



BC Cancer Agency

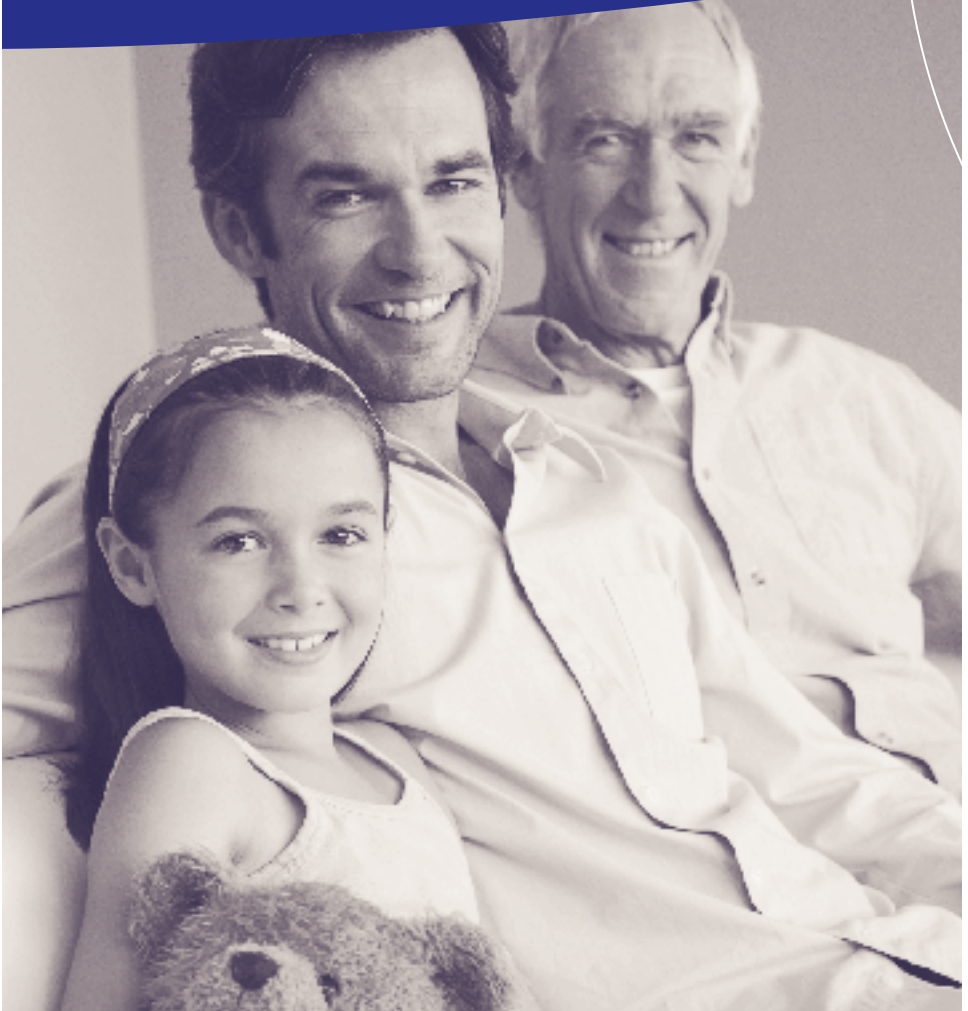
CARE + RESEARCH

An agency of the Provincial Health Services Authority

Hereditary Cancer Program

Understanding Lynch Syndrome

Hereditary Nonpolyposis Colorectal Cancer (HNPCC)





Hereditary Cancer Program

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Introduction

The purpose of this booklet is to review information about Lynch syndrome (also called Hereditary Nonpolyposis Colorectal Cancer or HNPCC) as discussed in a genetic counselling session. You may also wish to use this booklet to help share this information with other family members.

The terms Lynch syndrome and HNPCC are often used interchangeably. Lynch syndrome is named for American hereditary cancer expert Dr. Henry Lynch. Lynch syndrome is used in this booklet, but HNPCC may also be used by your health care team.

This booklet was prepared by staff of the Hereditary Cancer Program based on information that was current at the time of printing.

Words that may be new to you are highlighted once and are defined in the Glossary on page 23.

Acknowledgments

We are grateful to people who provided valuable feedback in the development of this booklet and to the BC Cancer Agency Multimedia Services Department for design, layout, and illustration.

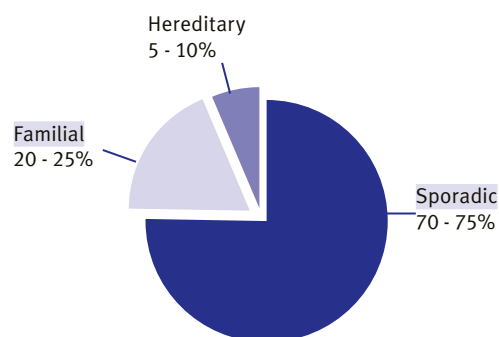
How are cancer & genes related?

Each **gene** has a specific function in the body. Some genes control **cell** division. When **mutations** occur in these genes, a cell may begin to divide without control. Cells that divide when they are not supposed to may eventually become a cancer. See Appendix on page 25 for more information about genes, **chromosomes** and **DNA**.

All cancer is genetic, most is not hereditary

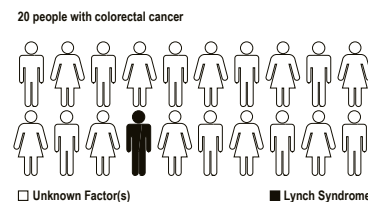
All cancers are the result of gene mutations. Mutations may be caused by aging, exposure to chemicals, radiation, hormones or other factors in the body and the environment. Over time, a number of mutations may occur in a single cell, allowing it to divide and grow in a way that becomes a cancer. This usually takes many years, and explains why most cancers occur at a later age in life. Because people are not born with these **acquired gene mutations**, they cannot pass them on to their children.

A small number of cancers are **hereditary**. This means that they are related to a specific gene mutation that was passed down (inherited) in a family. A person who is born with a mutation has it in every cell in his/her body, including some of the eggs or sperm. This means that it *may* be passed down when that person has children. People who inherit such gene mutations have a higher risk of developing certain forms of cancer compared to the general population. **Inherited gene mutations** help to explain why in some families, we see more people than expected with certain kinds of cancer.



What is known about hereditary colorectal cancer?

Colon cancer is one of the most common types of cancer in adults. Cancer of the **rectum** is less common. **Colorectal** cancer is a general term for cancer of the colon or rectum. In some families there are many more people with colorectal cancer than in the average family. This may mean that they have inherited a gene mutation that increases the risk of colorectal cancer. However, **most colorectal cancer is not hereditary**.



Up to 5% of all colorectal cancers (less than 1 in 20) are thought to be related to **Lynch syndrome**. There are other causes of hereditary colorectal cancer that are even less common (e.g. **Familial Adenomatous Polyposis**).

Is my family at risk?

The history of cancer in your close relatives is a clue to the chance of Lynch syndrome in your family. Close relatives include your children, brothers, sisters, parents, aunts, uncles, grandchildren, and grandparents **on one side of the family**. A history of cancer in cousins and more distant relatives may also be important.

Lynch syndrome cancers include colorectal, **endometrial**, ovarian, stomach, small bowel, pancreatic, kidney (renal pelvis), hepatobiliary, ureter, or brain, as well as sebaceous gland tumours.

Lynch syndrome is more likely if **one or more of the following features** can be confirmed in your family:

- A person with colorectal cancer at age 40 or younger
- A person with colorectal cancer and another Lynch syndrome cancer, with one diagnosed at age 50 or younger
- Two close family members with a Lynch syndrome cancer at age 50 or younger
- Three close family members (over more than one generation) with a Lynch syndrome cancer, including at least one case of colorectal cancer AND at least one cancer diagnosed at age 50 or younger

What genes are involved in Lynch syndrome?

There are at least four different genes associated with Lynch syndrome, and more genes may be discovered in the future. The four genes are called *MLH1*, *MSH2*, *MSH6* and *PMS2*. The majority of families with Lynch syndrome have an inherited mutation in either *MLH1* or *MSH2*. **In this booklet, we will refer to the four genes as the Lynch syndrome genes. Where there are specific differences, the genes will be described separately.**

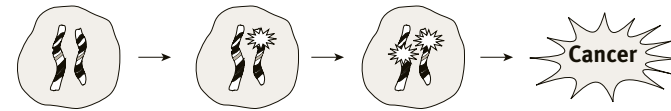
Everyone is born with two copies of each Lynch syndrome gene, one copy of each gene from their mother and one copy of each gene from their father. These genes are found in every cell in the body. The Lynch syndrome genes act like the “spell check” in a computer program. They are called **mismatch repair genes** because they provide instructions for the body to make specific proteins that repair DNA damage (acquired gene mutations). Without these genes, DNA damage would build up in a cell and a cancer could develop.



What happens if a person inherits a Lynch syndrome gene mutation?

We have two copies of every gene in every cell. As a person ages, mutations occur by chance, in different genes, in different cells. A person who is born with two normal copies of each Lynch syndrome gene has to acquire a mutation in both copies of the same Lynch syndrome gene in the same cell for a cancer to develop. This is what happens in sporadic cancer.

Sporadic Cancer



Hereditary Cancer



☀ Non-inherited mutation

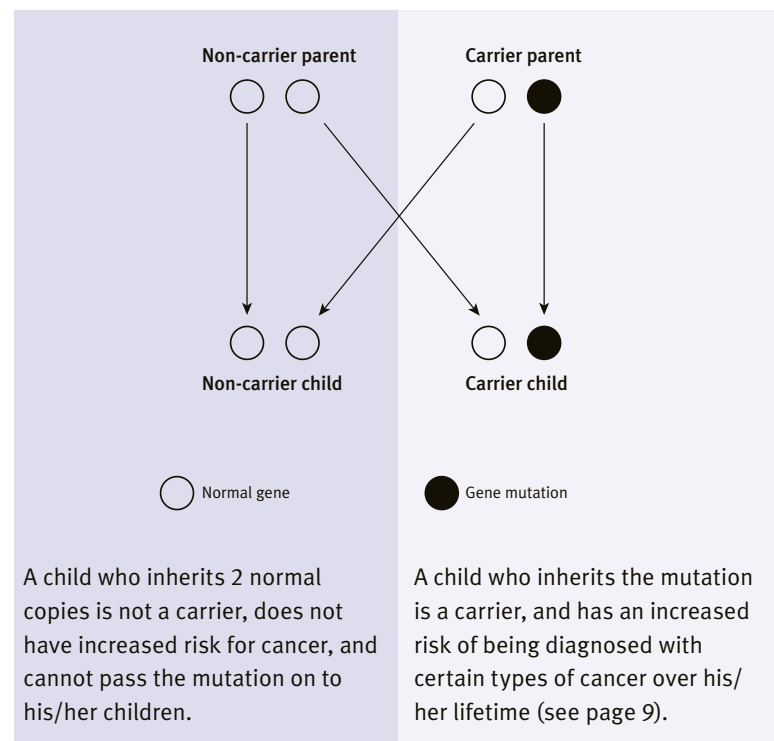
☀ Inherited mutation

In Lynch syndrome, a person is born with a mutation in one copy of one Lynch syndrome gene. This mutation is present in every cell of the body. The other copy of that gene is normal and is able to “do its job.” If a mutation occurs by chance in the normal copy of that Lynch syndrome gene in one cell, that cell no longer has a working copy of that gene.

This helps to explain why cancer is much more likely in a Lynch syndrome gene mutation carrier than a non-carrier. Hereditary cancer is also more likely to develop at a younger age than the same kind of cancer in the general population. Also, there is a greater chance of having more than one **primary cancer** (e.g. a woman with both colon cancer and uterine cancer).

What are the risks for the children of a parent with Lynch syndrome?

We inherit one copy of each of our genes from each parent, and we pass on only one copy of each of our genes to our children. This means that every time a mutation carrier has a child, either the normal copy of the gene or the gene with the mutation will be passed on. As shown below, each child has a 50% chance to inherit the gene mutation.



What is the risk of cancer for a person with Lynch syndrome?

The following table shows the chance that men and women with Lynch syndrome will develop specific types of cancer before age 70, compared to the general population. Differences between the Lynch syndrome genes are noted. These estimates may change as new information becomes available.

TYPE OF CANCER	GENERAL POPULATION RISK (Canada)	LYNCH SYNDROME RISK*	
		MLH1/MSH2	MSH6
Colorectal – men	7-8%	54-74%	22-42%
Colorectal – women	6%	30-52%	20-42%
Endometrial	2-3%	28-60%	20-40%
Ovarian	1-2%	6-7%	6-7%
Stomach	1%	6-9%	6-9%
Hepatobiliary tract, urinary tract (renal pelvis), small bowel, pancreas, brain/CNS	<1%	1-7%	1-7%

**Note: Cancer risks for PMS2 gene mutation carriers may be much lower than the other mismatch repair genes; however, the PMS2 research is limited at this time.*

As shown in the table above, it is important to remember that not every person with Lynch syndrome will develop cancer. It is also important to know that a person with Lynch syndrome who has already had cancer also has a significant risk for a new primary cancer.

Why some people with Lynch syndrome develop cancer(s) and others do not, is not yet well understood.

The risk of the other cancers that may be 'slightly increased' with Lynch syndrome is the subject of ongoing research and can be discussed in more detail with a genetic counsellor.

What is genetic testing?

Genetic testing for Lynch syndrome usually begins with testing on tumour tissue. If these results suggest Lynch syndrome, then further testing is done on a blood sample.

Finding a Lynch syndrome gene mutation may help to:

- Inform family members about their own cancer risks
- Direct appropriate **cancer screening** and risk reduction
- Explain the history of cancer in a family

If your family history of cancer suggests Lynch syndrome, genetic testing will be discussed during your genetic counselling appointment. You may also read the following pages to help you understand:

- Who can have genetic testing?
- How is Lynch syndrome genetic testing done and what do the results mean?
- How are genetic testing results provided?
- What are some issues to consider?
- What are some pros and cons of genetic testing?



Who can have genetic testing?

Lynch syndrome genetic testing is available through the Hereditary Cancer Program when specific criteria are met. Genetic testing does not take place without genetic counselling and the careful process of informed consent.

Genetic testing is complex, so the first test in a family is usually done on the person with the highest chance to have a mutation. This is called an **index** test. If the index test finds a mutation, other family members may choose to have carrier testing. See the table below, and the next page, for more details.

Index test

- First test in the family, usually offered to a person who has had either colon or uterine cancer
- Testing begins on tumour tissue
- If needed, further testing will be done on a blood sample
- Results take many months

Carrier test

- Offered when a gene mutation has already been found in the family
- Looks only for that specific mutation
- Testing is done on a blood sample
- Results usually take weeks



How is Lynch syndrome genetic testing done and what do the results mean?

Lynch syndrome genetic testing usually starts with tests on a sample of tumour tissue from a person who has had colorectal cancer. Your genetic counsellor can help to get a stored tumour sample from the hospital where the cancer surgery was done. Two different tests can be performed on the tumour sample to see whether a Lynch syndrome gene mutation is likely to be found. Your genetic counsellor will provide more detail about these tests if you are interested.

Most tumour tests for Lynch syndrome have normal (negative) results. This means that the tumour does not “look” like a Lynch syndrome tumour, and the chance of Lynch syndrome in your family is low.

If testing on the tumour sample does suggest Lynch syndrome, then further testing can be done on a blood sample, usually from the person whose tumour was tested. The goal of this test is to try to find a specific mutation in one of the Lynch syndrome genes.

It is possible that index genetic testing may not identify a specific mutation. In such cases, it is still possible that a gene mutation is being passed down in the family, but it cannot currently be detected. This may be due to the limits of technology, or it may mean that the mutation is in another gene that has not been tested. With this result, carrier testing is not offered to other family members.

It is also possible that index genetic testing identifies a gene change known as a **variant of uncertain significance.** This means that there is a change in the gene, but we do not know if that change causes cancer. With this result, carrier testing is not offered to other family members.

If index testing does find a mutation, then carrier testing is available to blood relatives who may want to learn their gene status. A carrier test is simpler because it looks only for the specific mutation that was already found in another family member. There are two possible results from Lynch syndrome carrier testing. They are described on the next page.

Positive Carrier Test

- You did inherit the Lynch syndrome gene mutation
- Your risk to develop Lynch syndrome related cancers is increased (see page 9)
- Each of your children has a 50% chance to have inherited the same gene mutation

Negative Carrier Test

- You did not inherit the Lynch syndrome gene mutation
- Your risk for Lynch syndrome related cancers is not higher than the general population risks
- Your children cannot inherit that gene mutation

How are genetic testing results provided?

You will be contacted when the testing is complete. You and your genetic counsellor will arrange to discuss the results when you are ready. Your Lynch syndrome genetic testing results are only shared with other people on your request.



What should I do to manage my cancer risks if I have Lynch syndrome?

Your genetic counsellor will discuss current cancer screening and risk reduction advice based on your family history of cancer and any genetic testing done in your family.

Guidelines for men and women who have Lynch syndrome are provided below and are based on published recommendations and expert opinions. References are available on request.

The goal of cancer screening is to find a cancer as early as possible, when treatment is likely to be most effective. Screening can also prevent colon cancer by finding and removing **polyps** from the colon before they become a cancer.

Colorectal cancer

Screening by **colonoscopy** is recommended for men and women with Lynch syndrome. This should usually start at age 25, OR 5-10 years before the youngest age of colorectal cancer diagnosis in the family, whichever is earlier. Colonoscopy screening should occur every 1-2 years until age 40. After age 40, colonoscopy should be done every year.

It is also important to be aware of common signs of colorectal cancer and bring any new concerns to a doctor's attention. Signs of colorectal cancer might include:

- Unexplained change in bowel habits (constipation or diarrhea)
- Change in size/shape of stools (e.g. narrower than usual)
- Blood in or on the stool (bright red or dark)
- Persistent abdominal pain/discomfort (bloating, fullness, cramps, gas pain)
- Unexplained weight loss

Endometrial (uterine) cancer

For most women, abnormal vaginal bleeding is the first sign of endometrial cancer. This means that new heavy bleeding with menstrual periods, bleeding between periods, or bleeding after menopause, should be brought to a doctor's attention. Other signs may include: watery pink or white vaginal discharge, pain in the lower abdomen or pelvic area, or pain during sexual intercourse.

Women with Lynch Syndrome should have prompt and complete investigation of any possible signs of endometrial cancer such as unusual vaginal bleeding with/between menstrual periods or occurring at any time after menopause. Although its effectiveness has not been proven, women may also consider having an internal (pelvic) exam every year or having an **endometrial biopsy** and **transvaginal ultrasound** every year, starting somewhere between age 25-35.

Other cancers

Ovarian cancer screening is not recommended at this time as current tests do not reliably detect ovarian cancer at an early stage.

If your family history includes other Lynch syndrome related cancers, additional screening may be discussed with your genetic counsellor. However, there are no standard screening guidelines at this time.

What about surgery to reduce cancer risks?

Surgery that is done to try to prevent cancer is called **prophylactic** or risk-reducing surgery. Some people with Lynch syndrome consider 3 types of surgery to reduce their cancer risks:

- Hysterectomy is surgery to remove the **uterus**
- Salpingo-oophorectomy is surgery to remove the **ovaries** and **fallopian tubes**
- Colectomy is surgery to remove the **colon**

Some people choose to have prophylactic surgery and some do not. Women who have Lynch syndrome are advised to seriously consider removing their uterus (hysterectomy) and fallopian tubes after age 35-40 or after childbearing is complete. Women may also consider removing their ovaries either at the same time as the hysterectomy or at a later date closer to the age of natural menopause. It is important to know that removing the ovaries will cause menopause to begin for a woman who is still having periods. Removing the uterus will not cause menopause but menstrual periods will stop.

Colectomy, instead of **segmental resection** at the time of a colorectal cancer diagnosis, may be a choice for some people with Lynch syndrome. This option may be considered because the chance to develop another colorectal cancer is higher for people with Lynch syndrome than for other people with colorectal cancer.

Having surgery to reduce cancer risk is a very personal decision. Ask your genetic counsellor or your doctor for more details if you are interested. You may also want to meet with a specialist who is an expert in this area or talk to people who have had surgery to learn what it was like for them. It is important to take the time you need to make the decision that is right for you.

What about using medications to reduce cancer risks?

There is some early evidence suggesting that the regular use of aspirin may reduce the risk of colorectal cancer and other cancers associated with Lynch Syndrome. However, the exact dose, how long it should be used for, and when to start is not yet clear. Aspirin is a widely used medication to treat minor aches and pains and to prevent heart disease and strokes, and is well tolerated by most people who use it. However, it can cause side effects in some people so it is important to discuss the current level of evidence for its cancer prevention effect with your doctor, in the setting of your own medical history, to decide whether or not it would be reasonable for you to use aspirin as a cancer prevention strategy.

What are some issues to consider?

There are many important issues related to Lynch syndrome genetic testing. This section includes some questions that other people have asked while deciding whether to have genetic testing. You may wish to discuss these topics with your genetic counsellor.

What kind of information will I gain from genetic testing?

Genetic testing may help to clarify your risks for a new cancer diagnosis. The results cannot tell you if, when, or what type of cancer may develop. Some people with Lynch syndrome never develop cancer, and some have several different cancers. Your genetic counsellor will discuss cancer screening based on the results of your genetic testing.

When is the right time to have genetic testing?

Deciding to have genetic testing is a choice that only you can make. It must be the right decision for you, at the right time in your life. Think about how and when you would use the test results. Some people find this an easy choice, and others find that it is very hard to decide. Talking with a genetic counsellor, your doctor, and family members may help you to make a decision. Support from those who are close to you may be helpful before and after you receive genetic test results.

You may feel pressured to have genetic testing when:

- You feel it is your responsibility. Other family members may not be able to have genetic testing if you do not have the test first
- Other members in the family have a gene mutation
- Your spouse or other family members are worried about you

It may be hard to make a decision when you feel pressure like this. You can take as much time as you need to decide, and you may want to talk with your genetic counsellor.

How might my genetic test result impact my family?

It is important to remember that we share our genes with our family members. Your genetic test result may provide information about your relatives' chance to also have Lynch syndrome. It may also impact their cancer risks and cancer screening advice.

Family members may have very different feelings about genetic testing and cancer. It may be important to discuss your thoughts about genetic testing with key family members before your blood is tested. These are hard topics to discuss in some families. It may be stressful if family members do not agree with your decision about genetic testing. Sharing the results of genetic testing may also cause stress in families.

What type of emotions might I feel?

Talking about your family history of cancer may bring up memories from many years ago. Thinking about genetic testing and getting your test results may lead to feelings of relief, anxiety, hope, confusion, guilt or worry. Sometimes these feelings are unexpected. It may not be possible to guess how a person is going to react to their genetic test result. You may wish to discuss your feelings with people who have given you support in other difficult situations (e.g. family, friends, therapist, religious leader, support group). Referral to the BC Cancer Agency's Patient and Family Counselling department is another option for support to address some of these feelings.

Is Lynch syndrome testing offered to children?

Lynch syndrome genetic testing is usually offered to people aged 18 or older. This is because a Lynch syndrome test result will not change the medical care for children. Also, it is important that a person is able to decide about genetic testing for him/herself.

Are genetic test results kept confidential?

Yes. Your Lynch syndrome test results are only shared with other people at your request.

Will genetic testing affect my insurance?

In Canada, you will have the same public health insurance whatever the result of your genetic testing. If you know you have a gene mutation, you must disclose your result to private life and medical insurance companies if you are asked. It is possible that this information could impact your chances and/or the costs of getting new life insurance or extended health coverage. You may wish to review your insurance policies before you have any genetic testing done.

What are some pros and cons of genetic testing?

The following table lists some of the possible advantages (pros) and disadvantages (cons) of genetic testing. You may find other advantages or disadvantages, which you can add to the table. This list may help you to think about which issues are most important to you.

PROS	CONS
<ul style="list-style-type: none"> • Results may help some people to make medical and lifestyle decisions 	<ul style="list-style-type: none"> • There are no proven ways for mutation carriers to eliminate all risk of cancer
<ul style="list-style-type: none"> • May provide helpful information for family members 	<ul style="list-style-type: none"> • Family members may have different ideas about sharing genetic test results
<ul style="list-style-type: none"> • Results may help some people make decisions about risk-reducing surgery 	<ul style="list-style-type: none"> • Employers and insurance companies may treat you differently if they learn you are a gene mutation carrier
<ul style="list-style-type: none"> • Results may reduce anxiety for some people 	<ul style="list-style-type: none"> • Results may increase anxiety for some people
<ul style="list-style-type: none"> • May help to explain why people in the family have had cancer 	<ul style="list-style-type: none"> • A negative result may provide a false sense of security for some people
<ul style="list-style-type: none"> • May have an impact on family relationships 	<ul style="list-style-type: none"> • May have an impact on family relationships
<ul style="list-style-type: none"> • May be able to be involved in research studies 	<ul style="list-style-type: none"> • More research is needed to understand the long-term impact of genetic testing

Other issues:

How do I contact the Hereditary Cancer Program?

You may contact your genetic counsellor directly at the number provided at your appointment. People who are seeking general information about hereditary cancer can call the Hereditary Cancer Program (HCP) at 604.877.6000 (1.800.663.3333) local 672325.

Resources – People

HCP genetic counsellors are available to you, and can make referrals to other professionals as needed (social worker, counsellor, surgeon, genetics programs in other provinces, etc.) or arrange for family members to have genetic counselling.

Genetic counselling appointments are available in person in Vancouver, Victoria, Abbotsford, Surrey, Kelowna, and Prince George. Genetic counselling by video-conference is also available to many locations in BC and the Yukon.

Your genetic counsellor's name:

Genetic counsellors in Abbotsford:

604.851.4710 (1.877.574.3777) local 645236

Genetic counsellors in Vancouver:

604.877.6000 (1.800.663.3333) local 672198

The HCP has a list of people who have gone through genetic counselling and offered to be available to others who might want to talk to someone who has “been there.” Ask your genetic counsellor if you think you might find such a contact helpful.

Resources – Websites

Hereditary Cancer Program/Cancer Screening Programs

www.screeningbc.ca

- Hereditary tab links to information about the Hereditary Cancer Program, referrals, eligibility, and information for healthcare professionals
- Information about cancer screening recommendations for the general population

BC Cancer Agency

www.bccancer.bc.ca

- General information about cancer and its treatment

Canadian Cancer Society

www.cancer.ca

- General information about cancer and other resources
- Offers a national telephone information service at 1.888.939.3333

Lynch Syndrome International

www.lynchcancers.com

- Volunteer organization founded and governed by Lynch syndrome survivors, their families, and health care professionals who specialize in Lynch syndrome
- Promotes awareness, provides public and health professional education, and offers support to individuals and families living with Lynch syndrome

Familial Gastrointestinal Cancer Registry (Mount Sinai Hospital, Toronto)

www.mountsinai.on.ca/care/fgicr

- Research program that studies families with inherited colorectal cancer syndromes
- Website provides information about various hereditary colorectal cancer syndromes including a special focus on information for children (Kids' Korner)

John's Hopkins Hereditary Colorectal Cancer Registry (U.S.A.)

www.hopkins-gi.org

- Select “Diseases and Conditions,” then select Hereditary nonpolyposis colorectal cancer
- Website provides education and information about Lynch syndrome and other hereditary colorectal cancer syndromes

Resources – Books & Videos

Colorectal Cancer Can Run in the Family

T Berk & F Macrae (eds), 2006, Medcom Ltd.

- A thorough and readable guide, written for families, by world experts in hereditary colorectal cancer
- Can be ordered for \$25 by contacting Terri Berk at 416.586.4800 local 8334 or tberk@mtsinai.on.ca

Living with Lynch syndrome:

An update for families and their care providers

- A day of education, support and networking that took place on June 12, 2010 at the BC Cancer Agency Research Centre in Vancouver. This event was generously supported by Concord Pacific Harmony Trust
- Each presentation was recorded and is now available for viewing. Follow the link at:
www.bccancer.bc.ca/PPI/Prevention/Hereditary/lynchsyndrome

The **BC Cancer Agency's Library and Cancer Information Centres** provide materials to people in British Columbia and the Yukon. You can visit the main library at 675 W 10th Ave in Vancouver or call 604.675.8001 (1.888.675.8001 local 8001) to request items. There is also a smaller library/information centre within the cancer centres in Vancouver, Victoria, Surrey, Kelowna, and Abbotsford.

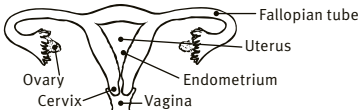


Glossary

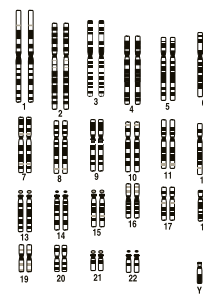
Acquired gene mutation	A change or alteration in a gene within a cell, that happens by chance during a person's life. Caused by aging, exposure to chemicals, radiation, hormones, other factors in the body and the environment.
Cancer screening	Specific medical tests that are done to try to find a cancer at an early stage, when treatment can be most effective. Screening tests are done when there are no symptoms of cancer.
Carrier	A person who is born with an inherited gene mutation.
Cell	The individual unit that makes up the tissues of the body. Human bodies are made up of millions of cells.
Chromosome	"Package" of DNA located within the nucleus of a cell. Normally, the human cell has 46 chromosomes (23 pairs). Genes are located on chromosomes. See Appendix on page 25.
Colon	Part of the digestive system where water is removed from digested food. Between the small bowel and the rectum. Also known as the large bowel or large intestine.

The Digestive System

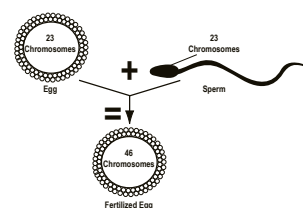
Colonoscopy	Medical test to examine the colon and rectum, done by specially trained doctors. A lighted flexible hollow tube is inserted into the anus. Allows the doctor to see whether polyps or cancer are present, and to remove polyps
Colorectal	Refers to the colon and rectum together. See diagram above.
DNA	DeoxyriboNucleic Acid. Chemical substance that makes up genes. See Appendix on page 25
Endometrial biopsy	A medical test that involves taking a sample of cells from the endometrium to look for signs of cancer.

Endometrium	The lining of the uterus (womb). Cancer of the lining of the uterus is called endometrial cancer. See diagram below. 
Familial adenomatous polyposis (FAP)	An inherited condition that causes hundreds or thousands of small polyps in the colon. Can begin in childhood. If polyps are not removed they are likely to become cancer.
Familial cancer	Refers to cancers caused by a combination of multiple genetic and environmental factors. Also known as multifactorial cancer.
Gene	Section of a chromosome, made up of a specific sequence of DNA. "Recipe" for a specific protein that has a specific function in the cell. See Appendix on page 25.
Hereditary	A disease related to a mutation in a gene which can be passed down (inherited) in a family.
HNPCC	Hereditary Nonpolyposis Colorectal Cancer - also called Lynch syndrome. Most colorectal cancers start as a polyp. Nonpolyposis means that Lynch syndrome does not cause hundreds of polyps (compare with FAP).
Index	The person whose tumour/blood sample is tested first, to try to find a specific gene mutation in a family.
Inherited gene mutation	A change in a gene that is passed down from parent to child (i.e. it is present in every cell in the body at birth). See Hereditary.
Lynch syndrome	Preferred term for an inherited pattern of cancer related to mutations in specific genes. See also HNPCC, Mismatch repair genes.
Mismatch repair gene	A gene that acts as the "spellcheck" system of a cell. The Lynch syndrome genes <i>MLH1</i> , <i>MSH2</i> , <i>MSH6</i> , and <i>PMS2</i> are mismatch repair genes.
Mutation	A change or alteration in a gene that may cause it not to function normally. Mutations may be inherited or acquired.
Polyp	A small mushroom-shaped growth in the lining of the colon or rectum. Some polyps can become cancer if they are not removed.
Primary cancer	Cancer can begin in any organ or tissue of the body. The original tumour is called the primary cancer or primary tumour.
Prophylactic	Surgery to remove healthy tissue with the goal of avoiding cancer in the future.
Rectum	The last 5-6 inches of the large bowel before the anus. See diagram on previous page.
Segmental resection	Surgery to remove only the part of the colon affected by cancer.
Sporadic cancer	Cancer that happens "by chance" or randomly. The biggest risk factor for sporadic cancer is getting older. Other common risk factors include diet and lifestyle.
Transvaginal	Through the vagina e.g. an ultrasound probe is inserted into the vagina to "see" the uterus and ovaries more clearly.
Variant	A change in a gene that is not yet understood, and may or may not have an impact on how the gene works.

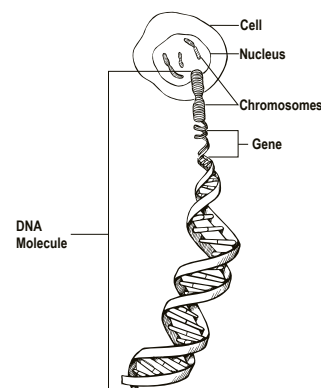
Appendix: What are DNA, chromosomes & genes?



Every cell in the human body contains a chemical substance called deoxyribonucleic acid (DNA). DNA is packaged into structures called chromosomes. Each human cell contains 23 pairs, or a total of 46 chromosomes. The 23rd pair of chromosomes determines our sex – females have 2 "X" chromosomes, and males have 1 "X" and 1 "Y" chromosome.



Chromosomes come in pairs because one set of 23 chromosomes comes from the mother in the egg and the other set comes from the father in the sperm. When a sperm and an egg unite, they form a new cell with 46 chromosomes. When this cell (the fertilized egg) divides, all 46 chromosomes are copied and passed on to every cell that eventually makes up a new human being.



Looking at a single chromosome, we see that its DNA is arranged in units called genes. Genes direct the growth, development and function of the human body; everything from eye colour, to height, to how often cells divide. We have approximately 25,000 different genes, each in a specific place on a specific chromosome. Since we have two copies of every chromosome, we also have two copies of every gene; one copy from each parent.

Sometimes a gene is changed in some way, so that it does not function properly. A change in a gene is called a mutation.

Notes



BC Cancer Agency

CARE + RESEARCH

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