PIP Digest

Canadian Cancer Research Alliance
Alliance canadienne pour la recherche sur le cancer

Patient Involvement in Cancer Research Program
Programme de Participation des Patients à la recherche sur le cancer

This PIP Digest presents a glossary of selected terms relevant to cancer research. It is designed to help you understand terminology that you may encounter when attending cancer research conferences or reviewing scientific papers.

REFERENCE MATERIAL: Glossary of Cancer Research Terms

Several excellent cancer and research-related glossaries are available online and some of these terms and definitions are used in this glossary. To access the full resources, see:

- Canadian Cancer Society Cancer Glossary
- CIHR Jargon Buster
- BioCanRx – The Immune System and Immunotherapy Glossary. Reprinted with permission from Patient Resource LLC and the Society for Immunotherapy of Cancer (SITC). Copyright Patient Resource LLC.
- American Cancer Society Cancer Glossary
- The NCI Dictionary of Cancer Terms, a very comprehensive source with over 9,000 terms related to cancer and medicine
- The Multilingual Cancer Glossary, a project of the Cancer Australia Supporting people with cancer Grant initiative that provides terms in multiple languages
- The National Human Genome Research Institute (NHGRI), an excellent source of understandable information on genomics that also has a "Talking Glossary of Genetic Terms"
- The University of Saskatchewan offers the "Generative Artificial Intelligence: Glossary of AI Related Terms"

Please note that in our glossary the source for the definition is provided in square brackets after the definition. If other sources are used, these are noted.

A

Adverse event: An unexpected medical problem that happens during treatment with a drug or other therapy. Adverse events do not have to be caused by the drug or therapy, and they may be mild, moderate, or severe. Also called adverse effect. [NCI]

Angiogenesis: Blood vessel formation. Tumour angiogenesis is the growth of new blood vessels that tumours need to grow. This process is caused by the release of chemicals by the tumour and by cells near the tumour. [NCI]

Antibody: A protein created by B-cells in direct response to specific antigens. An antibody attaches itself to its respective antigen, marking it for other immune cells to "see" and destroy. [Patient Resource LLC]

Antigen: A protein produced by a cell, virus or bacteria. In the case of cancer antigens, the protein or part of a protein is on the surface of the cancer cell. It alerts the immune system and causes the production of antibodies or the creation of T-cells that can recognize and potentially destroy the cancer cells expressing that antigen. [Patient Resource LLC]

Antigen-presenting cells (APCs): Special cells that digest invading cells or soluble (can be dissolved in water) protein antigens and present them to the T-cells and B-cells so they know what to attack. [Patient Resource LLC]

Apoptosis: A type of cell death in which a series of molecular steps in a cell lead to its death. This is one method the body uses to get rid of unneeded or abnormal cells. The process of apoptosis may be blocked in cancer cells. Also called programmed cell death. [NCI]

Autophagy: A normal process in which a cell destroys proteins and other substances in its cytoplasm (the fluid inside the cell membrane but outside the nucleus), which may lead to cell death. Autophagy may prevent normal cells from developing into cancer cells, but it may also protect cancer cells by destroying anti-cancer drugs or substances taken up by them. [NCI]

B

B-cells: Immune cells that produce antibodies for specific antigens that will bind to the antigens and mark them for destruction by other immune cells. [Patient Resource LLC]

Bioinformatics: The science of using computers, databases, and math to organize and analyze large amounts of biological, medical, and health information. Information may come from many sources, including patient statistics, tissue specimens, genetics research, and clinical trials. [NCI]

Biologic product: Medications made from living organisms, such as vaccines, human cells and tissues, and gene therapies. [Patient Resource LLC]

Biomarker: A biological molecule found in blood, other body fluids, or tissues that is a sign of a normal or abnormal process, or of a condition or disease. A biomarker may be used to see how well the body responds to a cancer treatment. Also called molecular marker and signature molecule. Biomarkers can be detected from invasive procedures (taking blood samples) or by imaging (PET scan). [Adapted from NCI]

Biorepository: Also called a biobank. A facility that collects, catalogs, and stores samples of biological material (**biospecimens**), such as urine, blood, tissue, cells, DNA, RNA, and protein, from humans, animals, or plants for laboratory research. If the samples are from people, medical information may also be stored along with a written consent to use the samples in laboratory studies. [NCI]

Biosimilar: A biologic drug demonstrated to be similar to a brand name drug already authorized for sale (known as the reference biologic drug). Biosimilars were previously known in Canada as subsequent entry biologics (SEBs). Biosimilars may enter the market after the expiry of reference biologic drug patents and data protections. Biosimilars are regulated as new drugs under the Food and Drugs Act and the Food and Drug Regulations. To obtain authorization as a biosimilar, the drug manufacturer must provide information to Health Canada to show that the biosimilar and the reference biologic drug are similar and that there are no clinically meaningful differences in terms of safety and efficacy

between them. [From: https://www.canada.ca/en/health-canada/services/drugs-health-products/biologics-radiopharmaceuticals-genetic-therapies/biosimilar-biologic-drugs.html]

Biospecimen: Samples of material, such as urine, blood, tissue, cells, DNA, RNA, and protein from humans, animals, or plants. Biospecimens are stored in a **biorepository** and are used for laboratory research. If the samples are from people, medical information may also be stored along with a written consent to use the samples in laboratory studies. [NCI]

Biostatistics: The science of collecting and analyzing biologic or health data using statistical methods. Biostatistics may be used to help learn the possible causes of a cancer or how often a cancer occurs in a certain group of people. [NCI]

C

Cachexia: Loss of body weight and muscle mass, and weakness that may occur in patients with cancer, AIDS, or other chronic diseases. [NCI]

Cancer incidence rate: The number of new cancers of a specific site/type occurring in a specified population during a year. Usually expressed as the number of cancers per 100,000 population at risk. [Multilingual Cancer Glossary]

Cancer stem cells: Cells that divide to replenish a population of cancer cells. They are the cells that survive a therapeutic treatment that destroys the vast majority of the tumour. Cancer stem cells (CSCs) divide to produce cells that make up the returning tumour and are often the cells that leave the primary tumour, survive in the blood stream, and metastasize to distant organs. Also called tumour initiating cells. [Adapted from: Nguyen, D.H. (2016). *Systems Biology of Tumour Physiology: Rethinking the Past, Defining the Future*, Chapter 2, Cellular plasticity, cancer stem cells, and cells-of-origin. Springer.]

Carcinogen: A carcinogen is an agent with the capacity to cause cancer in humans. Carcinogens may be natural, such as aflatoxin, which is produced by a fungus and sometimes found on stored grains, or manmade, such as asbestos or tobacco smoke. Carcinogens work by interacting with a cell's DNA and inducing genetic mutations. [NHGRI]

Cell Death: If a cell has an error in its DNA that cannot be repaired, it may undergo programmed cell death (apoptosis). Apoptosis is a common process throughout life that helps the body get rid of cells it doesn't need. Cells that undergo apoptosis break apart and are recycled by a type of white blood cell called a macrophage. Apoptosis protects the body by removing genetically damaged cells that could lead to cancer, and it plays an important role in the development of the embryo and the maintenance of adult tissues. [From https://medlineplus.gov/genetics/understanding/howgeneswork/]

Cell Division: There are two types of cell division: mitosis and meiosis. Most of the time when people refer to "cell division," they mean mitosis, the process of making new body cells. Meiosis is the type of cell division that creates egg and sperm cells. Mitosis is a fundamental process for life. During mitosis, a cell duplicates all its contents, including

its chromosomes, and splits to form two identical daughter cells. Because this process is so critical, the steps of mitosis are carefully controlled by a number of genes. When mitosis is not regulated correctly, health problems such as cancer can result. The other type of cell division, meiosis, ensures that humans have the same number of chromosomes in each generation. It is a two-step process that reduces the chromosome number by half—from 46 to 23—to form sperm and egg cells. When the sperm and egg cells unite at conception, each contributes 23 chromosomes so the resulting embryo will have the usual 46. Meiosis also allows genetic variation through a process of DNA shuffling while the cells are dividing. [From https://medlineplus.gov/genetics/understanding/howgeneswork/]

Cell Plasticity: The potential of a differentiated cell (a cell that has matured to have a specific function and identify) to de-differentiate back into a stem-like state and then to differentiate into a new state. The premise is that a cell's identity and function are not permanently fixed after a cell has differentiated. Within a tumour, neighbouring cells change from one shape to another in ways that normal cells do not. [Adapted from: Nguyen, D.H. (2016). *Systems Biology of Tumour Physiology: Rethinking the Past, Defining the Future*, Chapter 2, Cellular plasticity, cancer stem cells, and cells-of-origin. Springer.]

Chromatin: Chromatin is a substance within a chromosome consisting of DNA and protein. The DNA carries the cell's genetic instructions. The major proteins in chromatin are histones, which help package the DNA in a compact form that fits in the cell nucleus. Changes in chromatin structure are associated with DNA replication and gene expression. [NHGRI]

Chromosome: Thread-like structures located inside the cell nucleus. Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure. Except for sperm and eggs, all human cells contain 46 chromosomes (23 pairs). [Adapted from NCI; NHGRI]

Cohort study: A research study that compares a particular outcome (such as lung cancer) in groups of individuals who are alike in many ways but differ by a certain characteristic (for example, female nurses who smoke compared with those who do not smoke). [NCI]

Complementary and alternative medicine: Forms of treatment that are used in addition to (complementary) or instead of (alternative) standard treatments. These practices generally are not considered standard medical approaches. Standard treatments go through a long and careful research process to prove they are safe and effective, but less is known about most types of complementary and alternative medicine. Complementary and alternative medicine may include dietary supplements, megadose vitamins, herbal preparations, special teas, acupuncture, massage therapy, magnet therapy, spiritual healing, and meditation. Also called CAM. [NCI]

Confidence interval: It is impossible to study every single person in a given population, so researchers select a sample or sub-group of the population. This means that the researcher can only estimate the parameters (i.e. characteristics) of a population, the estimated range being calculated from a set of sample data. Therefore, a confidence interval is a way to measure how well your sample represents the population you are studying. The probability that the confidence interval includes the true value within a population is called the confidence level of the confidence interval. You can calculate a confidence interval for any confidence level you like, but the most commonly used value is 95%. A 95% confidence interval tells us that we can be 95% certain that the true rate lies somewhere

between the lower and upper limits of the confidence interval. (Adapted from https://www.simplypsychology.org/confidence-interval.html)

Co-stimulatory signal: The second stimulation required for T-cells to become fully activated (also called Signal 2). [Patient Resource LLC]

CRISPR-Cas9: A laboratory tool used to change or "edit" pieces of a cell's DNA. CRISPR-Cas9 uses a specially designed RNA molecule to guide an enzyme called Cas9 to a specific sequence of DNA. Cas9 then cuts the strands of DNA at that point and removes a small piece, causing a gap in the DNA where a new piece of DNA can be added. CRISPR-Cas9 is a breakthrough in science that will have important uses in many kinds of research. In cancer research, it may help to understand how cancer forms and responds to treatment as well as new ways to diagnose, treat, and prevent it. [NCI]

CTLA-4 (cytotoxic T lymphocyte associated antigen 4): A protein receptor found on the surface of T-cells. This protein is part of the CTLA-4 checkpoint pathway, which can shut down an immune system response in its early stages. Certain cancer cells have the ability to turn on this checkpoint, which stops the immune response against the cancer cells. [Patient Resource LLC]

Cytokines: Proteins released by immune cells to communicate with other immune cells. Certain cytokines, such as interferon and interleukin, help regulate specific immune system functions. [Patient Resource LLC]

Cytotoxicity: Refers to the ability of certain chemicals or mediator cells to destroy living cells by inducing either accidental cell death (necrosis) or programmed cell death (apoptosis). Given this information, the ability to accurately measure cytotoxicity can prove to be a very valuable tool in identifying compounds that might pose certain health risks to humans. Furthermore, by determining the cytotoxicity levels of cancer cells themselves, new drugs can be developed to hinder the proliferation of cancer cells by disrupting their genetic material or by blocking the nutrients that the cells need to survive. [Adapted from : https://info.gbiosciences.com/blog/bid/164400/what-is-cell-cytotoxicity-and-how-to-measure-it]

D

Dendritic cell (DC): A type of antigen-presenting cell responsible for processing antigen material and presenting it to the T-cells and B-cells for activation. DCs can also help regulate other immune cells. [Patient Resource LLC]

DNA: Abbreviation for deoxyribonucleic acid, the molecules inside cells that carry genetic information and pass it from one generation to the next. [NCI]

DNA methylation: An epigenetic mechanism that occurs by the addition of a methyl group to DNA, thereby often modifying the function of the genes and affecting gene expression. [From https://www.whatisepigenetics.com/dna-methylation/]

DNA repair: The process by which a cell uses a series of special enzymes to repair mutations (changes) in DNA and restore the DNA to its original state. The DNA is constantly mutating and being repaired. This repair process is controlled by special genes. A mutation in a DNA repair gene can cripple the repair process and cause a cascade of unrepaired mutations in the genome. [NCI]

Dormancy: A stage in cancer progression where the cells cease dividing but survive in a quiescent (inactive) state while waiting for appropriate environmental conditions to begin proliferation again. [From https://en.wikipedia.org/wiki/Cancer_dormancy]

Downregulation: Reducing either the overall immune system response or the specific responses of certain immune cells. [Patient Resource LLC]

E

Environmental risk factors: Things in your environment that may increase the risk of developing cancer. [From https://www.cancercenter.com/community/blog/2018/02/what-are-the-environmental-risk-factors-and-how-can-i-avoid-them]

Epidemiology: The study of the patterns, causes, and control of disease in groups of people. [NCI]

Epigenetics: An emerging field of science that studies heritable changes caused by the activation and deactivation of genes without any change in the underlying DNA sequence of the organism. The word epigenetics is of Greek origin and literally means over and above (epi) the genome. [NHGRI]

Epigenomics: The study of all the epigenetic changes in a cell. Epigenetic changes are changes in the way genes are switched on and off without changing the actual DNA sequence. They may be caused by age and exposure to environmental factors, such as diet, exercise, drugs, and chemicals. Epigenetic changes can affect a person's risk of disease and may be passed from parents to their children. [NCI]

Etiology: The cause of a disease. There are many possible causes of cancer. Research shows that both genetics (genes passed on from your parents) and lifestyle (including exposures to carcinogens) are major factors in many cancers. [ACS]

G

Gene-environment interaction: A situation in which the effect of genes depends on the environment and/or the effect of the environment depends on genotype. Often used to mean that both genes and environments are important. [From Dick, D.M. (2011). Gene-environment interaction in psychological traits and disorders. *Annual Review of Clinical Psychology*, 7: 383–409. PMC3647367]

Genome-wide association study: A study that compares DNA markers across the genome (the complete genetic material in a person) in people with cancer or other diseases and traits to people without these conditions/traits. These studies may uncover clues to help prevent, diagnose, and treat cancer and other diseases. Abbreviated as GWAS. [NCI]

Germline mutation: A gene change in a body's reproductive cell (egg or sperm) that becomes incorporated into the DNA of every cell in the body of the offspring. Germline mutations are passed on from parents to offspring. Also called hereditary mutation. [NCI]

Graft-Versus-Host Disease (GVHD): The condition that results when the immune cells of a transplant (usually a bone marrow or other type of stem cell transplant) from a donor attack the tissues of the person receiving the transplant. [ACS]

Granulocyte-macrophage colony stimulating factor (GM-CSF): A protein responsible for stimulating bone marrow and promoting the growth of immune cells, especially dendritic cells. GM-CSF is currently used to restore white blood cells that have been depleted in people receiving chemotherapy and is being used and studied as a treatment boost when combined with other immunotherapies. [Patient Resource LLC]

Growth factor: A substance made by the body that functions to regulate cell division and cell survival. Some growth factors are also produced in the laboratory and used in biological therapy. [NCI]

H

Hazard ratio: A measure of how often a specific event happens in one group compared to how often it happens in another group, over time. In cancer research, hazard ratios are often used in clinical trials to measure survival at any point in time in a group of patients who have been given a specific treatment compared to a control group given another treatment or a placebo. A hazard ratio of one means that there is no difference in survival between the two groups. A hazard ratio of greater than one or less than one means that survival was better in one of the groups. [NCI]

Histones: A family of basic proteins that associate with DNA in the nucleus and help condense it into chromatin. Nuclear DNA does not appear in free linear strands; it is highly condensed and wrapped around histones in order to fit inside of the nucleus and take part in the formation of chromosomes. Some histones function as spools for the thread-like DNA to wrap around. [From https://www.nature.com/scitable/definition/histones-57/]

Hypothesis: A proposed explanation for some event or phenomenon when the actual cause is either not known or does not adequately explain what is observed. A scientific hypothesis must explain all of the results of a study, and be testable, repeatable, and refutable (capable of being proven wrong). However, a scientific hypothesis can never be absolutely proven correct, because there is always the possibility that the real explanation is beyond our present state of knowledge. [CIHR]

Hypoxia: A condition in which there is a decrease in the oxygen supply to a tissue. In cancer treatment, the level of hypoxia in a tumour may help predict the response of the tumour to the treatment. [NCI]

I

Immune cells: The cells of the immune system involved in defending the body against infectious disease, foreign invaders and cancer cells. [Patient Resource LLC]

Immune checkpoint inhibitors: Drugs that block the activation of specific immune checkpoint pathways. These drugs allow the immune system to 'take the brakes off,' which allows the immune system to recognize and attack cancer cells. [Patient Resource LLC]

Immune checkpoint pathways: The system of checks and balances in place to prevent overactivation of the immune system. Different pathways function at different stages of the immune response to help regulate the length and intensity of T-cell activity; turning on an immune checkpoint typically results in shutting down the immune system response. [Patient Resource LLC]

Immune-related adverse events (IRAEs): Auto- immune reactions that occur as a result of boosting the immune system. Severe reactions may include colitis, dermatitis and hepatitis. [Patient Resource LLC]

Immunosuppression: A condition in which the immune system is prevented from launching successful attacks to protect the body against infection and disease. [Patient Resource LLC]

Immunotherapy: A treatment that uses certain parts of a person's immune system to fight diseases such as cancer. This can be done in a couple of ways: stimulating your own immune system to work harder or smarter to attack cancer cells; giving you immune system components, such as engineered immune system proteins. Some types of immunotherapy are also sometimes called biologic therapy or biotherapy. [From https://www.cancer.org/cancer/managing-cancer/treatment-types/immunotherapy.html]

- Cold tumours: tumours that for various reasons contain few infiltrating T cells and are not recognized nor provoke a strong response by the immune system. This makes them difficult to treat with current immunotherapies.
- Hot tumours: tumours where T cells are present and can be more easily mobilized against the cancer by current immunotherapies.

Research is underway on how to enhance immunotherapy to activate the immune system to destroy cancer cells, thereby turning immunologically "cold" tumours into "hot" ones.

Implementation science: The scientific study of methods and strategies that facilitate the uptake of evidence-based practice and research into regular use by practitioners and policymakers. The field of implementation science seeks to systematically close the gap between what we know and what we do (often referred to as the know-do gap) by identifying and addressing the barriers that slow or halt the uptake of proven health interventions and evidence-based practices. [From https://impsciuw.org/implementation-science/learn/implementation-science-overview/]

Infectious agents: Viruses, bacteria, and parasites that may cause cancer or increase the risk that cancer will form. Some viruses can disrupt signaling that normally keeps cell growth and proliferation in check. Some infections weaken the immune system, making the body less able to fight off other cancer-causing infections. And some viruses, bacteria, and parasites also cause chronic inflammation, which may lead to cancer. [From https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents]

Informed Consent: In any study involving humans, it is crucial that the participants voluntarily agree to take part in the research, and that they do so with a full understanding of their rights and the possible risks associated with participating in the study. Throughout the entire study, the researcher has an ethical obligation to share plain-language information with all participants that will enable them to give their free and informed consent. [CIHR]

In silico: scientific experiments or research conducted or produced by means of computer modeling or computer simulation. Some examples:

- automated testing of large numbers of chemical and/or biological compounds for a specific biological target (high-throughput screening for drug discovery)
- data mining approaches used to analyze vast repositories of genetic data
- computational approaches applied to understand and predict the complex dynamics of biological systems (computational biology)

Interferon: A protein released by immune cells that helps regulate different immune cell activity; types of interferon include alpha, beta, gamma and lambda. Different types help regulate different functions, including prompting increased T-cell activity, stimulating natural killer cells or affecting certain cell functions that influence tumor cell growth. Laboratory-made versions of the IFN-alpha protein are currently FDA-approved to treat certain types of cancer. [Patient Resource LLC]

Interleukin: A protein produced by cells of the immune system that helps regulate the production of certain immune cells, how they function during an immune response and their production of cytokines. The laboratory-made version of this protein, aldesleukin (Proleukin), is currently FDA-approved to treat metastatic melanoma and metastatic renal cell carcinoma (kidney cancer). [Patient Resource LLC]

Invasion/invasive cancer: Cancer that has spread beyond the layer of tissue in which it developed and is growing into surrounding, healthy tissues. [NCI]

Investigational drug: A drug that has been tested in the laboratory and has been approved by Health Canada for testing in people. Clinical trials test how well investigational drugs work and whether they are safe to use. An investigational drug may be approved by the Health Canada for use in one disease or condition but still be considered investigational in other diseases or conditions (off-label). Health Canada recently introduced a process for evaluating off-label use of authorized drugs in clinical trials. [See https://www.canada.ca/en/health-canada/services/drugs-health-products/drug-products/announcements/notice-statement-investigational-use-marketed-drugs-clinical-trials.html]

In vitro: In the laboratory (outside the body). In vitro studies are those are performed with microorganisms, cells, or biological molecules outside their normal biological context, like in a test tube or laboratory dish.

In vivo: In the body. In vivo studies are those conducted on living organisms.

K

Kinase: A type of enzyme (a protein that speeds up chemical reactions in the body) that adds chemicals called phosphates to other molecules, such as sugars or proteins. This may cause other molecules in the cell to become either active or inactive. Kinases are a part of many cell processes. Some cancer treatments target certain kinases that are linked to cancer. [NCI]

Kinase inhibitor: A substance that blocks a type of enzyme called a kinase. Human cells have many different kinases, and they help control important functions, such as cell signaling, metabolism, division, and survival. Certain kinases are more active in some types of cancer cells and blocking them may help keep the cancer cells from growing. Kinase inhibitors may also block the growth of new blood vessels that tumors need to grow. Some kinase inhibitors are used to treat cancer. [NCI]

Knowledge Translation (KT): A process of summarizing, distributing, sharing, and applying the knowledge developed by researchers to improve the health of the population, and strengthen the health care system through the use of more effective health services, products, and standards of practice. Integrated KT is a form of KT where researchers and knowledge users (e.g., policymakers, clinicians, patients) work together to determine research questions, decide on methodology, collect data, develop tools, interpret findings, and disseminate research results. This approach is intended to produce research findings that are more likely to be relevant to, and used by, the end users than studies designed and conducted by researchers alone. [CIHR] This may also be known as Knowledge Transfer and Exchange (KTE).

L

Ligands: Protein molecules on the surface of a cell that bind to the receptor on the surface of another cell. Most ligands are signal-triggering molecules, which means they send out immune cell signals when engaged by a receptor. These signals help to regulate specific immune system functions. [Patient Resource LLC]

Liquid biopsy: A test done on a sample of blood to look for cancer cells from a tumor that are circulating in the blood or for pieces of DNA from tumor cells that are in the blood. A liquid biopsy may be used to help find cancer at an early stage. It may also be used to help plan treatment or to find out how well a treatment is working or if cancer has come back. Being able to take multiple samples of blood over time may also help doctors understand what kind of molecular changes are taking place in a tumor. [NCI]

M

Major histocompatibility complex (MHC): A set of proteins on the surface of certain immune cells that influence the interaction of normal cells with immune cells. Antigen-presenting cells present digested antigens to T-cells through the MHC on their surface, which allows the T-cells to "see" the antigen and recognize it as foreign. The connection between the MHC and the receptor on the T-cell is the first signal (Signal 1) necessary to activate the T-cell to respond to a tumor and destroy it. [Patient Resource LLC]

Memory cells: T-cells and B-cells from a specific immune reaction that continue to circulate in the body even after the infection is resolved. They "remember" specific antigens and can multiple rapidly upon subsequent exposure, creating an immediate immune response already trained to eliminate the threat. [Patient Resource LLC]

Metabolomics: The large-scale study of small molecules, commonly known as metabolites, within cells, biofluids, tissues or organisms. Collectively, these small molecules and their interactions within a biological system are known as the metabolome. [From https://www.ebi.ac.uk/training/online/courses/metabolomics-introduction/what-is/]

Metastasis: The spread of cancer cells from the place where they first formed to another part of the body. In metastasis, cancer cells break away from the original (primary) tumour, travel through the blood or lymph system, and form a new tumour in other organs or tissues of the body. The new, metastatic tumour is the same type of cancer as the primary tumour. For example, if breast cancer spreads to the lung, the cancer cells in the lung are breast cancer cells, not lung cancer cells. [NCI]

Microbiome: The collection of all the microorganisms and viruses (microbiota) that live in a given environment, including the human body or part of the body, such as the digestive system. The human microbiome may play a role in a person's health. Studying the human microbiome may help prevent and treat disease in the future. [NCI]

Micrometastases: The spread of cancer cells in groups so small that they can only be seen under a microscope. [ACS]

Mitochondria: Small structures in a cell that are found in the cytoplasm (fluid that surrounds the cell nucleus). Mitochondria make most of the energy for the cell and have their own genetic material that is different from the genetic material found in the nucleus. Many diseases are caused by mutations (changes) in the DNA of mitochondria. Mitochondria are cell organelles. [NCI]

Model systems: Systems used to test hypotheses on what interventions may work with humans. In vitro (outside of a living being) systems are cultured cells, generally from humans. The more recent type of in vitro system is 3D cell cultures created from human cells, which are spherical in shape and thought to more closely resemble human tumours. In vivo models (models in living beings) are of two main types:

- patient-derived or zenograft models, where human cancerous cells or tissues are implanted into a mouse or other animal to simulate human tumour biology
- transgenic/genetically engineered models, where new or altered genes are inserted into the genome of a mouse or other animal by genetic engineering techniques, thereby making them more susceptible to cancer

Although mouse models are the mainstay of cancer research, zebrafish, a member of the minnow family, have become a popular model organism in cancer research and Canada has several leading experts. Zebrafish grow quickly, are nearly transparent allowing their internal structures to be easily examined, have had their genome fully sequenced, and share a similar genetic structure to humans. [From https://www.yourgenome.org/theme/model-organisms-the-zebrafish/]

Monoclonal antibodies (mAbs): Antibodies made in a laboratory that are designed to target specific parts of cancer cells, which may include certain proteins or molecules on the surface of the cancer cells; they are meant to stimulate an immune response in the same way as naturally produced antibodies do. [Patient Resource LLC]

mRNA: Short for messenger RNA. A type of RNA found in cells. mRNA molecules carry the genetic information needed to make proteins. They carry the information from the DNA in the nucleus of the cell to the cytoplasm where the proteins are made. [NCI]

Mutation: A change in the DNA of a cell. Most mutations do not cause cancer, and a few may even be helpful. But all types of cancer are thought to be due to mutations that damage a cell's DNA. Some cancer-related mutations can be inherited (passed on from a parent). This means that the person is born with the mutated DNA in all the body's cells. But most mutations happen after the person is born. These are called somatic or acquired mutations. This type of mutation happens in one cell at a time, and only affects cells that arise from the single mutated cell. [ACS]

N

Natural killer cells: White blood cells that contain enzymes that kill virally infected cells and tumor cells. They also communicate with T-cells to help regulate their development and response. [Patient Resource LLC]

Nucleus: Also known as the cell nucleus. The structure in a cell that contains the chromosomes. The nucleus has a membrane around it (nuclear envelope) and is where RNA is made from the DNA in the chromosomes. [NCI]

O

Occupational exposure: The exposure to potentially harmful chemical, physical, or biological agents that occurs as a result of one's occupation. [From http://www.reference.md/files/D016/mD016273.html]

Oncogene: A gene that is a mutated (changed) form of a gene involved in normal cell growth. Oncogenes may cause the growth of cancer cells. Mutations in genes that become oncogenes can be inherited or caused by being exposed to substances in the environment that cause cancer. [NCI]

Oncolytic virus: A virus that can infect and multiply within cancer cells, leading them to die. These viruses may be manufactured or naturally occurring and can be used to target and destroy specific tumor cells. They may also induce an immune response. [Patient Resource LLC]

P

Palliative care: Care given to improve the quality of life of patients who have a serious or life-threatening disease. The goal of palliative care is to prevent or treat as early as possible the symptoms of a disease, side effects caused by treatment of a disease, and psychological, social, and spiritual problems related to a disease or its treatment. Also called comfort care, supportive care, and symptom management. [NCI]

Pathognomonic: Having to do with a sign or symptom that is specific to a certain disease. [NCI]

Patient-oriented research: Refers to a continuum of research that engages patients as partners, focusses on patient-identified priorities and improves patient outcomes. This research, conducted by multidisciplinary teams in partnership with relevant stakeholders, aims to apply the knowledge generated to improve healthcare systems and practices. [CIHR]

PD-1 (programmed cell death-1): The receptor in the PD-1 checkpoint pathway that sends negative signals to the T-cell when it connects to a PD-1 or PD-2 ligand (PD-L1 or PD-L2). These negative signals normally slow down or stop the immune response when it's no longer necessary. Certain cancer cells can influence the engagement of this checkpoint, which puts the brakes on the immune response. [Patient Resource LLC]

PDX: Short form for "patient derived xenografts," are models of cancer where the tissue or cells from a person's tumour are implanted into an immunodeficient or "humanized" mouse (a mouse with functioning human genes, cells, tissues, and/or organs). PDX models simulate the person's cancer and can be used to identify and test different treatment options before using them in the person. [Adapted from Lai Y et al. (2017). Current status and perspectives of patient-derived xenograft models in cancer research. *Journal of Hematology & Oncology*, 10(1):106. https://jhoonline.biomedcentral.com/articles/10.1186/s13045-017-0470-7]

Pharmacodynamics: The study of actions of drugs on the body—what effects a drug has on the patient, including mechanisms of action, beneficial and adverse effects of the drug, and the drug's clinical applications. [From https://link.springer.com/article/10.1186/s13045-017-0470-7]

Pharmacogenomics: The study of how genetic makeup affects pharmacodynamics and pharmacokinetics and thus affects drug selection and application to individual patients. [From https://clinicalgate.com/basic-principles-and-pharmacodynamics/]

Pharmacokinetics: The study of actions of the body on drugs—the absorption, distribution, storage, and elimination of a drug. [From https://clinicalgate.com/basic-principles-and-pharmacodynamics/]

Placebo: In clinical trials, a placebo is usually a tablet or capsule with no active ingredients, or a sham treatment that is meant to make the patient believe that a medical procedure has occurred. Placebos are used so that the subjects in the control group (and often researchers involved in administering or evaluating the trial as well) are unable to tell who is receiving the active drug or treatment. Using placebos prevents bias in judging the effects of the medical intervention being tested. [CIHR]

Polymorphism: A common change in the genetic code in DNA. Polymorphisms can have a harmful effect, a good effect, or no effect. Some polymorphisms have been shown to increase the risk of certain types of cancer. [NCI]

Power: The power of a statistical test is a measure of a study's ability to detect a statistically significant difference between the results of the intervention group and the control group in a randomized controlled trial. A difference is considered statistically significant when it is highly unlikely to have occurred by chance. A study's power is partly determined by the size of the difference in scores between the groups, but it is also affected by how many people are included in the study and how much variation there is within each of the groups. For example, if there are too few people in the study, even a large difference may not produce a statistically significant result. [CIHR]

Precision medicine: A form of medicine that uses information about a person's genes, proteins, and environment to prevent, diagnose, and treat disease. In cancer, precision medicine uses specific information about a person's tumour to help diagnose, plan treatment, find out how well treatment is working, or make a prognosis. Examples of precision medicine include using targeted therapies to treat specific types of cancer cells, such as HER2-positive breast cancer cells, or using tumour marker testing to help diagnose cancer. Also called personalized medicine. [NCI]

Precursor lesion: A definable pathologic state that frequently progresses directly to disease. Well-studied precancers, or precursors of cancer, have illuminated several complex aspects of the natural history for cervical and colorectal cancer, and have helped to suggest and evaluate successful intervention programs in prevention and patient management. [From Wacholder, S. (2013). Precursors in cancer epidemiology: aligning definition and function. *Cancer Epidemiology, Biomarkers & Prevention*, 22(4): 521–7. PMC3738010.]

Predatory journal: An alleged academic publication, where publishers actively solicit manuscripts and charge publications fees without providing robust peer review and editorial services. Non-existent peer review, misleading journal names (often similar to legitimate journals), and false information about editors and journal impact factors are among the strategies deployed by these publishers. [Adapted from Shamseer L et al. (2017). Potential predatory and legitimate biomedical journals: can you tell the difference? A cross-sectional comparison. *BMC Medicine*, 15(28). https://link.springer.com/article/10.1186/s12916-017-0785-9]

Prevention: Primary - preventing a disease before it occurs. For example, reducing the chances that young people will take up smoking by providing school-based tobacco prevention programs. Secondary - preventing a worsening or future occurrence of a disease after evidence of the disease has already been found. An example would be a doctor

removing a pre-cancerous skin lesion before it becomes cancerous and spreads. Tertiary - means treatment for an ongoing disease. An example would be treatment designed to reduce the spread of cancer metastases. [Adapted from CIHR]

Prognosis: A medical prognosis is a prediction of the course of a disease and likelihood of recovery, disability, or death, based on medical expertise. It includes factors such as the patient's medical history, the course of treatment being followed, and the statistical likelihood of the outcome of the disease in other people. [CIHR]

Proliferation: Cell division and development (growth). [Patient Resource LLC]

Prophylactic: In medicine, something that prevents or protects. For example, prophylactic oophorectomy is surgery intended to reduce the risk of ovarian cancer by removing the ovaries before cancer develops. [Adapted from NCI]

Proteomics: The study of the structure and function of proteins, including the way they work and interact with each other inside cells. [NCI]

Proto-oncogene: A gene involved in normal cell growth. Mutations (changes) in a proto-oncogene may cause it to become an oncogene, which can cause the growth of cancer cells. [NCI]

Q

Qualitative analysis: The purpose of a qualitative analysis is to get a range of responses on an issue from a variety of perspectives, valuing unique responses as much as consistent ones. Qualitative analysis methods can include focus groups, individual observations, in-depth interviews, or documentary accounts. Qualitative assessments can often be used as a means of generating research questions and identifying themes that can later be used in a quantitative analysis. Qualitative analyses are subjective, meaning that they depend on the particular people included, and can be shaped by interactions with the researcher or other participants. [CIHR]

Quantitative analysis: Quantitative analysis attempts to understand the world objectively, rather than as different individuals might perceive it. It relies on compiling numerical data from many individuals into a single value, such as an average, or mean, that can be assessed by statistical tests. The goal of quantitative analysis is to be unbiased, which is why control groups and blinding are important considerations in constructing quantitative research studies. Statistical analyses applied to quantitative data define exactly how likely a result is to have occurred by chance alone, which helps the user understand how representative the results are for the entire population. [CIHR]

R

Real World Data (RWD): Data relating to patient health status and/or the delivery of health care routinely collected from a variety of sources. RWD can come from a number of sources, for example: electronic health records; insurance claims and billing activities; product and disease registries; patient-generated data including in home-use

settings; and data gathered from other sources that can inform on health status, such as mobile devices. [From https://www.fda.gov/science-research/science-and-research-special-topics/real-world-evidence]

Real World Evidence (RWE): Clinical evidence regarding the usage and potential benefits or risks of a medical product derived from analysis of RWD. RWE can be generated by different study designs or analyses, including but not limited to, randomized trials, including large simple trials, pragmatic trials, and observational studies (prospective and/or retrospective). [From https://www.fda.gov/science-research/science-and-research-special-topics/real-world-evidence]

Receptors (immune receptors): Proteins on the surface of immune cells that bind to ligands on the surface of other immune cells. This connection typically results in immune cell signaling that regulates specific immune system functions. [Patient Resource LLC]

Regulatory T-cells: T-cells that help maintain the necessity, strength and duration of an immune response by regulating T-cell activity. They shut down the other T-cells at the end of an immune reaction. Certain tumor cells can increase regulatory T-cell activity, which decreases the overall immune response. [Patient Resource LLC]

Ribosome: A structure found inside cells that is involved in making proteins. Ribosomes help link amino acids together to form proteins. [NCI]

RNA: Short for ribonucleic acid. One of two types of nucleic acid made by cells. RNA contains information that has been copied from DNA (the other type of nucleic acid). Cells make several different forms of RNA, and each form has a specific job in the cell. Many forms of RNA have functions related to making proteins. RNA is also the genetic material of some viruses instead of DNA. RNA can be made in the laboratory and used in research studies. [NCI]

S

Scientific rigor: The application to research of a well-thought-out plan and a methodology based on best practice in order to minimize bias. [Adapted from https://www.ncbi.nlm.nih.gov/books/NBK547546/]

Scientific reproducibility: Obtaining consistent results when research is conducted by a separate researcher using the same study design, methodology, and analysis. [Adapted from https://www.ncbi.nlm.nih.gov/books/NBK547546/]

Signal 1, Signal 2: The primary and secondary cell signals necessary for the immune system to activate. Signal 1 is the interaction between the antigen-presenting cell and the T-cell through a connection between the major histocompatibility complex (MHC) and a T-cell receptor. Signal 2 can be any number of connections formed by the molecules and receptors on the surfaces of both the antigen-presenting cell and the T-cell. [Patient Resource LLC]

Signaling pathway: Describes a group of molecules in a cell that work together to control one or more cell functions, such as cell division or cell death. After the first molecule in a pathway receives a signal, it activates another molecule. This process is repeated until the last molecule is activated and the cell function is carried out. Abnormal

activation of signaling pathways can lead to cancer, and drugs are being developed to block these pathways. These drugs may help block cancer cell growth and kill cancer cells. [NCI]

SNP: Short for single nucleotide polymorphism. The most common type of change in DNA (molecules inside cells that carry genetic information). SNPs occur when a single nucleotide (building block of DNA) is replaced with another. These changes may cause disease, and may affect how a person reacts to bacteria, viruses, drugs, and other substances. [NCI]

Somatic mutation: An alteration in DNA that occurs after conception. Somatic mutations can occur in any of the cells of the body except the germ cells (sperm and egg) and therefore are not passed on to children. These alterations can (but do not always) cause cancer or other diseases. [NCI]

Standard of care: A treatment regimen that is accepted by medical experts and is widely used as a treatment for a specific type of cancer. This can also be called best practice, standard medical care and standard therapy. [Patient Resource LLC]

Statistically significant: Describes a mathematical measure of difference between groups. The difference is said to be statistically significant if it is greater than what might be expected to happen by chance alone. Also called significant. [NCI]

Scientists use the term "p" to describe the probability of observing such a large difference purely by chance in groups of like people and this is known as the "p-value." Mathematical probabilities like p-values range from 0 (no chance) to 1 (absolute certainty). So 0.5 means a 50 per cent chance and 0.05 means a 5 per cent chance. In most sciences, results yielding a p-value of .05 are considered on the borderline of statistical significance. If the p-value is under .01, results are considered statistically significant and if it's below .005 they are considered highly statistically significant. [From: https://www.iwh.on.ca/what-researchers-mean-by/statistical-significance]

Surveillance: In **medicine**, closely watching a patient's condition but not treating it unless there are changes in test results. Surveillance is also used to find early signs that a disease has come back. It may also be used for a person who has an increased risk of a disease, such as cancer. During surveillance, certain exams and tests are done on a regular schedule. In **public health**, surveillance may also refer to the ongoing collection of information about a disease, such as cancer, in a certain group of people. The information collected may include where the disease occurs in a population and whether it affects people of a certain gender, age, or ethnic group. [NCI]

Survival rate: The percentage of people in a study or treatment group who are still alive for a certain period of time after they were diagnosed with or started treatment for a disease, such as cancer. The survival rate is often stated as a five-year survival rate, which is the percentage of people in a study or treatment group who are alive five years after their diagnosis or the start of treatment. Also called overall survival rate. [NCI]

T

T-cells: Immune cells that recognize specific antigens during antigen presentation. T-cells are the major players in the immune system's fight against cancer. Their activation and activity are two of the main focuses in immunotherapy research. [Patient Resource LLC]

T-cell receptors (TCRs): Molecules found only on the surface of T-cells. TCRs must bind to special molecules on the surface of antigen-presenting cells before they can receive information about a threat. This connection is the first signal (Signal 1) necessary to activate the T-cell to respond to the tumor. [Patient Resource LLC]

Telomerase: An enzyme in cells that helps keep them alive by adding DNA to telomeres (the ends of chromosomes). Each time a cell divides, the telomeres lose a small amount of DNA and become shorter. Over time, the chromosomes become damaged and the cells die. Telomerase helps keep this from happening. Cancer cells usually have more telomerase than most normal cells. [NCI]

Telomere: The ends of a chromosome. Each time a cell divides, the telomeres lose a small amount of DNA and become shorter. Over time, the chromosomes become damaged and the cells die. In cancer cells the telomeres do not get shorter, and may become longer, as the cells divide. [NCI]

Transcription: The process by which a cell makes an RNA copy of a piece of DNA. This RNA copy, called messenger RNA (mRNA), carries the genetic information needed to make proteins in a cell. It carries the information from the DNA in the nucleus of the cell to the cytoplasm, where proteins are made. [NCI]

Transcriptomics: The study of all RNA molecules in a cell. RNA is copied from pieces of DNA and contains information to make proteins and perform other important functions in the cell. Transcriptomics is used to learn more about how genes are turned on in different types of cells and how this may help cause certain diseases, such as cancer. [NCI]

Translation: The process by which a cell makes proteins using the genetic information carried in messenger RNA (mRNA). The mRNA is made by copying DNA, and the information it carries tells the cell how to link amino acids together to form proteins. [NCI]

Translational research: The research pipeline or continuum were promising findings from the laboratory move to testing in humans via progressive clinical studies and then to implementation in the health system and finally to broad-scale implementation, where benefits accrue to the larger population. The goal of translational research is to move basic science discoveries more quickly and efficiently into practice. It is often summarized by the terms "bench-to-bedside" and "bedside-to-community" research.

Tumour heterogeneity: Differences found in cancer cells in terms of their shape and structure (morphology), their gene expression, their metabolism, and their capacity to move, proliferate, and metastasize. Types:

- Interpatient: variation between patients with cancers at the same site of origin

- Intrapatient: variation within tumours in the same person
- Intratumour: variation within a single tumour

The diversity or heterogenous nature of tumours is the key reason why identifying effective cancer treatments is so challenging and it is the impetus behind a precision medicine approach.

Tumourigenesis: The transformation of normal cells into cancer cells. Also referred to as carcinogenesis (although some authors make a distinction). This multi-stepped process is characterized by changes at the cellular, genetic, and epigenetic levels and abnormal cell division. Tumours enlarge because cancer cells lack the ability to balance cell division by cell death (apoptosis) and by forming their own vascular system (angiogenesis). The transformed cells lose their ability to interact with each other and exhibit uncontrolled growth, invade neighbouring tissues and eventually spread through the blood stream or the lymphatic system to distant organs. (From *Mechanisms of Carcinogenesis: Contributions of Molecular Epidemiology*, IARC Scientific Publication No. 157).

Tumour microenvironment: The normal cells, molecules, and blood vessels that surround and feed a tumour cell. A tumour can change its microenvironment, and the microenvironment can affect how a tumour grows and spreads. [NCI]

Tumour-specific antigen: A protein or other molecule that is found only on cancer cells and not on normal cells. Tumor-specific antigens can help the body make an immune response against cancer cells. They may be used as possible targets for targeted therapy or for immunotherapy to help boost the body's immune system to kill more cancer cells. Tumor-specific antigens may also be used in laboratory tests to help diagnose some types of cancer. [NCI]

Tumour suppressor gene: A type of gene that makes a protein called a tumour suppressor protein that helps control cell growth. Mutations (changes in DNA) in tumour suppressor genes may lead to cancer. [NCI]

U

Upregulate: Increase either the overall immune system response or the specific responses of certain immune cells. [Patient Resource LLC]

W

Watchful waiting: Closely watching a patient's condition but not giving treatment unless symptoms appear or change. Watchful waiting is sometimes used in conditions that progress slowly. It is also used when the risks of treatment are greater than the possible benefits. [NCI]

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