LEUKEMIA & LYMPHOMA SOCIETY®

Biomarker Testing for Cancer Treatment

No. 31 in a series providing the latest information for patients, caregivers and healthcare professionals

Highlights

- A cancer biomarker is associated with the presence of cancer in the body. A biomarker can be produced by the tumor itself, or it may be a specific response by the body to the presence of cancer.
- Each person's cancer has a unique profile or biomarkers. Some biomarkers may affect how certain cancer treatments work.
- Examples of biomarker testing technologies include immunohistochemistry (IHC), flow cytometry, fluorescence in situ hybridization (FISH), next-generation sequencing (NGS), quantitative polymerase chain reaction (qPCR) and liquid biopsies.
- Biomarker testing can help diagnose and monitor cancer as well as guide treatment decisions.
- Precision medicine, also called "personalized medicine," uses information about a person's lifestyle, environment and biology to prevent, diagnose and treat diseases.
- Precision medicine aims to understand the relevant characteristics related to a particular disease and then tailor therapy to that disease.
- Biomarker testing can be costly and is not always covered by insurance. To overcome these barriers and increase access to testing, several states have passed laws requiring healthcare plans to cover biomarker testing and limit the use of prior authorization requirements.

Introduction

Cancer is a result of an uncontrolled growth of abnormal cells, driven by genetic (molecular) changes that are either acquired or inherited from our parents.

In the past, patients with a specific cancer type received the same type of treatment, but research over the last couple of decades has shown tumors have unique characteristics. Each person's cancer has a unique pattern of biomarkers that distinguish their type of cancer from others.

Biomarker testing offers a way to look for genes, proteins, and other substances that can provide information about cancer. Some biomarkers affect how certain cancer treatments work. Biomarker testing can help determine the diagnosis and prognosis (likely outcome) of some cancers and can also guide the selection of the best treatment for each person. Biomarkers can also help doctors monitor cancer during and after treatment.

The ultimate goal of biomarker testing is the development of individualized, highly targeted and effective treatments that can improve patient outcomes.

What are Cancer Biomarkers?

Cancer biomarkers are molecules that indicate either a normal or an abnormal process in the body; abnormal signs, substances, or processes may indicate an underlying disease or condition. Several types of molecules—including DNA, proteins, or RNA—can be used as biomarkers. Biomarkers are produced by the cancer tissue itself or by other cells in the body in response to cancer. Biomarkers may be found in the blood, urine, stool, and cancer tissue, as well as in other tissues and bodily fluids. Biomarkers are not limited to cancer. There are biomarkers for other conditions, such as heart disease, multiple sclerosis and many other diseases.

In cancer treatment, biomarkers are also known as "tumor markers." A tumor marker is anything present in or produced by cancer cells or other cells of the body in response to cancer. There are two main types of tumor markers:

Circulating tumor markers can be found in the blood, urine, stool or other bodily fluids. They can be used to:

- Estimate prognosis
- Assess how well a treatment is working
- Detect cancer that remains after the completion of treatment (measurable residual disease)
- Detect recurrence

An example of a commonly used circulating tumor marker in blood cancer treatment is beta-2-microglobulin. This is a substance measured in blood, urine or cerebrospinal fluid, which is used to estimate prognosis and monitor response to treatment for blood cancers such as multiple myeloma and chronic lymphocytic leukemia.

Tumor tissue markers are found in the actual tumors themselves, generally in a sample of the tissue that is removed during a biopsy. They can be used to:

- Diagnose, stage, and/or classify cancer
- Estimate prognosis
- Select an appropriate treatment, such as a targeted therapy

These types of markers can indicate whether someone is a candidate for a specific targeted therapy. An example of a tumor tissue marker is PD-L1 (programmed cell death ligand 1), which can help determine if a person is a candidate for treatment with an immune checkpoint inhibitor. PD-L1 is a protein that acts as a "brake" to keep the body's immune responses under control. PD-L1 may be found on some normal cells and in higher-than-normal amounts on certain cancer cells.

Cancer biomarkers can be also categorized depending on the particular characteristics of the molecule and their functions in relation to cancer diagnosis or treatment. They can be:

- **Diagnostic markers**—A large group of molecular tests can provide information used in the diagnosis or classification of certain diseases. An example of a diagnostic marker is the presence of the Philadelphia chromosome in chronic myeloid leukemia.
- **Prognostic markers**—These biomarkers help the doctor determine likely patient outcomes, such as overall survival. An example of a prognostic marker is the presence of TP53 mutations (the most commonly mutated gene in people who have cancer). The presence of a TP53 mutation identifies patients who are likely to have a more aggressive disease course, regardless of the treatment used in most cases, although this can be dependent on the specific subtype of cancer a patient has.
- **Predictive markers**—These biomarkers are used to help doctors tailor treatment decisions to a particular patient. They can predict the activity of a specific type of therapy. They indicate the potential benefit of a specific treatment for the intended patient. For example, patients with myelodysplastic syndromes (MDSs) who have the del(5q) mutation have shown improved outcomes when treated with lenalidomide (Revlimid®).

Biomarker Testing

Biomarker testing involves the use of various technologies to understand the underlying characteristics found in cancer cells. Biomarkers are molecules that show either normal or abnormal signs or processes in the body; abnormal signs could indicate disease. Biomarker testing can be used to identify specific biomarkers that are associated with response, resistance or lack of response to certain treatment approaches. This information can lead to the development of targeted therapies which are designed to be more effective for a specific tumor profile (a "profile" is information about the genes within cancer cells).

Biomarker testing for cancer treatment may also be called:

- Tumor testing or subtyping
- Somatic testing
- Genomic testing or genomic profiling
- Molecular testing or molecular profiling

The term "companion diagnostic testing" is used when a biomarker test is intended to be paired with a specific treatment.

Biomarker testing is not the same as genetic testing. Genetic testing looks for changes in genes, gene expression, or chromosomes in cells or tissue of a person. These changes may be a sign of a disease or condition, such as cancer. They may also be a sign a person has an increased risk of developing a specific disease or condition or of having a child or other family member with the disease or condition. Genetic testing may also provide information to help diagnose cancer, plan treatment, or find out how well treatment is working. Genetic testing is typically done on a blood, saliva or skin biopsy sample.

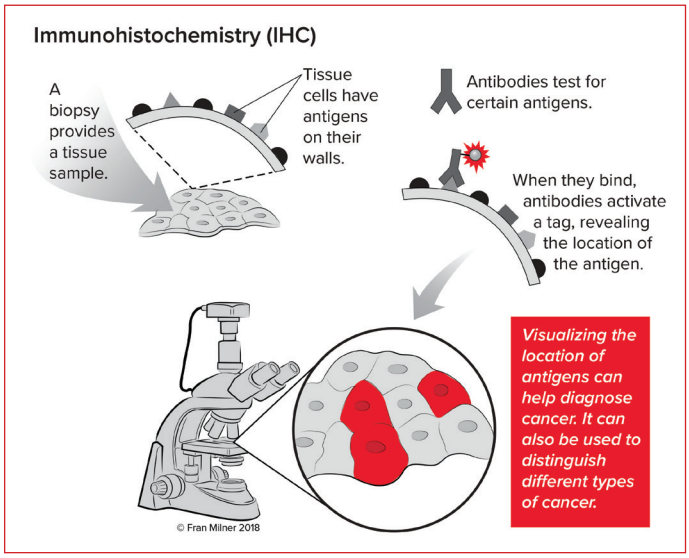
How Biomarker Testing Works. Biomarker testing identifies the specific DNA (deoxyribonucleic acid), RNA (ribonucleic acid), or protein molecule associated with a disorder. First, a biopsy procedure obtains a patient's sample from either tumor tissue, bone marrow, lymph node, or peripheral blood (in cases of some blood cancers where tumor cells or DNA are circulating in the blood). The sample is sent to a laboratory, where it undergoes various tests to identify the unique biomarkers that correspond to the patient's cancer.

Biomarker tests may be run on stored tumor tissue that was collected and saved at the time of diagnosis. Other tests require fresh tissue, which means a new biopsy may be necessary. This is often the case when cancer progresses or becomes resistant to treatment, as new cancer mutations are likely to appear and the patient's biomarker profile changes.

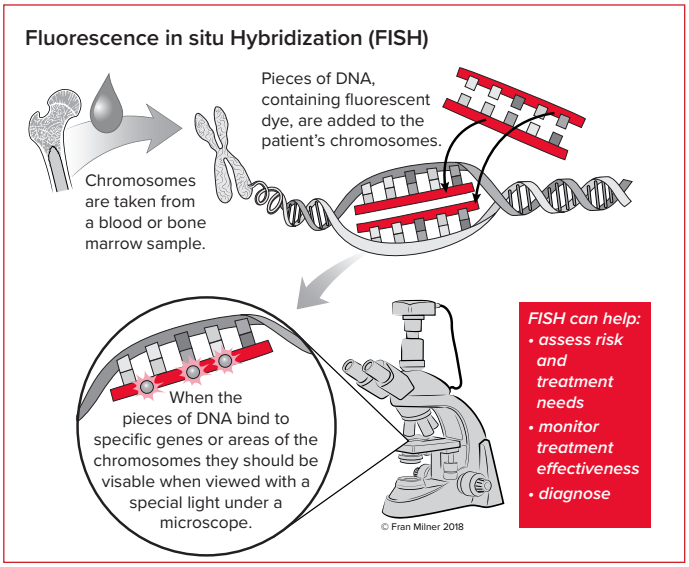
Some tests check for a single biomarker. Others check for many biomarkers at the same time and are called multigene or panel tests. An example of a panel test is Oncotype DX®, which looks for the presence of 21 different genes to help doctors predict which type of therapy is the best option for a patient with breast cancer.

These are some methods currently used for biomarker testing:

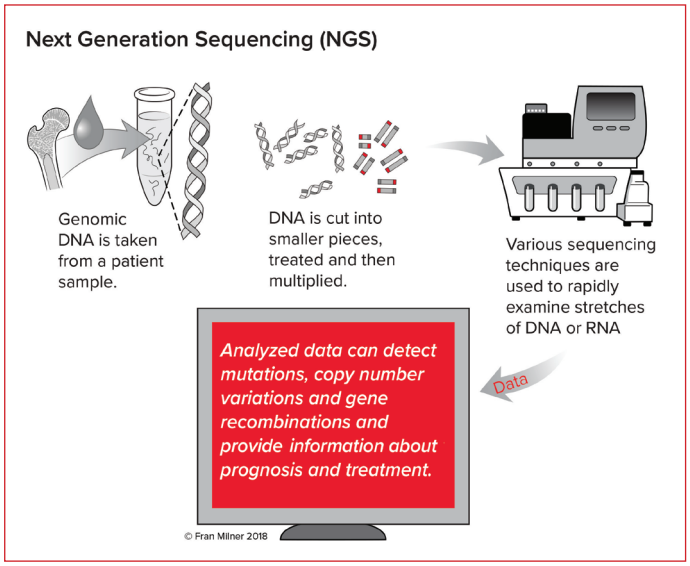
Immunohistochemistry (IHC)—This lab test uses antibodies to detect certain antigens (markers) in a tissue sample acquired from a biopsy. When the antibodies bind to the antigen in the tissue sample, fluorescent dyes or enzymes linked to the antibodies are activated and the antigen can be seen under a microscope. IHC provides information that helps doctors to diagnose diseases such as cancer. It may also be used to distinguish between different types of cancer. A test called "flow cytometry" uses the same principles, except it is performed on a suspension of cells in a liquid, rather than on cells embedded in a tissue sample.



Fluorescence in situ Hybridization (FISH)—This laboratory technique is used to evaluate genes and/or DNA sequences on chromosomes. Cells and tissue are removed using blood or marrow tests. In the laboratory, a fluorescent dye is added to segments of the DNA; the modified DNA is added to cells or tissues on a glass slide. When these pieces of DNA bind to specific genes or areas of chromosomes on the slide, they "glow" when viewed under a microscope that has a special light. In this way, portions of chromosomes that have either increased or decreased in number, or are rearranged, can be identified. FISH can be helpful in diagnosing, assessing risk and treatment needs, as well as for monitoring treatment effectiveness.

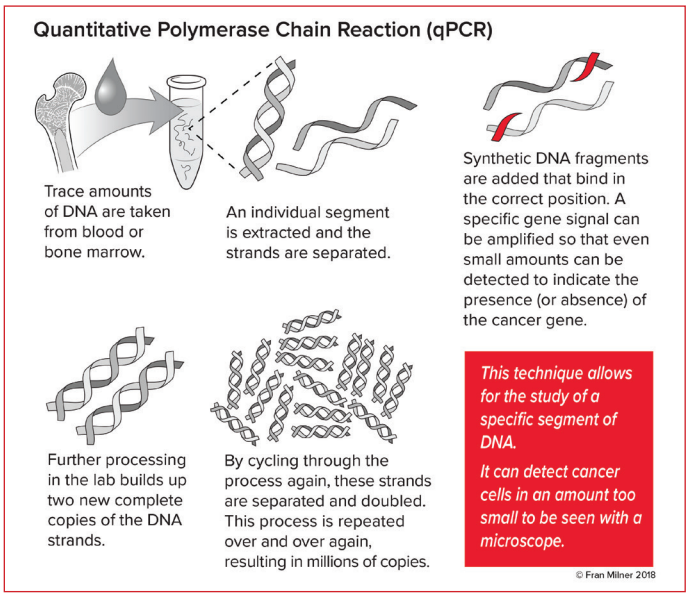


Next-Generation Sequencing (NGS)—This term describes a number of different sequencing technologies. NGS tests rapidly examine stretches of DNA or RNA. They detect DNA mutations, copy number variations and gene fusions across the genome and provide information about prognosis and treatment. NGS is generally used for patients with cancers that can be treated with a targeted therapy. It may also be recommended for patients with advanced cancer not responding to standard treatment. NGS panels can evaluate for mutations in many genes at the same time. Although the average panels range from 20-100 genes, some panels evaluate for more than 600 genes.



Quantitative Polymerase Chain Reaction (qPCR)— This is a technique that expands trace amounts of DNA so a specific segment of DNA can be studied. This technique has become useful in detecting a very low concentration of blood cancer cells-too few to be seen using a microscope.

A test using qPCR can detect the presence of one cancer cell within 100,000 to 1 million healthy cells. A patient's blood or bone marrow is used for this test. These tests are sometimes used to determine the quality of remission and if there is any disease still present (i.e. measurable residual disease [MRD])



Liquid Biopsies— These tests look in blood or other fluids for biomarkers derived from cancer cells. Currently, there are two liquid biopsy tests approved by the Food and Drug Administration (FDA). They are called Guardant360® CDx and FoundationOne® Liquid CDx. Both tests are approved for people with any solid cancer (e.g., lung, prostate), but not for those with blood cancers. Both tests were approved as companion diagnostic tests for lung cancer and prostate cancer therapies. This means the tests determine whether the patient's tumor has a genetic change that is targeted by a specific drug.

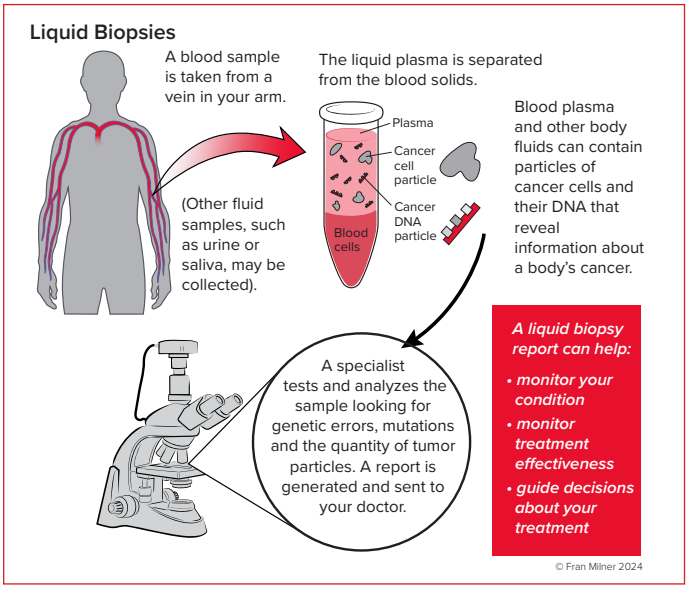


Table 1. Biomarkers Significant for Study and Treatment of Blood Cancers (not all inclusive)

This table lists some of the biomarkers that are currently known to be significant for the study and treatment of blood cancers.

Biomarkers (Chromosome and Gene Alterations)	Associated Cancer	Test Required	Targeted Therapies Associated
Philadelphia chromosome t(9;22) (translocation between chromosomes 9+22)	Chronic myeloid leukemia (CML), acute lymphoblastic leukemia (ALL)	FISH, qPCR, cytogenetics	Responds to imatinib (Gleevec®), dasatinib (Sprycel®), nilotinib (Tasigna®), bosutinib (Bosulif®), ponatinib (Iclusig®), and asciminib (Scemblix®)
IDH2 (R140 or R172) **mutations**	Acute myeloid leukemia (AML)	qPCR, NGS	Responds to enasidenib (Idhifa®)
***IDH1 (R132)* mutations**	AML, myelodysplastic syndrome (MDS)	NGS, qPCR	Responds to ivosidenib (Tibsovo®) and olutasidenib (only approved for AML, Rezlidhia™)
***JAK2, CALR, MPL* mutations**	Myeloproliferative neoplasms (MPNs): polycythemia vera (PV), myelofibrosis (MF)	qPCR, NGS	Responds to ruxolitinib (Jakafi®)
***PDGFRB* rearrangement**	Myelodysplastic/ myeloproliferative syndromes	FISH	Responds to imatinib (Gleevec®)
***PML-RARA* rearrangement**	Acute promyelocytic leukemia (APL)	NGS	Responds to all-trans retinoic acid (ATRA), arsenic trioxide (Trisenox®)
***FLT3-ITD* mutations**	AML	qPCR, NGS	Responds to midostaurin (Rydapt®), gilteritinib (Xospata®), and quizartinib (Vanflyta®)
ALK rearrangement	Anaplastic large-cell lymphoma (ALCL)	FISH, IHC, qPCR	Responds to crizotinib (Xalkori®)
***BRAF V600E* mutation**	Hairy cell leukemia*	NGS	Responds to vemurafenib (Zelboraf®)*

Key: FISH: fluorescence in situ hybridization; IHC: immunohistochemistry; NGS: next-generation sequencing; qPCR: quantitative polymerase chain reaction

*This drug is not FDA approved for this indication.

Adapted from Rack KA. *Leukemia.* 2019; Taylor J. *Blood.* 2017; and Malone E. *Genome Med.* 2020.

Precision Medicine

Precision medicine, also known as "personalized medicine," is defined by the National Cancer Institute as "a form of medicine that uses information about a person's genes, proteins, and environment to prevent, diagnose and treat disease." Precision medicine emerged within the last 30 years as a result of the development and refinement of molecular techniques.

Most tumors have multiple mutations, rather than just the one or two mutations originally suspected. This is an important discovery in recent years and it explains why therapies designed to target a single mutation may not be fully effective. Now, the challenge for researchers and doctors is to use the information biomarker testing provides and determine its implications for targeted therapy. Targeted treatments can be more effective, cause fewer side effects and have a better chance to cure, or at least effectively manage, a disease. Currently, not every form of cancer has biomarkers that researchers and doctors are able to test and target. Further research is needed.

In some cancers, biomarker testing has been instrumental in identifying factors that have led to noteworthy improvements in survival rates. They include:

- A current understanding of the molecular features of tumors
- The development of diagnostic technologies that identify patient biomarkers
- Modern drug development that enables targeting of either specific biomarkers or cellular mechanisms.

The following project/collaborations are helping to move precision medicine forward.

National Cancer Institute (NCI)'s Early Detection Research Network (EDRN). This is a collaborative association of academic and private sector researchers focused on the discovery, development and validation of biomarkers and imaging methods to detect early-stage cancers and to assess risk for developing cancer. One goal of EDRN is to develop biomarker testing that can distinguish aggressive early-stage cancers from slow-growing cancers.

National Cancer Institute (NCI) Cancer Moonshot Biobank. This group works with patient participants around the US to encourage them to donate tissue and blood samples over the duration of their cancer treatment. The samples are sent to researchers who use them to potentially identify new biomarkers.

The Cancer Genome Atlas (TCGA). This project, established by the National Institutes of Health (NIH), was designed to be a resource for groundbreaking research aimed at developing better strategies for preventing, diagnosing and treating cancer. The data from this project – compiled since 2006 – will be publicly available for anyone in the research community to use.

Financial Concerns

The cost of biomarker testing depends on the type of test, diagnosis and the person's health insurance coverage. Some tests are covered by Medicare and Medicaid. When a patient participates in a clinical trial, the trial may cover the cost of biomarker testing.

Private health insurance companies may cover the cost of biomarker testing when they are considered "medically necessary." Insurance companies may consider different factors including:

- Single versus Panel Tests – Tests that look at only one gene are more likely to be covered by insurance
- Diagnosis or Indication – Some biomarker tests are only covered for certain cancer diagnoses. Others are covered when a patient meets certain criteria (e.g. advanced stage cancer)

Some insurance companies require prior authorization, which means the company must approve the cost of the test in advance. A list of approved tests may be provided by the health insurer. Even if a test is not named in a patient's policy, it may be covered when considered medically necessary for the treatment of a specific cancer. Some companies require the use of specific tests, sold by specific companies.

To overcome barriers to testing access, at the state level, as of January 2023, nine states have passed legislation requiring health care plans to cover biomarker testing and limiting the use of prior authorization requirements on this testing. California and Washington have laws that prohibit insurers from requiring preauthorization for biomarker testing for individuals with some advanced stage cancers. Visit https://aimedalliance.org/biomarker-testing-enacted-laws/ for updated information.

Patients can speak to their healthcare team if they have any concerns about the cost of biomarker testing. A member of the team may be able to provide information and suggest resources that can help.

You can contact an LLS Information Specialist at (800) 955-4572 for information about our Co-Pay Assistance Program and other financial assistance

programs. For more information and resources to cope with the financial aspects of cancer care, see the free LLS booklet *Cancer and Your Finances.*

Clinical Trials for Blood Cancers

Every new drug for cancer goes through a series of carefully controlled research studies before it can become part of standard care. These research studies are called "clinical trials" and they are used to find better ways to care for and treat people who have cancer. In the United States, the FDA requires that all new drugs and other treatments be tested in clinical trials before they can be used. At any given time, there are thousands of cancer clinical trials taking place. Doctors and researchers are always looking for new and better ways to treat cancer.

Researchers use cancer clinical trials to study new ways to:

- Treat cancer using
  - A new drug
  - A drug that has been approved, but to treat a different kind of cancer
  - A new combination of drugs
  - A new way of giving a drug—by mouth, intravenously (IV), etc.
- Prevent and/or manage treatment complications
- Manage cancer signs and/or symptoms and ease treatment side effects
- Find and diagnose cancer
- Keep cancer from coming back (recurring) after treatment
- Manage long-term side effects

By taking part in a clinical trial, patients can see doctors who are experts in their disease; gain access to new, cutting-edge therapies; and provide helpful information for future patients. The treatments and information we have today are due in large part to patients being willing to join clinical trials. Anyone interested in being part of a clinical trial should talk to their hematologist-oncologist about whether a clinical trial might be right for them.

During this conversation it may help to:

- Have a list of questions to ask about the risks and benefits of each trial (visit www.LLS.org/WhatToAsk for lists of suggested questions)
- Ask a family member or friend to go with you when you see your doctor—both for support and to take notes

Clinical trials can be difficult to understand and to navigate, but The Leukemia & Lymphoma Society is here to help. Patients and caregivers can work with Clinical Trial Nurse Navigators who will help find potential clinical trials, overcome barriers to enrollment and provide support throughout the entire clinical-trial process. Our Clinical Trial Nurse Navigators are registered nurses who are experts in adult and pediatric blood cancers and clinical trials. Your Clinical Trial Nurse Navigator will:

- Talk with you about your treatment goals
- Help you understand the clinical-trial process, including your rights as a patient
- Ask you for details about your diagnosis (such as past treatments, treatment responses, and your cancer genetic profile), your current health and your medical history, because these might impact whether you can take part in certain clinical trials
- Help you understand how your finances, insurance coverage, support network, and ability and willingness to travel might impact your choice of clinical trials
- Guide and help you in your efforts to find and enroll in a clinical trial, including connecting you with trial sites
- Help deal with any problems you might have as you enroll in a trial
- Support you throughout the clinical-trial process

Please call an LLS Information Specialist at (800) 955-4572 or visit www.LLS.org/CTSC for more information about clinical trials and the Clinical Trial Support Center at LLS.

Also, visit www.LLS.org/booklets to view *Understanding Clinical Trials for Blood Cancers.*

Questions for Your Treatment Team

Biomarker testing may be neither appropriate nor available to every patient or for every cancer diagnosis. Patients should discuss with the members of their treatment team whether or not this is a good option for their particular case. When you have this conversation with your healthcare provider(s), the following questions may be useful.

Questions to ask about biomarker testing:

- Is biomarker testing available for my type of cancer?
- Can I have this type of testing if I have already received treatment?

- What biomarkers are generally associated with my cancer?
- What could biomarker analysis tell me about my specific cancer?
- Does the test require blood or a tissue biopsy?
- Will I need any additional testing? If so, what type of tests?
- Will the testing be covered by my insurance provider? If not, is there financial assistance available?
- Who will perform the biomarker testing? Where will it be performed?
- How long will it take to get results?
- How will you use the results of my tests?
- How likely is it the testing could identify a targeted treatment for my type of cancer?
- What happens if biomarker testing identifies a prescription drug that would be considered "off-label" use, but that may be an effective treatment for me?
- Will I ever need to repeat the testing for my diagnosis?
  - What if my cancer comes back?
  - What if I develop a different form of cancer?

Resources for Patients

My Cancer
www.mycancer.com

My cancer is an educational resource for cancer patients and their caregivers. The site is sponsored by the biotechnology company Caris Life Sciences and is designed to provide information about molecular profiling, cancer biomarkers and the transformation of cancer treatment through ongoing research.

My Cancer Genome
www.mycancergenome.org

A precision cancer medicine resource for physicians, patients, caregivers and researchers that provides up-to-date information on mutations, available therapies and clinical trials. It is managed by the Vanderbilt-Ingram Cancer Center

Triage Cancer
www.triagecancer.org

Provides free education on legal and practical issues that affect individuals diagnosed with cancer and their caregivers. This organization helps patients know their options by providing free counseling when an insurance claim is denied.

Health Terms

Copy number variations. Sections of the genome that are repeated. The number of times they are repeated varies from person to person as well as between some tumor cells and normal cells.

Cytotoxic. Toxic (harmful or poisonous) to living cells.

DNA. The molecules inside cells that carry genetic information and pass it from one generation to the next. Also called "deoxyribonucleic acid."

DNA sequencing. The process of determining the precise order of nucleotides (which form the basic structural unit of DNA) within a DNA molecule.

Gene. The functional and physical unit of heredity passed from parent to offspring. Genes are pieces of DNA, and most genes contain the information for making a specific protein.

Genome. The complete set of DNA (genetic material) in an organism. In people, almost every cell in the body contains a complete copy of the genome. The genome contains all the information needed for a person to develop and grow.

Hereditary Mutation. Inherited from a parent and present throughout a person's life in virtually every cell in the body. These mutations are also called "germline mutations" because they are present in the parent's egg or sperm cells, which are also called "germ cells."

Mutation. A change in a DNA sequence. Mutations can result from DNA copying mistakes made during cell division, exposure to ionizing radiation, exposure to chemicals or exposure to infection by viruses.

Molecular profiling. Various technologies used to identify cancer biomarkers associated with either the response or the resistance to certain treatments. The information gathered is used to identify and create targeted therapies designed to work better for a specific cancer or tumor profile. Also known as biomarker testing.

Protein. A molecule made up of amino acids. Proteins are needed for the body to function properly. They are the basis of body structures such as skin and hair and of other substances such as enzymes, cytokines and antibodies.

Precision medicine (personalized medicine). This type of treatment uses information about a person's lifestyle, environment, and biology to prevent, diagnose and treat diseases.

Prior authorization. Refers to a requirement by health care plans for patients to obtain approval of a health care service or medication before the care is provided.

Acknowledgement

LLS appreciates the review of this material by

David Sallman, MD
Associate Member, Myeloid Section Head,
Department of Malignant Hematology
H. Lee Moffitt Cancer Center & Research Institute
Tampa, FL

We're Here to Help

LLS is the world's largest voluntary health organization dedicated to funding blood cancer research, education and patient services. LLS has regions throughout the United States and in Canada. To find the region nearest to you, visit our website at www.LLS.org/LocalPrograms or contact an Information Specialist at (800) 955-4572.

LLS offers free information and services for patients and families affected by blood cancers. This section lists various resources you may find helpful.

For Help and Information

Consult with an Information Specialist. Information Specialists can assist you through cancer treatment and financial and social challenges, and provide accurate, up-to-date disease, treatment and support information. Our Information Specialists are highly trained oncology social workers and nurses. Language services are available. For more information, please:

- Call: (800) 955-4572 (Monday through Friday, 9 a.m. to 9 p.m. ET)
- Email and Live chat: www.LLS.org/InformationSpecialists

Clinical Trials (Research Studies). Research is ongoing to develop new treatment options for patients. LLS offers help for patients and caregivers in understanding, identifying and accessing clinical trials. Pediatric and adult patients and caregivers can work with our Clinical Trial Nurse Navigators who will help find clinical trials and provide personalized support throughout the entire clinical trial process. Visit www.LLS.org/CTSC for more information.

Nutrition Consultations. Schedule a free one-on-one nutrition consultation with one of our registered dietitians who have expertise in oncology nutrition. Consultations are available to patients of all cancer types and their caregivers. Dietitians can assist with information about healthy eating strategies, side effect management and more. Please visit www.LLS.org/nutrition for more information.

Free Information Booklets. LLS offers free education and support booklets for patients, caregivers and healthcare professionals that can either be read online or ordered. Please visit www.LLS.org/booklets for more information.

Telephone/Web Education Programs. LLS offers free telephone/web and video education programs for patients, caregivers and healthcare professionals. Please visit www.LLS.org/programs for more information.

Financial Assistance. LLS offers financial support to eligible individuals with blood cancer for insurance premiums, co-pays, and non-medical expenses like travel, food, utilities, housing, etc. For more information, please:

- Call: (877) 557-2672
- Visit: www.LLS.org/finances

Resources for Families. Blood cancer occurs in a small number of children. As families face new challenges, the child, parents and siblings may all need support. LLS has many materials for families including a caregiver workbook, children's book series, an emotion flipbook, dry erase calendar, coloring books and a coloring app, a school re-entry program, and other resources. For more information, please:

- Call: (800) 955-4572
- Visit: www.LLS.org/FamilyWorkbook

Podcast. The Bloodline with LLS is here to remind you that after a diagnosis comes hope. Listen in as patients, caregivers, advocates, doctors and other healthcare professionals discuss diagnosis, treatment options, quality-of-life concerns, treatment side effects, doctor/patient communication and other important survivorship topics. Visit www.LLS.org/TheBloodline for more information and to subscribe to access exclusive content, submit ideas and topics, and connect with other listeners.

3D Models. LLS offers interactive 3D images to help visualize and better understand blood cell development, intrathecal therapy, leukemia, lymphoma, myeloma, MDS, MPNs and lab and imaging tests. Visit www.LLS.org/3D for more information.

Free Mobile Apps.

- LLS Coloring For Kids™ – Allows children (and adults) to express their creativity and offers activities to help them learn about blood cancer and its treatment. Visit www.LLS.org/ColoringApp to download for free.
- LLS Health Manager™ – Helps you track side effects, medication, food and hydration, questions for your doctor, and more. Visit www.LLS.org/HealthManager to download for free.

Suggested Reading. LLS provides a list of selected books recommended for patients, caregivers, children and teens. Visit www.LLS.org/SuggestedReading to find out more.

Connecting with Patients, Caregivers and Community Resources

LLS Community. The one-stop virtual meeting place for talking with other patients and receiving the latest blood cancer resources and information. Share your experiences with other patients and caregivers and get personalized support from trained LLS staff. Visit www.LLS.org/community to join.

Weekly Online Chats. Moderated online chats can provide support and help cancer patients and caregivers reach out and share information. Please visit www.LLS.org/chat for more information.

Local Programs. LLS offers community support and services in the United States and Canada including the *Patti Robinson Kaufmann First Connection® Program* (a peer-to-peer support program), local support groups and other great resources. For more information about these programs or to contact your region, please:

- Call: (800) 955-4572
- Visit: www.LLS.org/LocalPrograms

Advocacy and Public Policy. Working closely with dedicated volunteer advocates, LLS's Office of Public Policy elevates the voices of patients to state and federal elected officials, the White House, governors and even courts. Together, we advocate for safe and effective treatments. We pursue policies that would make care more accessible to all patients. And, most of all, we advocate for the hope for a cure. Want to join our work? Visit www.LLS.org/advocacy for more information.

Other Helpful Organizations. LLS offers an extensive list of resources for patients and families. There are resources that provide help with financial assistance, counseling, transportation, patient care and other needs. For more information, please visit www.LLS.org/ResourceDirectory to view the directory.

Additional Help for Specific Populations

Información en Español (LLS information in Spanish). Please visit www.LLS.org/espanol for more information.

Language Services. Let members of your healthcare team know if you need translation or interpreting services because English is not your native language, or if you need other assistance, such as a sign language interpreter. Often these services are free.

Information for Veterans. Veterans who were exposed to Agent Orange while serving in Vietnam may be able to get help from the United States Department of Veterans Affairs. For more information, please

- Call: the VA (800) 749-8387
- Visit: www.publichealth.va.gov/exposures/AgentOrange

Information for Firefighters. Firefighters are at an increased risk of developing cancer. There are steps that firefighters can take to reduce the risk. Please visit www.LLS.org/FireFighters for resources and information.

World Trade Center Health Program. People involved in the aftermath of the 9/11 attacks and subsequently diagnosed with a blood cancer may be able to get help from the World Trade Center (WTC) Health Program. People eligible for help include:

- Responders
- Workers and volunteers who helped with rescue, recovery and cleanup at the WTC-related sites in New York City (NYC)
- Survivors who were in the NYC disaster area and those who lived, worked or were in school in that area
- Responders to the Pentagon and the Shanksville, PA, crashes

For more information, please

- Call: WTC Health Program at (888) 982-4748
- Visit: www.cdc.gov/wtc/faq.html

People Suffering from Depression. Treating depression has benefits for cancer patients. Seek medical advice if your mood does not improve over time; for example, if you feel depressed every day for a two-week period, reach out to a mental health professional. For more information, please:

- Call: The National Institute of Mental Health (NIMH) at (866) 615-6464
- Visit: NIMH at www.nimh.nih.gov and enter "depression" in the search box.

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