferent between the two options. The time tradeoff utility score is calculated by dividing the number of years without the disability by the number of years with the disability at the indifference point, yielding a value between 0 (which occurs when the respondent would give up his or her entire life expectancy to avoid the disability, meaning he or she equates it with death) to 1 (which occurs when the respondent would not give up any life expectancy to avoid the outcome, suggesting that he or she equates it with life without a disability).

After completing a practice preference-elicitation exercise, all participants were asked to provide utilities for three types of health states: 1) sibling states, in which the participants were asked to imagine that their sibling had colorectal cancer and had tested positive for Lynch syndrome; 2) proband states, in which participants were asked to imagine that they themselves had colorectal cancer that was suspected to be Lynch syndrome-related, and 3) general cancer states, for which participants were asked to imagine that they had colorectal, uterine, or ovarian cancer (with no mention of Lynch syndrome). . To help ensure that the participant understood the scenarios, the interviewer read aloud and presented information cards as needed to the participants as they worked through the preference elicitation exercise.

Female participants assessed 10 scenarios in total, which included 4 sibling states (having a sibling with Lynch-related colorectal cancer and undergoing testing and testing negative, testing positive and undergoing TAH/BSO, testing positive and foregoing TAH/BSO, and declining testing); 3 proband states (having colorectal cancer, testing positive for Lynch syndrome and then undergoing or foregoing TAH/BSO to prevent endometrial and ovarian cancer; and declining testing), and 3 general cancer states (colorectal, endometrial and ovarian, all without reference to Lynch syndrome). Men did not assess the endometrial or ovarian cancer or the TAH/BSO scenarios; instead they were presented scenarios involving undergoing or foregoing subtotal colectomy to prevent a secondary colon cancer (Table 1).

Analyses

We began our analyses by describing the demographic and clinical characteristics of the enrolled sample. Utility score distributions were described using sample means, standard

deviations, medians and interquartile ranges for the whole sample, as well as by recruitment site. We then calculated simple difference scores to identify subgroups of participants who appeared to be inclined to undergo genetic testing for Lynch syndrome if their sibling tested positive for Lynch syndrome, and who would be inclined to undergo risk-reducing surgery to prevent a secondary cancer if they had colorectal cancer. Specifically, the dichotomous variables consisted of a positive (versus zero or negative) utility difference score for undergoing Lynch testing and receiving negative results versus foregoing Lynch testing (sibling states), and for undergoing rather than foregoing surgery to prevent a subsequent cancer (proband states). These dichotomous outcomes were regressed onto *a priori* selected predictors including age, gender, education, recruitment site, having a biological child, having had genetic testing, history of cancer, having had a hysterectomy, and cancer worry scale score, using bivariable and multivariable logistic regression models. For the final multivariable models, we utilized a backward elimination process where the predictors with p value greater than 0.20 were removed from the model. A 2-sided p-value of < 0.05 was considered statistically significant. All analyses were implemented using SAS Version 9.2 (SAS Institute, Cary, NC).

Results

A total of 70 individuals participated in our study – 49 who were recruited from the General Medical Clinic and 21 who were recruited from the Colorectal Cancer Prevention Program (Table 2). The mean age of the participants was 52.3 years; nearly two thirds (61%) were female; and about half (49%) were married or living with a partner. Over half (54%) had at least one biological child, and 93% had at least one biological sibling. About two-thirds (67%) of the participants where white, nearly three quarters (72%) had college degrees, and about half (47%) had annual household incomes of at least $100,000. Males comprised a significantly larger percentage of the participants who were recruited from the Colorectal Cancer Prevention Program (62% versus 29% from the General Medical Clinic, p=.009), and patients recruited from the Colorectal Cancer Prevention Program were significantly more likely than General Medical Clinic patients to report a history of colorectal cancer (24% versus 0%, p=.001), other cancers (24% versus 19%, p=.001), and genetic testing (100% versus 6%, p<.001).

The highest mean utilities were assigned to the sibling states, all of which described situations in which the participant did not have cancer but his or her sibling had colorectal cancer and had tested positive for Lynch syndrome (Table 3). These utilities ranged from 0.760 (undergoing testing and receiving negative results), to 0.669 (undergoing testing, receiving positive results, and then foregoing TAH/BSO).

Utilities for the proband states, all of which described situations in which the participant had colorectal cancer and was offered Lynch syndrome testing, yielded lower values. These utilities ranged from 0.682, the value assigned to testing positive and undergoing colectomy to prevent a secondary colorectal cancer (utilities obtained only from men), to 0.605, the value assigned to testing positive and then choosing to forego TAH/BSO to prevent endometrial and ovarian cancer (utilities obtained only from women). Two of the general cancer states that did not mention Lynch syndrome received the lowest mean values (0.601

for colorectal and 0.593 for ovarian cancer). With the exception of the outcomes describing undergoing or foregoing TAH/BSO, the utilities for sibling states obtained from the Colorectal Cancer Prevention Program patients were lower than those obtained from the General Medical Clinic patients. For the proband states, the Colorectal Cancer Prevention Program patients had higher utilities than the General Medical Clinic patients for all outcomes except those entailing foregoing preventive surgery.

Less than half (43%) of the sample assigned higher scores to the sibling state consisting of undergoing Lynch testing and receiving negative results compared to foregoing Lynch testing, while half (50%) had higher scores for the proband state involving undergoing rather than foregoing surgery to prevent a subsequent cancer. Given the small sample size, we were unable to identify any significant correlates of having a higher utility for undergoing Lynch testing and receiving negative results versus foregoing Lynch testing, although a trend emerged toward having greater odds of preferring testing among participants who reported a history of cancer (adjusted odds ratio (aOR) = 3.02, 95% CI = (0.94-9.71); p=.06; Table 4.) Similarly, three marginally significant predictors of preferring to undergo rather than forego surgery to prevent a subsequent cancer among probands were identified: older participants (aOR=1.22, 95% CI=0.98 to 1.51, p=.07 for every five-year increment in age) and participants recruited from the Colorectal Cancer Prevention Program (aOR=3.51, 95% CI=0.88 to 14.05, p=.08) were both found to be at higher odds of preferring preventive surgery than other participants, while male participants had lower odds than female participants of preferring to undergo preventive surgery after controlling for recruitment site, cancer history, and having previously undergone genetic testing (aOR=0.35, 95% CI=0.11 to 1.10, p=.07; Table 5).

Discussion

In this study, we found that scenarios involving having cancer, or having a sibling with cancer, were associated with large anticipated decrements in health-related quality of life. Within this context, testing negative for Lynch syndrome, or testing positive and undergoing risk-reducing surgery, both appeared to attenuate this effect. Together, these results suggest that on average patients attach value to receiving information that they can use to take action to prevent cancer.

However, we found substantial variability in how individuals view the prospect of Lynch syndrome testing. Less than half of the sample assigned higher scores to undergoing Lynch testing and receiving negative results versus foregoing Lynch testing in the context of having a blood relative with Lynch syndrome. This suggests that knowing that one does not carry a Lynch syndrome-causing mutation may not be viewed as a net gain to many of the people to whom current guidelines are directed. In addition, the fact that only half of the sample assigned higher utilities to undergoing versus foregoing risk-reducing surgery in the context of Lynch syndrome-associated colorectal cancer suggests that this preventive action is also not necessarily viewed as a net gain. Together these findings suggest that acceptance of genetic testing for Lynch syndrome may not be as high as anticipated among colorectal cancer patients whose tumors are suggestive of Lynch syndrome and among relatives of individuals with Lynch syndrome.

We were somewhat surprised by the relatively low values assigned to the sibling states, as these scenarios all described situations in which the assessor did not have cancer. Because the time tradeoff exercise asks the respondent to indicate how many years of their own life they would be willing to give up to avoid the state being assessed (which in all sibling states entailed having a blood sibling who had colorectal cancer), we believe that these low utilities may reflect the distress associated with having a sibling with cancer and the willingness of an unaffected sibling to give up some of his or her own life expectancy to "prevent" that cancer in their sibling. Finding comparable studies in which the assessors are asked how much of their own life expectancy they would give up to "prevent" someone else from having a condition is challenging. In our own study of utilities in the context of prenatal genetic testing, low time tradeoff values also were obtained when we asked pregnant women how many years of their own life they would give up to "prevent" their future child from having Down syndrome (mean =0.67; median =0.73).[19] Disentangling the reasons for these relatively low values – and whether similar factors underlie the low values in both contexts - would require extensive qualitative interviews with participants from these studies.

Several limitations of this study deserve comment. First, although we were successful in recruiting a relatively diverse population with respect to race/ethnicity and experience with Lynch syndrome, the sample was highly educated, and all the participants were receiving care at one academic institution in the San Francisco Bay area, potentially limiting the generalizability of our findings. In addition, sample size constraints limited our ability to offer precise utility estimates for patient subgroups and to analyze the determinants of the preferences we assessed. Finally, although we elicited utilities for many of the potential outcomes of decisions to undergo or forego Lynch syndrome testing, limiting the list to a reasonable number that could be assessed in a one-hour interview necessitated excluding some of the outcomes that may be important drivers of testing preferences.

Nonetheless, this is, to our knowledge, the first publication of utilities for potential outcomes of decisions to undergo or forego genetic testing for Lynch syndrome for the individuals with colorectal cancer suggestive of Lynch syndrome and for relatives of individuals known to have Lynch syndrome – the two populations to whom current guidelines are addressed. The utilities assessed in our study can be used in conducting cost-effectiveness analyses of current and alternative screening recommendations for Lynch syndrome. Such analysis would incorporate the important effects of genetic testing on quality-of-life, and can explore the consequences of variations in preferences for such testing.

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Table 1
Outcome Descriptions for Utility Assessments

Sibling States	
Assessed by Male Participants	**Assessed by Female Participants**
Have testing, test negative • Your sibling has colorectal cancer and has been found to have Lynch syndrome. • You are at increased risk for Lynch syndrome. • You have genetic testing. • You do not have Lynch syndrome. • Your chances of developing ***colorectal cancer*** are average. • You have not passed on Lynch syndrome to your children. • Your other blood siblings and parents could still have Lynch syndrome. • You may feel anxious about getting tested. • You will probably feel relieved after you get results. • You also may feel reassured and less worried about cancer in general. • You live with any other health problems you may have.	***Have testing, test negative*** • Your sibling has colorectal cancer and has been found to have Lynch syndrome. • You are at increased risk for Lynch syndrome. • You have genetic testing. • You do not have Lynch syndrome. • Your chances of developing ***colorectal, endometrial, or ovarian cancer*** are average. • You have not passed on Lynch syndrome to your children. • Your other blood siblings and parents could still have Lynch syndrome. • You may feel anxious about getting tested. • You will probably feel relieved after you get results. • You also may feel reassured and less worried about cancer in general. • You live with any other health problems you may have.
Have testing, Lynch syndrome (preventive surgery not offered) • Your sibling has colorectal cancer and has been found to have Lynch syndrome. • You are at increased risk for Lynch syndrome. • You have genetic testing. • You are told you HAVE Lynch syndrome. • You are at increased risk of developing colorectal cancer. • Your children have a 50/50 chance of having Lynch syndrome. • You may feel anxious, worried, empowered or burdened. • Other possible emotions include regret, relief, feeling overwhelmed or afraid. • You are told that you should have high risk surveillance for colorectal cancer. • You spend the rest of your life knowing that you are at increased risk for colorectal cancer. • You live with any other health problems you may have.	***Have testing, test positive, undergo preventive surgery (TAH/BSO)*** • Your sibling has colorectal cancer and has been found to have Lynch syndrome. • You are at increased risk for Lynch syndrome. • You have genetic testing. • You are told you HAVE Lynch syndrome. • You are at increased risk of developing colorectal, endometrial or ovarian cancer. • Your children have a 50/50 chance of having Lynch syndrome. • You may feel anxious, worried, empowered or burdened. • Other possible emotions include regret, relief, feeling overwhelmed or afraid. • You are offered a ***hysterectomy and BSO***, and you choose to have this surgery. • You may feel empowered, but you may feel a loss. • At times you may wonder if you should have had the surgery. • You spend the rest of your life knowing that you will not develop endometrial or ovarian cancer, but that you are still at increased risk for colorectal cancer. • You live with any other health problems you may have.
	Have testing, Lynch syndrome, forego preventive surgery (TAH/BSO) • Your sibling has colorectal cancer and has been found to have Lynch syndrome. • You are at increased risk for Lynch syndrome.

Sibling States	
Assessed by Male Participants	**Assessed by Female Participants**
	• You have genetic testing. • You are told you HAVE Lynch syndrome. • You are at increased risk of developing colorectal, endometrial or ovarian cancer. • Your children have a 50/50 chance of having Lynch syndrome. • You may feel anxious, worried, empowered or burdened. • Other possible emotions include regret, relief, overwhelmed or afraid. • You are offered a hysterectomy and BSO, and you choose to NOT HAVE this surgery. • You spend the rest of your life knowing that you are at increased risk for all three cancers. • You undergo yearly vaginal ultrasounds, endometrial biopsies and colonoscopies every 1 or 2 years. • You live with any other health problems you may have.
Decline testing, no knowledge of Lynch status • Your sibling has colorectal cancer and has been found to have Lynch syndrome. • You are at increased risk for Lynch syndrome. • You choose NOT to have genetic testing. • You have a 50/50 chance of having Lynch syndrome. • If you have Lynch syndrome, your children, siblings and parents have a 50/50 chance of having Lynch syndrome. • It may be recommended that your blood relatives have genetic testing. • Testing will be more complicated for them. • You are offered high risk surveillance. • You may feel anxious, worried or guilty, or you may feel relieved to not have this information. • You live with any other health problems you may have.	***Decline testing, no knowledge of Lynch status*** • Your sibling has colorectal cancer and has been found to have Lynch syndrome. • You are at increased risk for Lynch syndrome. • You choose NOT to have genetic testing. • You have a 50/50 chance of having Lynch syndrome. • It may be recommended that your blood relatives have genetic testing. • Testing will be more complicated for them. • You are offered high risk surveillance ***for all three cancers***. • You may feel anxious, worried or guilty, or you may feel relieved to not have this information. • You live with any other health problems you may have.
Proband States	
Assessed by Male Participants	**Assessed by Female Participants**
Have testing, test positive, undergo preventive surgery (colectomy) • You have colorectal cancer. • You have genetic testing for Lynch syndrome. • You are told you have Lynch syndrome. • Your children, parents, and siblings have a 50/50 chance of having Lynch syndrome. • You are offered a ***colectomy*** and you choose have this surgery. • You may need to wear an “ostomy” bag for the rest of your life.	***Have testing, test positive, undergo preventive surgery (TAH/BSO)*** • You have colorectal cancer. • You have genetic testing for Lynch syndrome. • You are told you have Lynch syndrome. • Your children, parents, and siblings have a 50/50 chance of having Lynch syndrome. • You are offered a ***hysterectomy and BSO***, and you choose to have this surgery. • You are told that you should still have high risk surveillance for a second colorectal cancer. • You spend the rest of your life knowing that you that you will not develop endometrial or ovarian cancer.

Sibling States	
Assessed by Male Participants	**Assessed by Female Participants**
• You spend the rest of your life knowing that you will not develop a second colorectal cancer. • You may feel empowered, but you may wonder if you should have had the surgery. • You live with any other health problems you may have.	• You may feel empowered, but you also may feel a loss. • You may wonder if you should have had the surgery. • You live with any other health problems you may have.
Have testing, test positive, forego preventive surgery (colectomy)	***Have testing, test positive, forego preventive surgery (TAH/BSO)***
• You have colorectal cancer. • You have genetic testing for Lynch syndrome. • You are told you have Lynch syndrome. • You are at increased risk of developing a second colorectal cancer. • Your children, parents, and siblings have a 50/50 chance of having Lynch syndrome. • It is recommended that they have genetic testing. • You are offered a colectomy and you choose NOT to have this surgery. • You are told that you should have high risk surveillance for colorectal cancer. • You spend the rest of your life knowing that you that are at high risk for developing a second colorectal cancer. • You live with any other health problems you may have.	• You have colorectal cancer. • You have genetic testing for Lynch syndrome. • You are told you have Lynch syndrome. • You are at increased risk of developing a second colorectal, endometrial, or ovarian cancer. • Your children, parents, and siblings have a 50/50 chance of having Lynch syndrome. • It is recommended that they have genetic testing. • You are offered a hysterectomy and BSO, and you choose NOT to have this surgery. • You are told that you should have high risk surveillance for these three cancers. • You spend the rest of your life knowing you are at increased risk for developing colorectal, endometrial or ovarian cancer and that your blood relatives may have Lynch syndrome. • You live with any other health problems you may have.
Decline testing, no knowledge of Lynch status	***Decline testing, no knowledge of Lynch status***
• You have colorectal cancer. • You choose NOT to have genetic testing. • It is very likely that you have Lynch syndrome. • If you have Lynch syndrome, your children, siblings and parents have a 50/50 chance of having Lynch syndrome. • It may be recommended that your blood relatives have genetic testing. • Testing will be more complicated for them. • You are offered high risk surveillance. • You may feel anxious, worried or guilty, or you may feel relieved to not have this information. • You live with any other health problems you may have.	• You have colorectal cancer. • You choose NOT to have genetic testing. • It is very likely that you have Lynch syndrome. • If you have Lynch syndrome, your children, siblings and parents have a 50/50 chance of having Lynch syndrome. • It may be recommended that your blood relatives have genetic testing. • Testing will be more complicated for them. • You are offered high risk surveillance for colorectal, endometrial and ovarian cancer. • You may feel anxious, worried or guilty, or you may feel relieved to not have this information. • You live with any other health problems you may have.
General Cancer States	
Assessed by all Participants	
Colorectal Cancer • You have colorectal cancer. • You may or may not have symptoms. • You may feel worried about your cancer diagnosis and not knowing if treatments will work. • Your chance of dying of colorectal cancer is 35% and your chance of surviving is 65%.	

Sibling States	
Assessed by Male Participants	**Assessed by Female Participants**
• You have surgery and chemotherapy and radiation. • You may need to wear an “ostomy” bag for the rest of your life • You have a colonoscopy every 1-2 years for the rest of your life. • You live the rest of your life knowing that you are at increased risk of dying from cancer. • You live with any other health problems you may have.	
Assessed by Female Participants	
Endometrial Cancer • You have endometrial cancer. • You may or may not have symptoms. • You may feel worried about your cancer diagnosis and not knowing if treatments will work. • Your chance of dying of endometrial cancer is 17% and chance of surviving is 83%. • You have a hysterectomy, chemotherapy and radiation. • You live the rest of your life knowing that you are at increased risk of dying from cancer. • You live with any other health problems you may have.	
Ovarian Cancer • You have ovarian cancer. • You may or may not have symptoms. • You may feel worried about your cancer diagnosis and not knowing if treatments will work. • Your chance of dying of ovarian cancer is 55% and your chance of surviving is 45%. • You have a hysterectomy and BSO (ovaries are removed) and chemotherapy. • You live the rest of your life knowing that you are at increased risk of dying from cancer. • You live with any other health problems you may have.	

Table 2
Characteristics of Study Participants (N=70)

	Participants recruited from:		
	General Medicine Clinic n=49	Colorectal Cancer Prevention Program n=21	p-value
Participant characteristic*			
Age (y)	54.0 ±12.8	48.4 ±16.9	.13
Female	35 (71.4%)	8 (38.1%)	.01
Married/living with partner	21 (42.9%)	13 (61.9%)	.14
Number of blood children			.28
0	23 (46.9%)	9 (42.9%)	
1	11 (22.4%)	2 (9.5%)	
≥2	15 (30.6%)	10 (47.6%)	
Number of blood siblings			.69
0	4 (8.2%)	1 (4.8%)	
1	12 (24.5%)	7 (33.3%)	
≥2	33 (67.3%)	13 (61.9%)	
Race/ethnicity			.18
Asian	5 (10.2%)	2 (9.5%)	
Black, African American	8 (16.3%)	0 (0.0%)	
Latina, Latin American	6 (12.2%)	1 (4.8%)	
White	29 (59.2%)	18 (85.7%)	
Native American	1 (2.0%)	0 (0.0%)	
Educational attainment			.26
Professional or graduate degree	19 (39.6%)	10 (47.6%)	
College graduate	13 (27.1%)	8 (38.1%)	
Some college or less	16 (33.3%)	3 (14.3%)	
Educational attainment			.97
< $25,000	8 (17.4%)	3 (15.0%)	
$25,001-$50,000	7 (15.2%)	4 (20.0%)	
$50,001-$100,000	9 (19.6%)	4 (20.0%)	
> $100,000	22 (47.8%)	9 (45.0%)	
History of cancer			.001
Colorectal	0 (0.0%)	5 (23.8%)	
Other cancer	9 (18.8%)	5 (23.8%)	
Had undergone genetic testing	3 (6.1%)	21 (100.0%)	<.001
Mean cancer worry scale score ≥3†	10 (20.4%)	4 (19.0%)	.90

*All values n (%) or mean + SE

†Mean response to three items from Cancer Worry Scale,[16] "during the past month, how often have you thought about your own chances of developing cancer; have thoughts about getting cancer affected your mood; and have you been bothered by thoughts or worry about your chances of getting cancer," with response options ranging from 1= not at all to 5 = all of the time.

Table 3

Time Tradeoff Utilities for Health States Associated with Undergoing or Forgoing Lynch Syndrome Testing

	Whole Sample N=70		General Medicine Clinic n=49		Colorectal Cancer Prevention Program n=21	
	Mean (SD)	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**
Sibling states						
Undergo testing, Lynch negative	0.760 (± 0.220)	0.852 (0.606, 0.944)	0.777 (±0.211)	0.852 (0.611, 0.947)	0.718 (±0.240)	0.765 (0.585, 0.890)
Undergo testing, Lynch positive, no surgery offered (men)	0.739 (± 0.230)	0.868 (0.583, 0.942)	0.793 (±0.237)	0.889 (0.688, 0.962)	0.680 (±0.216)	0.625 (0.500, 0.880)
Undergo testing, Lynch positive, undergo TAH/BSO (women)	0.697 (± 0.245)	0.750 (0.500, 0.907)	0.691 (±0.253)	0.750 (0.548, 0.907)	0.724 (±0.220)	0.786 (0.495, 0.910)
Undergo testing, Lynch positive, forego TAH/BSO (women)	0.669 (± 0.231)	0.750 (0.500, 0.889)	0.667 (±0.232)	0.727 (0.500, 0.889)	0.679 (±0.239)	0.760 (0.500, 0.878)
Decline testing	0.719 (± 0.222)	0.762 (0.500, 0.889)	0.745 (±0.228)	0.830 (0.669, 0.909)	0.661 (±0.198)	0.600 (0.500, 0.867)
Proband states						
Undergo testing, Lynch positive, undergo surgery						
Colectomy (men)	0.682 (± 0.246)	0.741 (0.488, 0.895)	0.623 (±0.261)	0.694 (0.378, 0.885)	0.746 (±0.220)	0.778 (0.602, 0.929)
TAH/BSO (women)	0.666 (± 0.241)	0.750 (0.485, 0.870)	0.655 (±0.242)	0.750 (0.484, 0.865)	0.710 (±0.247)	0.783 (0.556, 0.902)
Undergo testing, Lynch positive, forego surgery						
Colectomy (men)	0.649 (± 0.269)	0.725 (0.421, 0.881)	0.671 (±0.225)	0.747 (0.454, 0.875)	0.624 (±0.318)	0.511 (0.421, 0.957)
TAH/BSO (women)	0.605 (± 0.252)	0.661 (0.451, 0.833)	0.616 (±0.258)	0.692 (0.470, 0.833)	0.559 (±0.235)	0.462 (0.364, 0.758)
Decline testing	0.660 (± 0.248)	0.743 (0.495, 0.884)	0.654 (±0.243)	0.743 (0.485, 0.884)	0.675 (±0.265)	0.752 (0.504, 0.886)
General cancer states						
Colorectal	0.601 (± 0.238)	0.608 (0.458, 0.811)	0.574 (±0.249)	0.588 (0.400, 0.770)	0.665 (±0.203)	0.713 (0.500, 0.821)
Endometrial (women)	0.728 (± 0.179)	0.760 (0.640, 0.870)	0.726 (±0.184)	0.758 (0.633, 0.877)	0.744 (±0.160)	0.760 (0.737, 0.804)
Ovarian (women)	0.593 (± 0.272)	0.713 (0.257, 0.828)	0.588 (±0.276)	0.727 (0.240, 0.823)	0.624 (±0.261)	0.627 (0.490, 0.833)

SD, standard deviation; IQR, inter-quartile range; TAH/BSO, total abdominal hysterectomy/bilateral salpingo-oophererctomy.

Table 4

Predictors of Having Higher Utilities for Undergoing Lynch Testing and Receiving Normal Results than for Declining Lynch Testing (Sibling States)

Participant characteristic	Unadjusted OR (95% CI)	P Value	Adjusted OR (95% CI)	P Value
Age*	1.03 (0.87-1.21)	.76		
Gender				
Male	2.33 (0.87-6.25)	.09	2.08 (0.72-5.98)	.17
Female	Reference			
Education				
College degree	2.58 (0.81-8.26)	.11	2.55 (0.76-8.60)	.13
No college degree	Reference			
Recruitment site				
Colorectal Cancer Prevention Program	1.32 (0.47-3.69)	.60		
General Medical Clinic	Reference			
Have biological child	0.94 (0.36-2.42)	.89		
Have had genetic testing	1.20 (0.44-3.25)	.72		
Have been diagnosed with cancer	2.65 (0.88-7.99)	.08	3.02 (0.94-9.71)	.06
Have undergone hysterectomy†	1.23 (0.37-4.14)	.74		
Cancer worry score‡	1.65 (0.92-2.95)	.10		

OR, odds ratio; CI, confidence interval

*OR for every 5-year increase in age.

†For males, a hysterectomy indicator of “none” was given in order to retain the full sample in the model.

‡OR for every 1-point increase on the 5-point cancer worry scale.

Table 5

Predictors of Having Higher Utilities for Undergoing Risk-Reducing Surgery than for Declining Risk-Reducing Surgery (Proband States)

Participant characteristic	Unadjusted OR (95% CI)	P Value	Adjusted OR (95% CI)	P Value
Age*	1.09 (0.92-1.28)	.34	1.22 (0.98-1.51)	.07
Gender				
Male	0.54 (0.21-1.44)	.22	0.35 (0.11-1.10)	..07
Female	Reference			
Education				
College degree	1.49 (0.51-4.33)	.46		
No college degree	Reference			
Have biological child	1.00 (0.39-2.56)	1.00		
Recruitment site				
Colorectal Cancer Prevention Program	1.51 (0.54-4.22)	.44	3.51 (0.88-14.05)	.08
General Medical Clinic	Reference			
Have had genetic testing	1.67 (0.61-4.52)	.32	0.35 (0.09-1.40)	.14
Have been diagnosed with cancer	0.71 (0.24-2.09)	.54	0.39 (0.10-1.49)	.17
Had hysterectomy†	1.25 (0.37-4.20)	.72		
Cancer worry score‡	1.26 (0.72-2.23)	.42		

OR, odds ratio; CI, confidence interval

*OR for every 5-year increase in age.

†For males, a hysterectomy indicator of “none” was given in order to retain the full sample in the model.

‡OR for every 1-point increase on the 5-point cancer worry scale.