# 2023 RESEARCH REPORT

UBC

BC CANCER RESEARCH INSTITUTE

Provincial Health Services Authority

# CONTENTS



## ON THE COVER

Si Wei Vivian Wu, graduate student with the Connie Eaves Lab

## MESSAGE FROM THE SENIOR EXECUTIVE DIRECTOR OF RESEARCH DR. FRANÇOIS BÉNARD

Our mission to reduce the burden of cancer in British Columbia drives our research each year. Our researchers pursue this objective with the goal of improving the lives of people with cancer and, one day, eliminating the disease for good. Many of us have family members affected by cancer, and the drive to advance this research is very personal.

BC Cancer researchers continue to make exciting discoveries through advanced technologies in the lab, as well as impactful clinical trials, finding ways to improve care. From preventing cancer cells from evading therapies, to finding more effective treatments and determining what types of supportive care can be most beneficial to cancer survivors – patients are at the heart of the work we do and central to our mission.

This year saw our scientists revolutionize cancer research by pairing their expertise in cancer biology and immunology with advanced technologies, including high-end, mass spectrometry imaging infrastructure. Additionally, our researchers have made significant impacts in their ongoing work to understand why some patients have different outcomes than others.

BC Cancer clinicians continued to investigate ways to improve the standard of care to offer more successful cancer treatments with 378 active clinical trials underway in 2023. Important research like this can enable more people to survive cancer and live longer, and our clinicians continue to study how we can support cancer survivors to lead healthy, fulfilling lives.

I would like to acknowledge the immense contributions of the late Dr. Connie Eaves on cancer stem cell research, and on training generations of new scientists during her brilliant career at BC Cancer. Dr. Eaves's legacy continues through all the students and post-doctoral fellows that she trained at the Terry Fox Laboratory. Her legacy will continue as those she mentored go on to achieve great successes through their published work, awards and grants.

Through the dedication of our researchers and their trainees, and the strength of our partnerships, we will continue to be a global leader in cancer research as we strive towards a world free from cancer.

**Dr. François Bénard**
**Senior Executive Director**
**Research**

# MESSAGE FROM BC CANCER FOUNDATION PRESIDENT & CEO SARAH ROTH

BC Cancer Foundation donors have a long history of supporting innovative research at BC Cancer that advances the future of cancer treatment. But our community is becoming increasingly aware that their donations are crucial to bringing cutting-edge care closer to home for patients across the province.

Clinical trials are a lifeline to patients who have run out of options. People like Allan Wolfram, a Winnipeg resident who was on palliative chemotherapy for esophageal cancer. After relocating to B.C. to enrol in an immunotherapy trial at BC Cancer – Kelowna, he is now gratefully free from disease.

But not everyone can uproot their lives to access a life-saving clinical trial. And so, in 2023, we were proud to power research in every corner of B.C. through a $2.2 million fundraising campaign to support SIMPLIFY, a precision radiation clinical trial led by BC Cancer – Prince George's Dr. Rob Olson, which will be available at all six BC Cancer centres.

Early phase clinical trials will be available to patients for the first time in the Interior due in part to the Bannister family's $1.5 million gift to help expand infrastructure in the new, state-of-the-art systemic therapy suite at BC Cancer – Kelowna.

And some endometrial cancer patients can now be safely treated in their own community thanks to donor support of Dr. Jessica McAlpine's research, including a study published last year confirming the efficacy of a more streamlined DNA-based test to perform molecular classification.

In 2023, we received the largest gift in Canadian history in support of liver cancer from Vancouver biotechnology firm Acuitas Therapeutics — $1 million to help establish a unique multidisciplinary liver cancer research program at BC Cancer led by Dr. Pamela Hoodless.

The Foundation recognized Dr. Connie Eaves's more than five decades of pioneering research through the naming of BC Cancer's Eaves Stem Cell Assay Laboratory. We're honoured to continue her legacy of fostering the next generation of talent through the Rising Stars Awards, an initiative inspired by Dr. Eaves's advocacy for women and Black, Indigenous and People of Colour (BIPOC) leaders in science.

Similarly, donor support of the inaugural BC Cancer Clinician Researcher Start Up Competition is fuelling groundbreaking studies including using methadone to treat chemotherapy-induced peripheral neuropathy, treating mental health in male breast cancer patients, and advancing gynecologic cancer survivorship through digital innovation.

Investing in these projects, and more in our own backyard, benefits all of B.C. and beyond.

Sarah Roth
BC Cancer Foundation
President & CEO

# FAST FACTS

**940** total publications

**772** journal articles

**8,821** total cumulative subject enrolment in clinical trials

**378** active clinical trials

**16** active spin-off companies (2 new)

**36** patents issued

**10** patents filed

**52** active licenses

**349.5**
**Researchers**
excluding affiliate investigators

**727**
**Trainees**
increase of 70 from 2021/22

**Funding by sector**

- 15% Industry & other sources
- 39% Government
- 46% Non-profit

**Funding:**
**Total Grants Awarded**
**$107 million**

**Funding by award type**

- 89% Operating grants
- 4% Salary awards
- 4% Infrastructure awards
- 3% Other

# Remembering Dr. Connie Eaves, a world-renowned pioneer in stem cell research

The BC Cancer Research Institute remembers the late Dr. Connie Eaves, distinguished scientist at BC Cancer's Terry Fox Laboratory and professor in the Department of Medical Genetics and the School of Biomedical Engineering at UBC, who passed away in early 2024.

Dr. Eaves's passing was a great loss to the cancer research community not only in British Columbia and Canada, but throughout the world. She left a lasting international legacy as trailblazer in the field of stem cell research and an advocate for more women in the fields of science, technology, engineering and mathematics (STEM).

Upon moving to Vancouver in 1973, Dr. Eaves was the second research scientist to be hired to the staff of the BC Cancer Institute. She later co-founded the Terry Fox Laboratory in 1981 with her husband Dr. Allen Eaves. With over 50 years of service, she was the longest-serving BC Cancer Research employee.

Over that time, Dr. Eaves became a global authority on stem cells with translational impact on bone marrow transplantation and treatments for leukemia and breast cancer. Her discoveries have advanced knowledge on the origin of these cancers and her pioneering research methodologies, including developing a technique to separate cancerous from normal stem cells, have become gold standard approaches used by laboratories around the world.

Dr. Eaves's work has been celebrated both nationally and internationally. Here is a brief timeline of some of her many awards and recognitions:

- 2022: received Till and McCulloch Lifetime Achievement Award
- 2021: appointed to the Order of Canada
- 2021: elected into the Royal Society (London)
- 2019: inducted into the Canadian Medical Hall of Fame
- 2019: received the Gairdner Wightman Award
- 2019: named as one of Chatelaine's Women of the Year
- 2016: recognized as a Status of Women Canada Pioneer by the Government of Canada

Her passion extended beyond the laboratory. In her first year of medical school, Dr. Eaves was one of just 10 women in a class of 70. Since then, she continued to advocate for more women in STEM as they remain underrepresented in those areas. Dr. Eaves also played a major role in the recruitment and training of graduate students and post-doctoral fellows at the Terry Fox Laboratory.

Dr. Eaves was a mother of four, grandmother of 11, mentor, close advisor, friend and inspiration to many. She will be dearly missed.

# AWARDS & FUNDING

# 2023

## JANUARY

- **Canadian Institutes of Health Research (CIHR) Project Grant: Fall 2022 Results**

- **Dr. Shoukat Dedhar,** "Investigation of Neutrophil Extracellular Trap DNA (NET-DNA) induced signaling in the progression of pancreatic ductal adenocarcinoma." $956,250 (5 years)

- **Dr. Brad Nelson,** "Deciphering the hottest immune neighbourhoods in ovarian cancer to advance immunotherapy." $983,025 (5 years)

- **Dr. Adi Steif,** "The impact of chromosomal instability on ovarian cancer progression." $902,700 (5 years)

- **Dr. Peter Stirling,** "Dominant genetics of cohesin pathway proteins to kill cancer." $883,575 (5 years)

- **Canadian Cancer Society Challenge Grants**

- **Dr. Kevin Bennewith,** "Repurposing the angiotensin II receptor blocker telmisartan to promote anti-tumour immune responses." $510,000 (3 years)

- **Dr. Kristin Campbell,** "Improving supportive care for people with breast cancer." $521,791 (3 years)

- **Dr. Cathie Garnis,** "A blood test for earlier detection of recurrent head and neck cancer." $442,450 (3 years)

- **Dr. Cheryl Peters,** "Combating online misinformation about cancer causes and prevention." $517,077 (3 years)

- **Dr. Christian Steidl,** "Improving understanding of a rare type of lymphoma." $524,878 (3 years)

- **Dr. Isabella Tai,** "Using artificial intelligence to identify people at risk of early onset colorectal cancer." $525,000 (3 years)

- **Dr. Samuel Aparicio,** with Dr. Joan Brugge (Harvard Medical Centre), received a Gray Foundation bridge grant for the project titled, "Development of strategies to track and prevent breast cancer development in BRCA mutation carriers." $205,000 USD (1 year)

- **Personalized OncoGenomics (POG) Program** was the recipient of the Canadian Association of Research Administrators 2023 Public Engagement and Advocacy Award.

- **Dr. Kasmintan Schrader,** with Dr. Trevor Pugh (Ontario Institute for Cancer Research), received a Canadian Cancer Society grant for the project titled, "Early cancer detection in children and adults with familial cancer syndromes across Canada." $7,497,581 (4 years)

## FEBRUARY

- **Dr. François Bénard, Dr. Kuo-Shyan Lin, Dr. Dean Regier** and **Dr. Carlos Uribe** received a New Frontiers in Research Fund award for the project, "Rare isotopes to transform cancer therapy." $23,796,774 (6 years)

- **Dr. Leah Lambert** received a CIHR Catalyst Grant: Policy Research for Health System Transformation for the project titled, "Informing policy to optimize the clinical nurse specialist workforce: advancing the quadruple aim and health equity." $148,850 (1 year)

- **Dr. Negin Shahid** received a Victoria Oncology Intimacy and Sexual Health grant to develop a new data registry. $2,000 (1 year)

## MARCH

**CIHR Project Grant: Spring 2023 Results**

- **Dr. Samuel Aparicio,** "Decoding the impact of single cell mutational processes in triple negative breast cancer and high-grade serous ovarian cancer." $1,040,400 (5 years)

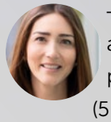
- **Dr. Samuel Aparicio,** "Mechanisms and targeting of repair deficient cancers with G-quadruplex small molecule ligands." $1,048,050 (5 years)

- **Dr. Ramon Klein Geltink,** "Glucose restriction-mediated changes to mitochondria as a driver of anti-tumour CD8+ T cell function." $983,026 (5 years)

- **Dr. Gillian Hanley** and **Dr. Michael Anglesio,** "Endometriosis-associated ovarian cancer: Understanding which patients are at high risk." $680,851 (4 years)

- **Dr. Jonathan Loree,** "STOPNET - a randomized study of cessation of somatostatin analogues after peptide receptor radionuclide therapy in mid and hind gut neuroendocrine tumours." $260,101 (4 years)

- **Dr. Helen McTaggart-Cowan,** "Following reproductive and sexual health care and outcomes of adolescent and young adult cancer patients (FUTURE)." $313,649 (3 years)



- **Dr. Rachel Murphy,** "HEALthy Eating and Supportive Environments (HEAL): A pan-Canadian study." $1.73 million (5 years)

- **Dr. Fumio Takei,** "Innate lymphoid cells in hepatitis and liver fibrosis." $814,726 (5 years)

- **Dr. Poul Sorensen,** with Dr. Wei Li (University of Pittsburgh), received a D-Feet Cancer - The Dalton Fox Foundation grant for a project titled, "Circumventing Ewing sarcoma antigen heterogeneity by IL1RAP and B7-H3 dual-targeting bispecific antibody drug conjugates." $100,000 USD (1 year)

- **Dr. Poul Sorensen** received a Rutledge Cancer Foundation grant for the development of immunotherapies targeting the surface protein IL1RAP for the treatment of Ewing sarcoma. $100,000 USD (1 year)

## APRIL

- **Canada Research Chairs Program**

- **Dr. David Huntsman,** Tier 1 Canada Research Chair in Molecular and Genomic Pathology (Renewed)

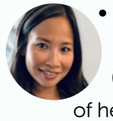
- **Dr. Ly Vu,** Canada Research Chair in RNA Biology in Hematological Malignancies (Awarded)

- **Dr. Kim Chi** received Founder's Award – Dr. Joseph Pater Excellence in Clinical Trials Research Award from the Canadian Cancer Trials Group (CCTG). The award is presented yearly to a clinical trials research investigator whose leadership and body of work has contributed to significant advances in the understanding, diagnosis, treatment, cure and prevention of cancer.

- **Dr. Shoukat Dedhar** received a National Research Council of Canada – Ideation Fund grant for the project titled, "Combinatorial therapeutic strategy for hypoxic solid tumours through modulation of redox homeostasis." $32,000 (1 year)

# AWARDS & FUNDING

# 2023



- **Dr. Elaine Goh** received the Canadian Association of Pharmacy in Oncology (CAPhO) 2023 Merit Award in recognition of her work on the Medication Assessment by Pharmacist (MAP) program. This award is given in recognition of a project in oncology pharmacy aimed at improving patient care and outcomes.
- **Dr. Leah Lambert** received a UBC Health Innovation Funding Investment award for the project titled, "Adapting educational tools and resources to reduce substance use stigma and promote health equity in the cancer care sector." $24,982 (1 year)

- **Dr. Pierre Lane** received a Natural Sciences and Engineering Research Council of Canada Discovery Grant for the project titled, "Instrumentation for real-time in vivo fluorescence lifetime imaging." $210,000 (5 years)

- **Dr. Renelle Myers** received a Canadian Cancer Society Breakthrough Team Grant for the project titled, "Improving detection of early lung cancer in a diverse population." $5.4 million (5 years)
- **Dr. Renelle Myers** received a Michael Smith Health Research BC/Lotte & John Hecht Memorial Foundation Health Professional-Investigator Award for the project titled, "Lung cancer detection using the lung microbiome and exhaled breath." $465,000 (5 years)
- **Dr. Kasmintan Schrader** received a Genome Canada Genomic Applications Partnership Program grant for the project titled, "Parent-of-origin-aware genomic analysis." $6,040,300 (3 years)
- **Dr. Kasmintan Schrader,** with Dr. Trevor Pugh (Ontario Institute for Cancer Research), received a Terry Fox Research Institute Marathon of Hope Cancer Centres Network grant for the project titled, "MOHCCN: Pan-Can – Early cancer detection using circulating tumour DNA enabled by whole genome sequencing of primary solid tumours." $174,000 (3 years)

## MAY

- **Dr. Yvette Drew** received a Michael Smith Health Professional Investigator (HP-I) award for patient engagement work. $450,000 (5 years)

- **Dr. Gerry Krystal** received a Lopker Award for the project titled, "Testing natural compounds for their ability to reverse cancer cell-induced upregulation of glycolysis." $104,000 (1 year)

- **Dr. Nathalie LeVasseur** received a Rethink Breast Cancer and Pfizer Canada quality improvement grant for a project to quantify and improve upon racial and ethnically determined disparities in outcomes for patients with metastatic breast cancer in B.C. $100,000 (1 year)

- **Dr. Arman Rahmim** and **Dr. Ren Yuan** received a UBC Radiology - AI Fund grant for the project titled, "Artificial intelligence imaging tools to assist precise and personalized oncology." $60,000 (2 years)

- **Dr. Dean Regier** and **Dr. Ryan Woods** received a BC Cancer Foundation grant to support the Real-World Evidence (RWE) program at BC Cancer. $1,499,998.63 (3 years)

- **Dr. Haishan Zeng** received a Canadian Dermatology Foundation Innovation Grant for the project titled, "Investigation of skin dynamic response after precise multiphoton-thermolysis using non-invasive multimodality microscopy and imaging-guided micro-raman spectroscopy." $50,000 (2 years)

## JUNE

- **Dr. Poul Sorensen** and **Dr. Gregg Morin** received an Osteosarcoma Institute translational and preclinical science grant for the project titled, "Harnessing the osteosarcoma surfaceome for immunotherapy targets to block metastatic capacity." $500,000 USD (2 years)
- **Dr. Ly Vu** was a recipient of the Women Scientists Innovation Award for Cancer Research, V Foundation for Cancer Research to support defining a high-resolution functional map of m6A RNA epi transcriptome in normal and malignant blood stem cells. $600,000 (3 years)
- **Dr. Ly Vu** received a Leukemia Lymphoma Society Canada operating grant to investigate how cancer cells rewire the surrounding environment to survive and escape the effects of treatment. $200,000 (2 years)

## JULY

- **Dr. Helen McTaggart-Cowan** received a Leukemia & Lymphoma Society of Canada Blood Cancer Quality of Life Grant, as well as the United Food and Commercial Workers' Special Recognition Award, for the project titled, "The mental health of adolescent & young adult hematologic cancer patients." $148,650 (2 years)
- **Terry Fox New Frontiers Program Project Grants**
  - **Dr. Shoukat Dedhar, Dr. Julian Lum** and **Dr. Poul Sorensen,** "The spatial metabolome hubble project to decipher tumour-driven immunosuppression (MetaboHUB)." $2.4 million (4 years)

  - **Dr. Stephen Lam** and **Dr. William Lockwood,** "The environment and lung cancer." $2.4 million (4 years)

## AUGUST

- **Dr. Samuel Aparicio,** with Dr. Joan Brugge (Harvard Medical Centre), received a Gray Foundation bridge grant for the project titled, "Development of prevention and detection approaches to mitigate risk in BRCA1/2 germline mutation carriers." $716,928 USD (3 years)
- **Dr. Shoukat Dedhar** received a Cancer Research Society Charlotte Légaré Memorial Fund award for the project titled, "Targeting hypoxia-driven metabolic effectors of immunosuppression in pancreatic cancer." $125,000 (2 years)

- **Heather Kilgour, RN, Dr. Leah Lambert & Ruby Gidda, RN,** received a Michael Smith Health Research BC/BC Nurses' Union-Reach Grant for the project titled, "Embedded knowledge mobilization: strengthening oncology nurses' capacity for effective advanced care planning conversations." $15,000 (1 year)

- **Dr. Jenny Ko** received an AstraZeneca grant for the project titled, "Data collection and analysis on male patients who are diagnosed with cancer gene (BRCA) and their health outcomes. " $15,000 (1 year)

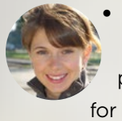
- **Dr. Will Lockwood** and **Dr. Kevin Bennewith** received a Cancer Research Society Operating Grant for the project titled, "ILK as a mediator of drug tolerant persister cell survival and target for combination therapy in EGFR mutant lung adenocarcinoma." $125,000 (2 years)

# AWARDS & FUNDING

2023

## SEPTEMBER

- **Dr. Samuel Aparicio** was named the recipient of the Canadian Cancer Society 2022 Robert L. Noble Prize (announced in 2023) for outstanding achievements in biomedical cancer research, such as discovering the origins and consequences of changes in the number of copies of a particular gene in the genetic information of breast and ovarian cancers. Award amount: $20,000 (1 year)



- **Mar'yana Fisher** was named a CIHR Health System Impact Fellow for the project titled, "Advancing equitable care for incarcerated patients." $50,000 (1 year)

- **Dr. Chantelle Recsky** was named a CIHR Health System Impact Fellow for the project titled, "Optimizing nursing workforce transformation using digital tools: advancing quintuple aim in cancer care." $155,000 (2 years)

- **USA Department of Defense Grants**
  - **Dr. Samuel Aparicio,** "Decoding and targeting genomic instability in pediatric osteosarcoma." $438,500 USD (2 years)
  - **Dr. Samuel Aparicio,** "Therapeutic targeting of genomic instability in triple negative breast cancer." $907,170 USD (3 years)
  - **Dr. Gillian Hanley** and **Dr. David Huntsman,** "The Ovarian Cancer Observatory: prevention impact and learning from opportunistic salpingectomy." $1,080,000 USD (4 years)

## OCTOBER

- **Dr. Samuel Aparicio** received a Breast Cancer Research Foundation grant for the project titled, "Developing predictive biomarkers for genome targeting agents in TNBC, to single cell resolution." $225,000 USD (1 year)
- **Dr. Kasmintan Schrader** received a CIHR Maud Menten New Principal Investigator prize for the project titled, "Parent-of-origin-aware genomic analysis in hereditary cancer." $30,000 (1 year)
- **Dr. Kasmintan Schrader** received a Michael Smith Health Research BC Convening & Collaborating Program grant for the project titled, "Exploring health professional attitudes towards parent-of-origin-aware genomic analysis hereditary cancer and beyond." $15,000 (1.5 years)

## NOVEMBER

- **Dr. Andrew Minchinton** received a Pancreas Centre BC IDEAs grant for the project titled, "Pancreas hypoxia in pancreatic cancers: turning a liability into a therapeutic benefit." $100,000 (2 years)

## DECEMBER

- **Dr. Zu-hua Gao** and **Dr. Yuzhuo Wang** received a BeiGene Canada Fund for Research & Innovation grant for the project titled, "Hydrogel-based Adhesive Artificial Mucosa (HAAM): A novel versatile platform for cancer therapy and prevention." $40,000 (2 years)
- **Dr. Elaine Goh** and BC Cancer – Surrey were awarded Leading Practice status by Health Standards Organization in recognition of the Medication Assessment by Pharmacist program.

- **Dr. Farhia Kabeer** received a UBC Science Co-op Supervisor Recognition Award in recognition of work in the OVCARE program.
- **Dr. Brad Nelson** received a U.S. Department of Defense - Ovarian Cancer Research Program award for the project titled, "Harnessing the immune response in exceptionally long-term survivors to develop novel therapeutics." $400,000 (3 years)

- **Dr. Andrew Robertson** received the CNSC Innovation grant for the project titled, "Radiation shielding for ultra-high dose rate electron FLASH radiation therapy." $30,000 (1.5 years)
- **Dr. Poul Sorensen** received a Team Jack Foundation grant evaluate the functions of eEF2K for therapeutic targeting in pediatric medulloblastoma. $290,000 USD (3 years)

## METABOLOMICS, PROTEOMICS AND CANCER BIOLOGY: STUDYING THE RELATIONSHIP BETWEEN CANCER CELLS AND THE IMMUNE SYSTEM

Researchers at the BC Cancer Research Institute are studying the relationship between cancer cells and the immune system to help therapies target cancers more effectively.

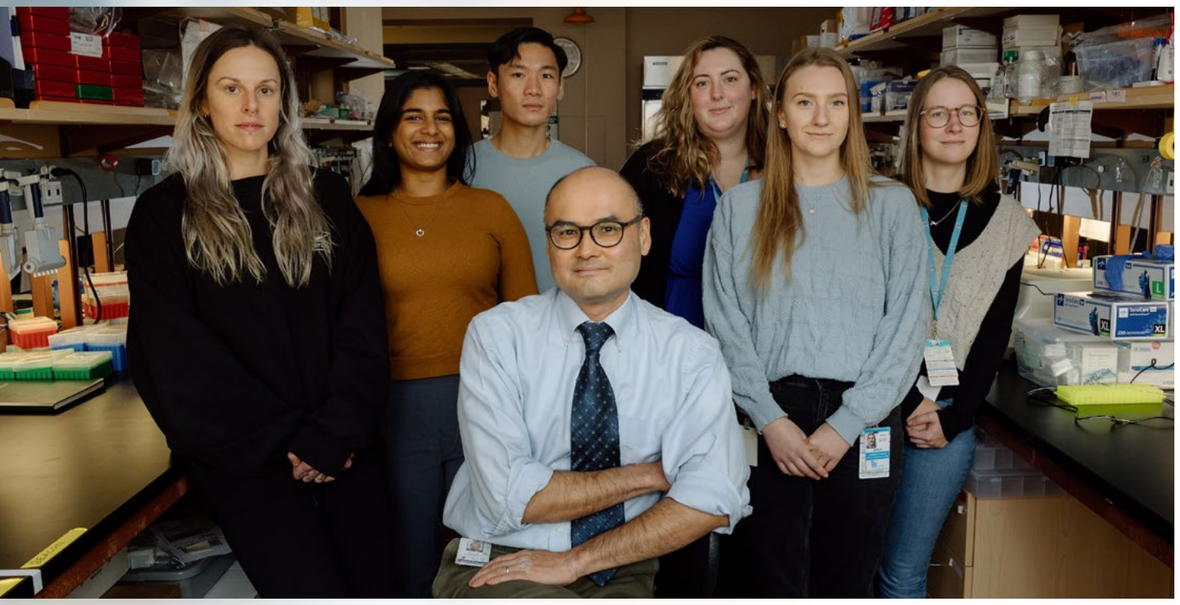
In 2023, Dr. Shoukat Dedhar, Dr. Julian Lum and Dr. Poul Sorensen were awarded a Terry Fox New Frontiers Program Project Grant to use state-of-the-art mass spectrometry imaging "telescopes" to identify where nutrients called metabolites can be found in the cancer cell environment. This was the first team in Canada to use this new spatial imaging technology, which provides more contextual information than previous infrastructure about where metabolites are found in relation to cancer cells.

This research builds on the foundational work that Dr. Gregg Morin undertakes in proteomics, as it is essential to understand the interactions of protein networks in the cell environment to study metabolomics.

This year, we are highlighting the innovative way BC Cancer scientists are researching how cancers thrive and block therapies from working so we can understand how to effectively target them.

## MAPPING OUT THE METABOLISM OF OUR IMMUNE SYSTEM TO ELIMINATE CANCER

Dr. Julian Lum is a distinguished scientist at the BC Cancer Research Institute. His team at the Lum Lab studies how cancers use nutrients to their advantage by shutting down the immune system. Finding the identity of these nutrients holds the key to discovering interventions that can be applied through cancer immunotherapies, treatments that awaken the immune system to fight cancer.



Dr. Julian Lum with members of his lab who contributed to this research (L to R): Gillian Carleton, PhD candidate; Kesia Dias, MSc student; Tian Zhao, PhD candidate; Samantha Punch, research assistant; Jessica Morgan, PhD candidate; Sarah McPhedran, PhD candidate.

Through the study of metabolomics, scientists have learned that cancer cells have a need to consume and utilize nutrients, such as glucose, from their surrounding environments to use as energy to support their rapid growth.

Dr. Julian Lum studies metabolomics to understand the relationship between cancer cells and the immune system, with a particular focus on the nutrients in the tumour microenvironment that can strengthen cancer cells to a point where they can no longer be destroyed by immune cells.

In 2023, Dr. Lum's lab used a new technology called mass spectrometry imaging, or spatial metabolomics, to precisely identify the nutrients present in CD8+ T-cells, a type of immune cell that is unleashed by the body to eliminate cancers.

"Traditional metabolomics has been primarily conducted on a large mixture of different cells that make up a cancer. In other words, when a patient would have a surgical resection of their tumour, the tumour would be ground up and put into a mass spectrometer to analyze metabolites," said Dr. Lum. "This new technology is significant as it provides far more contextual information about where the metabolite is found in relation to the cancer cells."

With a focus on ovarian cancer, Dr. Lum's lab partnered with Dr. David Goodlett's lab to produce two key findings through their analysis of the tumour microenvironment. First, their labs found that the nutrients used by immune cells for fuel are different nutrients than those captured by cancer cells.

"This is quite different than the traditional view in this field," said Dr. Lum. "It turns out that cancer cells and immune cells are not actually in competition for capturing the same nutrients."

A second discovery was that, similar to other cells, cancer cells secrete products into their surroundings, or the tumour microenvironment, once they have consumed the necessary nutrients to fuel their growth and expansion.

"These metabolites, which were initially thought of as waste, are actually products that directly suppress the immune system," added Dr. Lum.

This work led to the discovery of 1-Methylnicotinamide (1MNA), a metabolite that suppresses the immune response of T-cells.

The next step in this research is underway to identify how to produce a synthetic T-cell that would block the 1MNA metabolite from suppressing the immune system. Combined with gene-editing technology and immunotherapeutic treatment approaches, such as CAR T-cell therapy, their approach may successfully destroy cancer cells that have previously evaded these therapies.

## UNDERSTANDING HOW CANCER CELLS SURVIVE IN LOW-OXYGEN ENVIRONMENTS

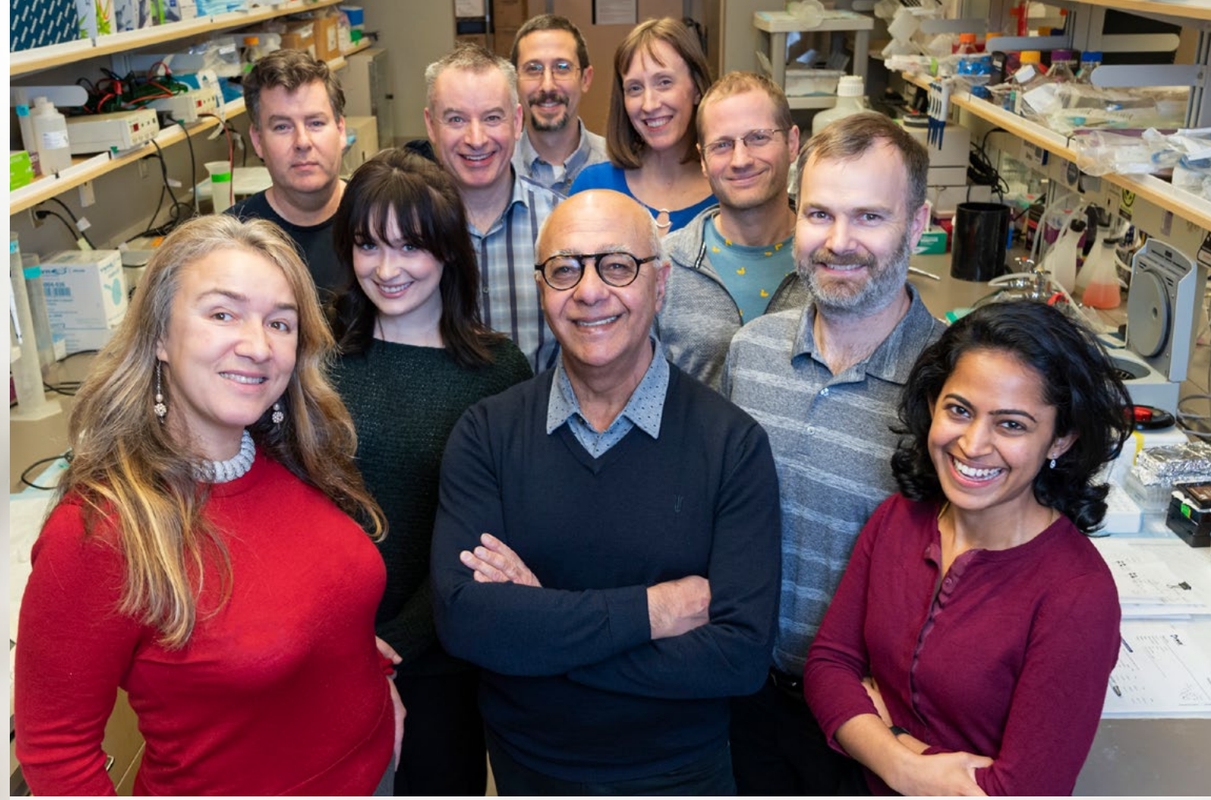
Dr. Shoukat Dedhar is a distinguished scientist at the BC Cancer Research Institute. His team at the Dedhar Lab studies how tumour cells communicate with the extracellular microenvironment and how these interactions promote tumour growth and metastasis.

When faced with a harsh environment, such as the low-oxygen condition called hypoxia, cancer cells adapt rapidly to allow tumour growth and metastasis, which is the spread of cancer cells from the original tumour to other parts of the body. This hypoxic microenvironment also suppresses patients' immune systems, leading to poor treatment outcomes as their T-cells, a type of white blood cell that helps our bodies fight off infections and diseases, can no longer attack the tumour.

Dr. Shoukat Dedhar's lab is working to better understand how we can stop cancer cells from adapting to low-oxygen environments, thus limiting resistance to treatments such as chemotherapy, radiation therapy and immunotherapy.

"If you find yourself in an environment that is harsh, you would have to adapt to survive," said Dr. Dedhar. "It's evolution, but for cancer cells this evolution is happening at a very rapid pace."

Dr. Dedhar's team had previously discovered two proteins found on the cell surface that play important roles in how cancer cells adapt to low-oxygen levels, CA9 and MCT4, both of which help the cancer cells maintain their internal environments and keep functioning despite a lack of oxygen. In addition, these proteins enhance the acidity of the tumour microenvironment, which is a key factor in suppressing the immune system and promoting metastasis. Tumour hypoxia also enhances the expression of CD73, a protein which produces a potent suppressor of the immune system called adenosine.



Dr. Shoukat Dedhar with previous members of his lab who had contributed to this research (L to R): Oksana Nemirofsky, research technician; Jennifer Nagle, graduate student; Ed Morris, post-doctoral fellow; Paul McDonald, staff scientist; Wells Brown, post-doctoral fellow; Shannon Awrey, research technician; Zack Gerbec, post-doctoral fellow; Shawn Chafe, research associate; Geetha Venkateswaran, graduate student.

In 2023, Dr. Dedhar's lab began studying methods to block CA9, MCT4 and CD73 together to alleviate their suppression on the immune system, with a focus on identifying metabolic changes that impact immune suppression. This involved treating the tumours with inhibiting drugs, and then examining them using mass spectrometry imaging to identify where metabolites exist and what changes occurred in the treated tumours.

"We want to find out what changes are occurring in the metabolism of the cell in general," said Dr. Dedhar. "We're working with other researchers, including Dr. Julian Lum and researchers at the University of Victoria, to identify the metabolic changes that could occur, and thus eventually identify new therapeutic targets."

Another key finding in 2023, in collaboration with Dr. Poul Sorensen and Dr. Seth Parker, was that CA9 does not function by itself but together with other proteins, such as a glutamine transporter found on the cell's surface. They found that by simultaneously inhibiting CA9 and blocking the tumour cells' ability to utilize glutamine, the cells became highly vulnerable to a form of cell death called ferroptosis, which is controlled by an enzyme called GPX4.

Dr. Dedhar's lab is currently working on developing new compounds to block both GPX4 and a protein called CAIX to induce ferroptosis, allowing for new therapeutic strategies that can improve patient outcomes.

## DISRUPTING TUMOUR PATHWAYS TO HELP MAKE CANCER TREATMENTS MORE EFFECTIVE

Dr. Poul Sorensen is a distinguished scientist at the BC Cancer Research Institute. His team at the Sorensen Lab studies how childhood cancer cells respond to signals from inside and outside of their cell environments to better understand how to target tumour-specific pathways.

When solid tumours spread to distant organs through the blood stream, they are often put under metabolic stress as they no longer have access to the nutrients that were available in their primary tumour environments. For example, while some cancer cells in these stressful environments are vulnerable to a type of cell death called ferroptosis that kills the pre-metastatic cells in the blood stream, others can adapt and survive, which increases their capacity to spread.

With a focus on Ewing sarcoma, an aggressive cancer of bone and soft tissues in children and adolescents, Dr. Poul Sorensen studies how various signals inside and outside of cancer cells can help solid tumours avoid ferroptosis.

Alongside Dr. Gregg Morin, his lab had previously used mass spectrometry to identify a protein called IL1RAP, which is upregulated, or produced more, in these tumour cells. IL1RAP transfers an amino acid called cystine into the cell where it gets converted into glutathione (GSH).

"This is an important process because when GSH levels are high, it can block ferroptosis from occurring," said Dr. Sorensen. "This suggests that by targeting IL1RAP, we can restore this type of cell death to tumour cells, and potentially prevent tumours from metastasizing."

Dr. Poul Sorensen with members of his lab who contributed to this research (L to R). Lower row: Ellie Tiliakou, summer student; Manideep Pachva, PhD candidate; Joe Huang, MSc student; Qingfeng Huang, international visiting student; Second row: Michael Lizardo, staff scientist; Ahmed Elbassiouny, postdoctoral fellow; Third row: Busra Turgu, postdoctoral fellow; Jessica De Santis, international visiting student; Amy Li, lab manager; Annalena Renner, PhD candidate; Fourth row: Luxin Liu, international visiting student; Justin Long, MSc student; Brian Mooney, postdoctoral fellow; Rouhollah Mousavizadeh, research associate.

In 2023, Dr. Sorensen studied how to target IL1RAP using reagents, which are substances or compounds that can interfere with specific molecules or pathways that are critical to the growth, survival and spread of cancer cells. They collaborated with researchers from the University of Pittsburgh who created specific IL1RAP binders, which are antibodies designed to target IL1RAP, and converted those binders into specific immunotherapies to target IL1RAP.

In initial laboratory models, these reagents have been found to dramatically inhibit Ewing sarcoma tumour growth. The next step will be to use these reagents clinically to treat Ewing sarcoma.

"This is exciting because we've taken our metabolomic findings and have potentially turned them into clinical therapies," added Dr. Sorensen.

Another important aspect to the study is linked to the specific set of oncogenic drivers, which are genes or genetic alterations playing a significant role in the progression of cancer, that are expressed in Ewing sarcoma. The team found that tumour-specific alterations in Ewing sarcoma directly activate IL1RAP in these stressful environments, further supporting the role of IL1RAP in metastatic progression.

"These oncogenic drivers occur through chromosomal translocations, which is when a segment of a chromosome can break off and attach to a different chromosome," said Dr. Sorensen. "This is an important discovery because researchers have been searching for many years to find how these genetic alterations drive cancer progression."

While this research focuses on childhood cancers, IL1RAP is also expressed in adult tumour types, such as adult acute myeloid leukemia (AML). These adult cancers may also benefit from potential clinical therapies that would target the IL1RAP proteins.

## STUDYING PROTEIN CHANGES IN CANCER CELLS TO BETTER UNDERSTAND CANCER BIOLOGY

Dr. Gregg Morin is a senior scientist at the BC Cancer Research Institute and head of proteomics at the Michael Smith Genome Sciences Centre. The BC Cancer Proteomics Platform team Dr. Gregg Morin directs combines expertise in advanced proteomics, biochemistry, and RNA processing to develop methods to study how proteins function in the body.

Through the study of proteomics, Dr. Gregg Morin analyzes how proteins in cancer cells function, are structured, interact with one another, and how they may change. This important foundational research has supported significant discoveries that could lead to better cancer treatment options.

"To understand the biology of cancers, we need to understand the changes that occur in the DNA that drive most cancers," said Dr. Morin. "This means learning how these changes affect the proteins, biology and biochemistry of the cells."

Using mass spectrometer instruments funded by public donors to the BC Cancer Foundation, Dr. Morin's lab observes how proteins produced by cancer cells behave differently than in normal cells. To understand how proteins change, the mass spectrometers are used to examine changes in protein fragments, termed peptides, which are short chains of amino acids derived from larger proteins in the cancer cell.

In 2023, Dr. Morin's lab accessed archived patient samples through BC Cancer pathologists and oncologists to study what drives different cancer subtypes. This was done by comparing different tumours of the same cancer type, as well as different cancer types, and identifying the underlying features at the protein level.

"For example, there are at least four subtypes of breast cancer which can be defined by various DNA changes that can affect the protein landscape," said Dr. Morin. "By defining the protein landscape across many patients, we can identify potential markers that can possibly be used in clinical settings to diagnose and decide how to treat patients."

Dr. Gregg Morin with members of his lab who contributed to this research (L to R): Richard Chen, graduate student; Genny Trigo-Gonzalez, research associate; Ryan Riley, research assistant; Grace Cheng, staff scientist; Brian Mooney, postdoctoral fellow; Fraser Johnson, graduate student; Sandra Spencer, staff scientist.

Alongside Dr. Will Lockwood, Dr. Morin used a method called thermal proteome profiling (TPP) to identify which proteins in a cancer cell can be targeted by new drug candidates. This method involves observing how drugs bound to proteins within a cell react to heat. This method can shed light on which proteins are involved in important cellular processes and can support the development of more effective treatments.

With Dr. Poul Sorensen's lab, Dr. Morin's lab also developed a surfaceome profiling method to isolate the membranes of cancer cells and identify the proteins in the membranes. These proteins would then be compared to those in normal cells to identify which proteins are produced more, or upregulated, on cancer cell surfaces. Upregulated surface proteins are candidates for immunotherapies, an emerging cancer treatment strategy. Upregulated proteins could also be candidate therapeutic targets for theranostics, an approach where both the diagnosis and treatment of a medical condition are integrated into one process.

"If you can identify a surface protein that is specific to a cancer, you can design a theranostic to it, and/or you could design an antibody, or other types of binders, to that protein – which is the basis for immunotherapy," said Dr. Morin. "Surfaceome analysis is a powerful approach that can be applied to many types of cancers."

## NEW RECRUIT: DR. CAROL CHEN IS UNRAVELLING THE MYSTERIES OF HIGH-GRADE GLIOMAS

Dr. Carol Chen, scientist, is dedicated to understanding the complexities and finding innovative solutions to high-grade gliomas (HGGs); a particularly aggressive form of brain cancer affecting children and young adults. The early career investigator, who joined the Terry Fox Laboratory in 2023, is focused on understanding how mutations in certain proteins, called histones or histone-modifying enzymes, contribute to the development of HGGs.

"By studying these mutations and their effects on the epigenetic landscape, my goal is to identify safer and more effective targets for treating this deadly cancer," said Dr. Chen. "This research has the potential to greatly improve cancer care."

Dr. Chen shares that rapid progress in this field has been made possible by advancing technologies. "When I was a graduate student, genomic sequencing enabled the discovery of histone mutations in cancer. Today, these mutations are now being used by the World Health Organization as diagnostic markers for primary brain tumours. New clinical trials have also been designed to specifically target these mutations."

Despite significant progress, there are still challenges to overcome in understanding HGGs. Dr. Chen notes that HGGs are a diverse disease, and researchers still don't know the causes behind some tumours that lack known molecular features. Many cells from primary brain tumours don't grow well or respond to manipulation, which limits the ability to study and develop effective treatments for them.

By studying the genetic mutations and the impact on the epigenetic landscape, Dr. Chen is working to develop safer and more effective treatments. Although challenges remain, her passion and commitment is paving the way for a brighter future in cancer research.

"My PhD supervisor once told me 'follow your nose' - this meant pursuing scientific questions that are interesting and motivating, and finding your own research path," said Dr. Chen. "This has served me very well, and I have found this type of research to be the most fulfilling. I would strongly urge young scientists to stay curious and find a problem that you would like to solve."

As a researcher at BC Cancer, Dr. Chen shared her deep sense of pride in her work. "Having trained at UBC as both an undergraduate and graduate student, I consider myself fortunate to be back in Vancouver, surrounded by supportive mentors," noted Dr. Chen. "I'm proud to be a part of the Terry Fox Lab, which is well-known in the industry for combining stem cell biology with clinical cancer research."

The scientist's own research program focuses on brain cancer and neurodevelopmental syndromes, aligning perfectly with the Terry Fox Laboratory's philosophy of integrating developmental biology and disease research.

## ANALYZING SINGLE-CELL GENOMICS TO FIND NEW WAYS TO TREAT PEDIATRIC LEUKEMIA

Dr. Marco Marra is a distinguished scientist with Canada's Michael Smith Genome Sciences Centre at the BC Cancer Research Institute and a professor of Medical Genetics at the Michael Smith Laboratories at UBC. His MATCH (Multi-omic Analyses of Treatment Resistance and Cancer Heterogeneity) laboratory aims to uncover targetable genomic and epigenomic alterations driving cancer treatment resistance.

New therapies have dramatically improved survival rates among children with pediatric acute myeloid leukemia (pAML), a heterogeneous cancer that starts in the blood-forming cells of the bone marrow. However, pAML can return after a period of remission and can resist conventional treatments.

In 2023, Dr. Marco Marra's team discovered that relapsed pAML tumours may differ substantially from tumours at diagnosis.

"We found that cancer cells at relapse took on characteristics that are very different from what we saw at initial diagnosis, before treatment," said Dr. Marra. "Knowing how cancer changes at relapse may give us new insight into how we can target it, possibly anticipate who may be at risk of relapse, and perhaps, in the future, even prevent relapse from happening."

The findings stem from a long-standing collaboration between Dr. Marra and Dr. Soheil Meshinchi's team at the Fred Hutchinson Cancer Research Center in Seattle. Dr. Meshinchi is involved in clinical trials that test new pAML therapies, and through that work has built a collection of rare bone marrow samples at three distinct points in time during a child's cancer journey: at initial diagnosis, upon remission and in cases where the disease relapsed.

Using advanced single-cell sequencing, Dr. Marra and his team analyzed the cellular and genetic composition of more than 650,000 individual cells from samples at each of the three time periods. This allowed them to observe how the cancer cells had changed at relapse in response to treatment at diagnosis.

Upon relapse, pAML cells were observed to revert to a more "primitive" state, resembling an earlier stage of blood cell development, known as progenitor cells or stem-like cells. The team also observed that not all pAML subtypes behaved identically at relapse, indicating different relapse mechanisms may be acting in the different pAML subtypes.

"In the cancer cells of most pAML subtypes we studied, a pronounced shift toward an earlier point in the cell lineage was seen," said Dr. Marra. "These types of cells don't divide as rapidly, perhaps making them less susceptible to treatments, including the one used in the clinical trial, and allowing them to survive."

How the cancer changed over time appeared dependent on the specific genetic alterations driving the pAML subtype, underscoring the complex genetic diversity of pAML. Dr. Marra said research insights into cancer heterogeneity and the evolution of treatment resistance will one day help inform the development of precision treatment strategies.

*With files from UBC Faculty of Medicine*

# REVOLUTIONIZING THE TREATMENT LANDSCAPE FOR CHRONIC LYMPHOCYTIC LEUKEMIA

Dr. Alina Gerrie is a hematologist oncologist with the Centre for Lymphoid Cancer at BC Cancer. Her work focuses on translational, clinical trial and outcomes-based research related to leukemia and lymphoma.

Chronic lymphocytic leukemia (CLL) is the most common leukemia in North America. The standard treatment for CLL had previously been chemoimmunotherapy, which was shown to improve survival outcomes compared to chemotherapy alone in CLL patients.

In 2023, Dr. Alina Gerrie led a population-based study investigating the outcomes of a new drug called ibrutinib, which was used for patients receiving their first treatments, as well as those who had either tried a previous treatment that did not work or had their cancer return after going into remission. Ibrutinib is the first in a class of new targeted inhibitors that work by blocking a protein called Bruton tyrosine kinase (BTK) which helps CLL cells grow and survive.

“This new class of drugs have completely changed the treatment landscape for CLL,” said Dr. Gerrie. “It’s remarkable that some patients with very high-risk features are now living for 10 years or more, whereas, previously, with only chemotherapy they would have only lived for about two years after their diagnosis.”

With a team of researchers, Dr. Gerrie analyzed patterns of use of ibrutinib among CLL patients in B.C., as well as their survival outcomes. They found these patients had excellent outcomes, including a two-year overall survival rate of 84 per cent and 76 per cent of patients remaining free from negative events related to cancer within that time period.

Ibrutinib was first introduced as a potential CLL treatment through three phases of clinical trials. However, researchers recognized the importance of observing the effects of the drug on patients in a real-world setting and were able to analyze a population of patients using the B.C. Provincial CLL Database.

While ibrutinib is the first treatment of its kind in Canada and first to be assessed, the next steps to expand upon this work are already underway as there are now second generation BTK inhibitors and newer drugs available.

“These new drugs work very well but are also extremely expensive, so we need to figure out how to deliver the best treatment to patients in a way that our health-care system can sustain,” added Dr. Gerrie.

Building off this work, newer studies are beginning to look at health-care utilization for BTK inhibitors, identifying factors such as how often patients are going to the ER due to complications, or how often they have new medications prescribed or have to see a specialist due to toxicities.

“This drug has had an enormous impact on our patients,” said Dr. Gerrie. “Beyond looking at patient outcomes, it is also important for us to understand how this treatment is being prescribed, how it is tolerated by patients, any toxicities they may experience in a real-world setting, and what may prevent patients from continuing with their treatment.”

# NEW RECRUIT: DR. JOSEPH LAU IS ADVANCING RADIOPHARMACEUTICAL RESEARCH

Dr. Joseph Lau, scientist, is working to develop the next generation of radiopharmaceuticals for both diagnostic and therapeutic purposes. Radiopharmaceuticals are radioactive compounds used in cancer care. From a diagnostic perspective, his work focuses on making these radioactive agents better able to detect and visualize cancers in the body. From a treatment perspective this helps oncologists determine whether a cancer is operable, delineates margins for radiation planning or select targeted therapies based on molecular properties of cancer.

"Radiopharmaceuticals have the potential to greatly improve the quality of life and life expectancy of patients with cancer, especially for people with metastatic cancer," said Dr. Lau. "Radiopharmaceuticals are molecules produced in a lab that can selectively bind to biomarkers found on the surface of cancer cells. By selecting different radioisotopes, we can repurpose a diagnostic agent into a potent radiotherapeutic."

Over the course of his career, Dr. Lau notes some significant steps forward in the field of nuclear medicine including major advances in drug development, radioisotope production, synthetic chemistry, instrumentations and image quantification.

As a former trainee with the BC Cancer Research Institute, Dr. Lau is thrilled to be back and start his independent research group, which was made possible through an anonymous donation to the BC Cancer Foundation.

"BC Cancer is well-positioned to be a leader in radiopharmaceutical imaging and therapy administration," said Dr. Lau. "Recently, we were designated as a Society of Nuclear Medicine and Molecular Imaging (SNMMI) Comprehensive Radiopharmaceutical Therapy Centre of Excellence. This designation improves the ability of our patients to access new radiopharmaceutical therapies, participate in clinical trials, and it further solidifies our commitment to patient engagement and education. With the Institute of Advanced Medical Isotopes (IAMI) being commissioned, we will have increased research and clinical capacities for BC Cancer and the province."

Joining BC Cancer also allows Dr. Lau the opportunity to reconnect with old mentors and establish new cross-disciplinary collaborations with scientists and clinicians. For new scientists looking to get into the field, he offers some advice, "Nuclear medicine spans many disciplines, including radiochemistry, biology, biochemistry, and medical physics. It's important to embrace collaborative research."

He recommends attending departmental events, conferences or symposiums where new trainees can interact with researchers and seek out mentors.

# SHEDDING LIGHT ON WHY PATIENTS THAT EXPERIENCE EARLY AND LATE RELAPSE OF DIFFUSE LARGE B-CELL LYMPHOMA MAY HAVE DIFFERENT OUTCOMES

Dr. David Scott is a clinician scientist at BC Cancer. He is senior scientist and deputy head of the department of Lymphoid Cancer Research and clinical director at the Centre for Lymphoid Cancer at the BC Cancer Research Institute. His team at the Scott Lab studies genomics with the aim of characterizing cancer driver mutations and other alterations relevant to cancer.

In 2023, Dr. David Scott and a team of Terry Fox Research Institute-funded researchers shed light on the cause behind the different outcomes of patients with diffuse large B-cell lymphoma (DLBCL) who experienced a relapse of their disease. The study confirmed that patients whose cancer relapses shortly after treatment typically have poor responses to additional chemotherapy-based treatment. However, when the relapse occurs more than two years from the time of diagnosis, the outcomes of chemotherapy are significantly better.

With this project, the team aimed to understand the molecular characteristics of both the initial diagnostic and relapse tumour samples of DLBCL patients being treated at BC Cancer and across Canada.

"For some time, we have known that patients who experience early relapse have had very poor outcomes when we used our traditional approach that essentially relies on providing more chemotherapy," said Dr. Scott. "With chemotherapy resistance baked into the tumour from the start, we require new tools for these patients. New strategies, such as CAR T-cell therapy and bispecific antibodies, have emerged and the task now is to deliver these to our patients. Meanwhile, patients with late relapses have what we consider to be new lymphomas that can likely be cured with chemotherapy."

DLBCL is a relatively common type of lymphoma, with approximately 300 cases diagnosed each year in British Columbia; around 100 patients experience relapse annually. The study findings offer this group improved chances of long-term remission.

Traditionally, chemotherapy-based treatments have been the standard of care for DLBCL patients who relapse. However, recent studies have shown that CAR T-cell therapy can significantly improve outcomes for patients with early relapse. Understanding what causes resistance and the differences between patient subgroups can help tailor treatment approaches and ultimately improve outcomes.

The research team plans to focus on patients with early relapse to further understand treatment resistance and identify more effective therapies. Additionally, they aim to explore the common precursor cells that contribute to the development of DLBCL and their role in determining how patients will respond to a range of different treatments.

The study's insights have far-reaching implications, influencing the design of clinical trials and the development of targeted therapies. By distinguishing between different patient populations, researchers can better assess treatment efficacy and develop personalized approaches for improved outcomes.

# ENHANCING CANCER TREATMENTS THROUGH SUPPORTIVE CARE

BC Cancer's Supportive Care services enhance patient support by providing evidence-based care that helps patients get through and recover from cancer treatments.

Supportive Care encompasses a range of specialized services including psychiatry, pain and symptom management, palliative care, counselling, nutrition, speech and language pathology, spiritual care and physiotherapy. Within counselling, there are also more subspecialized supports such as vocational counselling for return to work, Chinese language counselling, and art and music therapy.

"Supportive Care helps patients manage the physical and psychological effects of cancer and its treatment to improve their quality of life," said Dr. Alan Bates, program medical director of Supportive Care at BC Cancer. "Supportive care is an important part of care from diagnosis right to end of life or into survivorship."

Researchers in supportive care produced several studies in 2023. This includes a study led by Dr. John-Jose Nunez, psychiatrist and clinical research fellow with BC Cancer and the UBC Mood Disorders Centre, to predict cancer patients' survival using artificial intelligence (AI).

With a team of researchers, Dr. Nunez developed a model to predict whether a patient with cancer will survive 6, 36 and 60 months by analyzing oncologists' notes following a patient's initial consultation. The model uses natural language processing, an area of AI that understands, interprets and generates human language in a meaningful way.

"We can currently predict cancer patients' survival at a population level, but this research is significant because it would give patients a personalized understanding of what their survival may look like," said Dr. Nunez. "For a given type of cancer and stage, we may know that 60 per cent of patients are likely to survive five years and 40 per cent are not likely, but when it comes to the individual, there has been a need for tools to help know which group that person might fall into."

Left: Dr. John-Jose Nunez

An oncologist's initial consultation document is rich in data and easy to access. It also includes important information specific to the cancer, such as the size and stage, as well as other key details such as the patient's comorbidities (e.g., high blood pressure or diabetes) and lifestyle choices (e.g., smoking or physical activity).

"Having more information about the likely course of their illness might allow patients to make important decisions, not only concerning cancer treatment but also in regard to supportive care," added Dr. Nunez.

"For example, a patient might decide to see a counsellor or meet earlier with a palliative care doctor if survival predictions are worse than what they anticipated. And, on the other hand, they might be more likely to engage in physical rehabilitation services if the prediction is that they are likely to be living with cancer for longer than they thought."

This AI model could complement current methods for predicting cancer survival, which include imaging, blood tests and genetic markers.

Dr. Alan Bates

Dr. Caroline Mariano, a medical oncologist with BC Cancer, led significant research in 2023 with a population-based review of supportive care and healthcare service utilization in older adults with a new cancer diagnosis.

“Older adults represent the most rapidly growing segment of the oncology population and they have unique supportive care needs,” said Dr. Mariano. “This study provides a baseline for supportive care initiatives to help connect vulnerable older adults with cancer to supportive care services, which may improve their quality of life and decrease the use of acute care services like the ER.”

The team of researchers, including Dr. Bates and Dr. Nunez as contributing authors, used population-based databases in British Columbia to document referrals to supportive care services, including social work, psychiatry, palliative care, nutrition and home care.

“We examined a broad population of older adults with a new diagnosis of cancer in B.C. to see which supportive care services they accessed,” added Dr. Mariano. “We found that less than half of patients accessed supportive care services, and patients above 80 years were less likely to access services than those between 70 and 79 years.”

Older adults may face additional complexity with a cancer diagnosis as they may be dealing with age-related comorbidities, cognitive dysfunction, lack of social support and impaired functional status.

The results of this review demonstrate that more research is needed to identify potential barriers to accessing supportive care, as well as new ways to deliver holistic care. This is significant as cancer is primarily a disease of older adults, with an estimated 63 per cent of new cancer diagnoses occurring in those over the age of 65, and the prevalence of cancer among older adults expected to rise in the coming decades.

Dr. Caroline Mariano

# CLINICAL RESEARCH & CLINICAL TRIALS

- Dr. Kaethe Clarke led an immunotherapy clinical trial at BC Cancer – Kelowna to determine the efficacy and safety of investigational drug relatlimab plus nivolumab in combination with chemotherapy in participants with unresectable, untreated, locally advanced or metastatic gastric or gastroesophageal junction adenocarcinoma cancer.

- Dr. Kim Chi led Canadian Cancer Trials Group PR21, a randomized phase II study of 177Lu-PSMA-617 versus docetaxel in patients with metastatic castration-resistant prostate cancer and PSMA-positive disease. 177Lu PSMA 617 is a new type of therapy which is designed to deliver high doses of radiation directly to prostate cancer sites in the body. The purpose of this study was to find out whether 177Lu-PSMA-617 can slow the growth of prostate cancer compared to standard chemotherapy treatment.

- Dr. Bernie Eigl and his team at BC Cancer – Vancouver were key contributors to a study that investigated how well two drugs (enfortumab vedotin and pembrolizumab) worked together to treat patients with urothelial cancer. The study compared these drugs to other drugs that are usually used to treat this cancer (standard of care). The patients in this study will have cancer that has spread from their urinary system to other parts of their bodies. The results of this research could change practice as this marks the first time in 30 years that a new first-line treatment is available for bladder cancer patients with overall survival nearly doubled compared with standard chemotherapy.

- Dr. Kevin Hay and his team at BC Cancer – Vancouver were the first academic group to produce and deliver CD19 CAR T-cells to cancer patients in Canada through the CLIC-01 trial. Building on that success, the team began work on the launch of CLIC-02. This Phase 1 study for leukemia and lymphoma will focus on the novel CD22 target, providing an important alternative for patients who don't respond to CD19 CAR T-cell therapy.

- BC Cancer – Vancouver was designated as a Comprehensive Radiopharmaceutical Therapy Center of Excellence – the first in Canada to receive the honour from the Society of Nuclear Medicine & Molecular Imaging. This designation ensures patients have reliable access to high-quality radiopharmaceutical therapy, well-integrated into their pathway of care. Further, the program is to ensure that therapy is delivered by highly qualified therapy teams at technically qualified sites and led by physicians appropriately trained in nuclear medicine acting as the patient's "nuclear oncologist."

# 2023 RESEARCH REPORT

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