GlycoNet

DRIVING INNOVATION AND CREATING IMPACT

2021 ANNUAL REPORT

CORPORATE PROFILE

Canadian Glycomics Network (GlycoNet) is a federally funded Network of Centres of Excellence (NCE) established in 2015 to develop carbohydrate-based solutions to unmet health needs.

GlycoNet brings together more than 170 funded and affiliated researchers from 35 universities and research institutions across Canada. The Network works with industry, government, and non-profit partners on developing solutions for several healthcare areas: cancer, chronic disease, infectious disease, and neurodegenerative disease. In addition to funding research, GlycoNet focuses on knowledge mobilization, commercialization, networking, and partnerships to translate research into tangible benefits for Canadians. To date, GlycoNet has provided support and professional development to over 550 trainees in order for them to achieve their full potential, both during training and in the next steps of their careers.

Our Vision

Delivering solutions to important health issues and improving the quality of life of Canadians through glycomics.

Our Mission

To ensure that GlycoNet and Canada are internationally recognized as leaders in glycomics research through delivering exceptional training, bridging the gap between research and industry, encouraging entrepreneurship, as well as translating research advances into tangible benefits for Canadians.

What is glycomics?

Glycomics is the study of carbohydrates (sugars) in biological systems. Carbohydrate chains, or glycans, are found in the cell membrane of every living cell and are key to almost every biological process. The field is experiencing an explosion of activity with the recognition that there are many ways scientists can exploit biological processes involving carbohydrates to improve human health.

Commitment to Equity, Diversity, and Inclusion (EDI)

GlycoNet believes that in the Canadian research landscape, a culture change is needed to fully realize inclusive behaviours in all levels of research endeavours. Working with the Board of Directors, EDI Committee, Management, and all members, GlycoNet is implementing several strategies towards increasing EDI awareness and making it a priority in its daily functions. GlycoNet will continue to develop, implement, and monitor strategies for better integration of EDI throughout the Network.

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Acknowledgement

GlycoNet is supported by the Government of Canada through the NCE program, a joint initiative of the Natural Sciences and Engineering Research Council, the Canadian Institutes of Health Research and the Social Sciences and Humanities Research Council.

Government of Canada
Networks of Centres of Excellence

Gouvernement du Canada
Réseaux de centres d'excellence

EXECUTIVE MESSAGE

A MESSAGE FROM THE BOARD CHAIR AND EXECUTIVES

The 2020-2021 fiscal year was one of resilience, perseverance, and growth for GlycoNet. While COVID-19 impacted nearly every aspect of our operations, we were able to adapt and continue to fulfill our mission to deliver solutions to important health issues and improve the quality of life of Canadians through glycomics. On behalf of the Board of Directors, we are delighted to provide an overview of GlycoNet and how we will help Canada build a sustainable and healthy future.

The GlycoNet community has grown to 175 research groups across the country who have worked closely with 143 partners from industry, as well as foundations and research consortia from the public and private sectors to create "Made-In-Canada" health innovations. In Cycle II, GlycoNet has shifted its focus to later-stage, translational, clinical, and commercialization-ready projects in the areas of cancer, chronic conditions, infectious diseases, and neurodegeneration. This year, we have significantly increased industry engagement through our strategic funding program to ensure funded projects are of industrial interest and of national priority. As a result, our funding was leveraged by an additional $11.4M from partners and we invested in 17 projects that were supported since Cycle I, along with 8 new multidisciplinary projects. In the past year, our research excellence is evidenced by 54 publications by Network Investigators (NIs) in high-impact, peer-reviewed journals. Multiple NIs were recognized with prestigious awards and major research grants. For instance, Dr. Lori West was appointed an Officer of the Order of Canada, and Dr. Todd Lowary was elected a Fellow to the Academy of Science by the Royal Society of Canada.

While the COVID-19 pandemic has interfered with the Network's research program, GlycoNet was able to mitigate the risks thanks to Government funding support and the NCE's approval of a one-year no-cost extension. In addition, given the crucial importance of glycans and glycosylation in viral infections and immune response, we are pleased to report that, last year, 57 GlycoNet NIs have joined Canada's response to COVID-19 and worked diligently to address pandemic-related issues. Furthermore, GlycoNet supported a project aimed at addressing coronavirus acute respiratory distress syndrome, a serious yet underestimated complication of COVID-19 that requires early recognition and comprehensive management.

The progress made in knowledge and technology exchange and exploitation—a strategy implemented to ensure that projects and technologies advance competitively in line with market needs—is another highlight of this fiscal year. In FY 2021, 11 patent applications were filed for therapeutic candidates, biomanufacturing methods, and drug discovery platforms. Our efforts in partnerships and business development have led to an increased visibility of the Network to biopharmaceutical companies, investors, and end users. Several GlycoNet projects and NIs were highlighted in the media while several more secured new partnerships with leading biopharmaceutical companies and technology receptors.

GlycoNet continues to cultivate entrepreneurialism in the biotech community. To date, we have supported five Canadian technology-based start-up companies in the fields of cryopreservation, cancer diagnostics, therapeutic biomanufacturing, blood transfusion,

and molecular discovery. Notably, one of our start-up companies, PanTHERA CryoSolutions, has secured a US $4M investment to advance technologies in regenerative medicine, while another, 48Hour Discovery, has expanded internationally with two new subsidiaries in Korea and the US. Our most recent start-up company, ABOzymes Biomedical, closed an oversubscribed seminal financing round raising $1.3M in equity investment to advance its "universal blood" technology. Also worth noting, AmacaThera, whose technology was supported in Cycle I, completed a $10.3M Series A financing for the development of a carbohydrate-based therapeutics delivery platform.

Despite the pandemic, GlycoNet established a strong line of communication with existing and potential stakeholders to expand our Network and strengthen our relationships. Although the Scientific Annual General Meeting and Canadian Glycomics Symposium were cancelled, we continued to support networking and knowledge exchange activities through a virtual poster session and weekly glycomics webinars, the latter of which was attended by over 800 international participants and is now conducted in partnership with the American Chemical Society's Carbohydrate Division. We have expanded our international knowledge exchange and training with the launch of a partnership with Japanese universities.

GlycoNet strongly believes in investing in its people and forging a diverse and inclusive culture to achieve success. As such, this year, we incorporated several EDI initiatives across the Network. With the support of our EDI Committee, we launched a "Diversity and Inclusion Bootcamp" mandatory for all NIs and highly qualified personnel (HQP), and a "Bias in Peer Review" training for Committee members. In turn, NIs have been actively implementing EDI into projects, including equitable recruitment, management, and research design. In addition, with support from the Training Committee and the GlycoNet Trainee Association Executive Committee, we organized five professional development workshops and granted 18 training awards that provided research opportunities and technical courses to our HQP, helping them grow professionally and gain a competitive advantage before entering the next phase of their careers. With 551 HQP trained to-date, we launched an Alumni Association last year, aiming to connect with former trainees and help current trainees grow their professional networks.

In terms of outreach, we continued to work with the Centre for Math, Science, and Technology Education (CMASTE) to deliver training resources to secondary school teachers, aiming to incorporate glycomics research within high school curriculum. Early in 2021, we hosted a full-day virtual workshop for 21 high school teachers across Northern British Columbia and the Northwest Territories, where science professional development opportunities are extremely limited.

In all activities, GlycoNet relies on the exceptional leadership of the Board of Directors and Committee members who bring diverse backgrounds and complementary expertise to the organization. We are pleased to report the appointment of five new Directors: Dr. Samuel Abraham, Dr. Walter Dixon, Dr. Lisa Kalynchuk, Dr. David Rabuka, and Dr. Donald Sheppard. In addition, Dr. Elizabeth Nanak has been appointed the Chief Executive Officer, Dr. Warren Wakarchuk has assumed the position of Scientific Director, and Dr. Rui Resendes was recruited as Director of Strategic Partnerships.

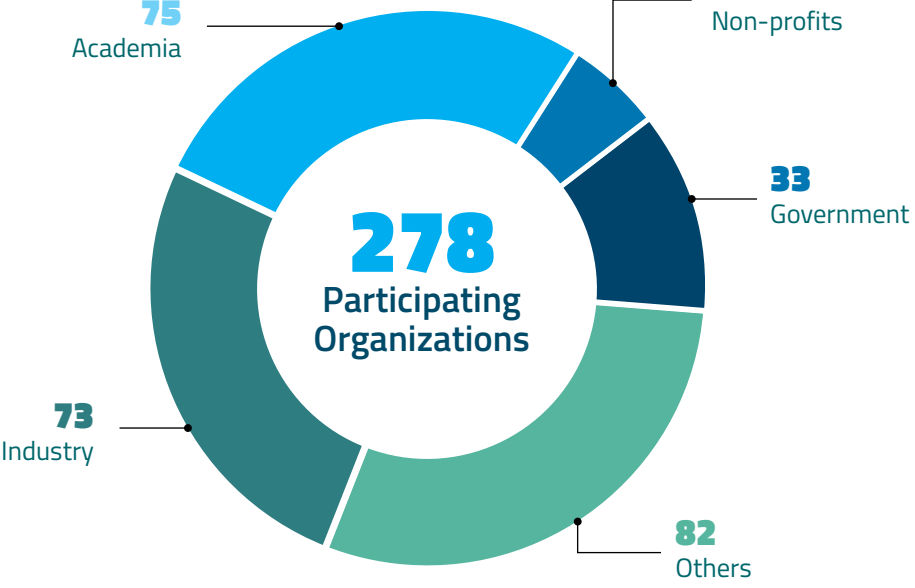
The health and biosciences sectors are two of the fastest-growing industries in the Canadian economy. It is therefore imperative that we leverage existing national strengths and capitalize on areas of commercialization potential, like glycomics, to drive economic growth. By uniting innovators from coast to coast, investing strategically in high-caliber translational research, building domestic and international public-private partnerships, as well as fostering an entrepreneurial culture, GlycoNet is poised to make a positive, lasting, and meaningful impact on Canada's bio-economy. Not only do we catalyze and mobilize innovations made by and for Canadians, but through national alliances we continue to build and promulgate Canada's leadership around the world. Fueled by its diverse talents, its rich network of academic and industrial partners, and a proven discovery-to-innovation-to-commercialization pipeline, GlycoNet is emerging as a globally unrivaled glycomics research and commercialization engine. We are extremely proud to be part of GlycoNet's journey and We are excited to see what the Network will accomplish in the years ahead.

Sincerely,

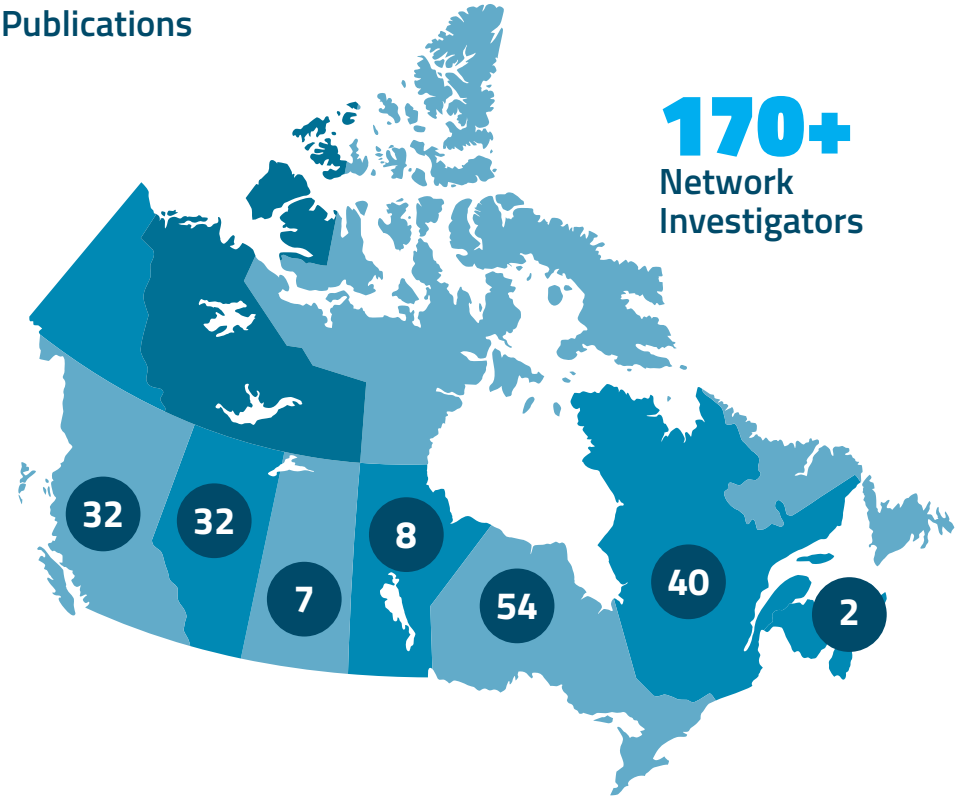
Karimah Es Sabar
Elizabeth Nanak
Warren Wakarchuk

GlycoNet
BY THE NUMBERS

125
Research Projects

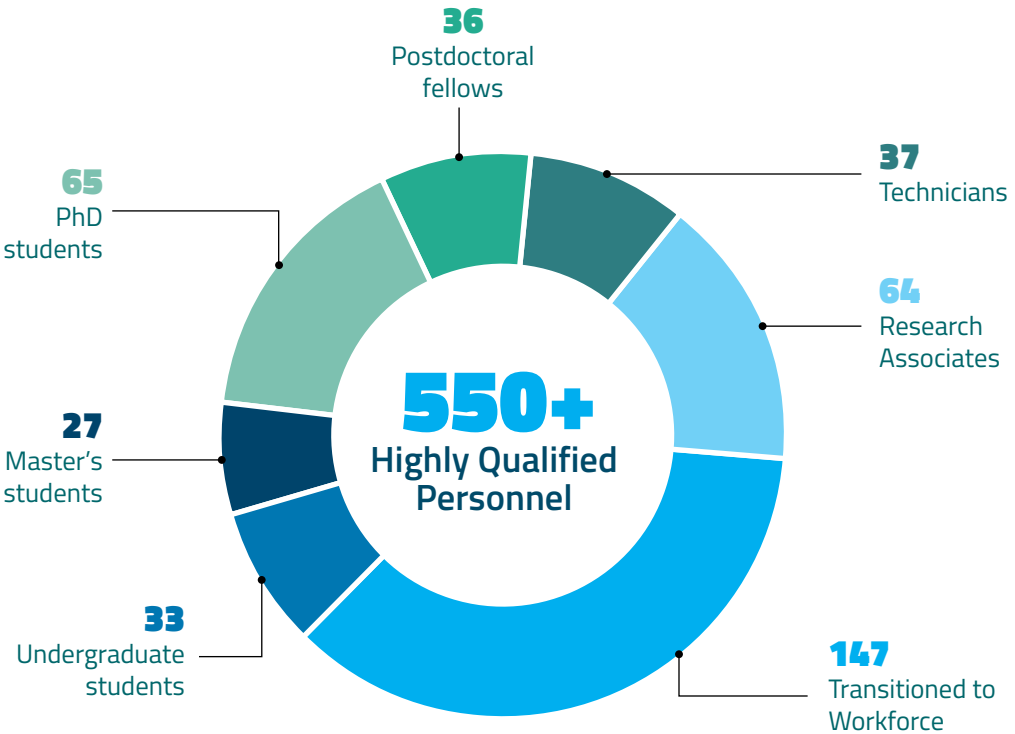


374
Peer-reviewed Publications



170+
Network Investigators

35
Member Universities and Research Institutions



293
Former HQP

$26.5M
research funds distributed and committed

$27.3M
cash and in-kind partner contributions

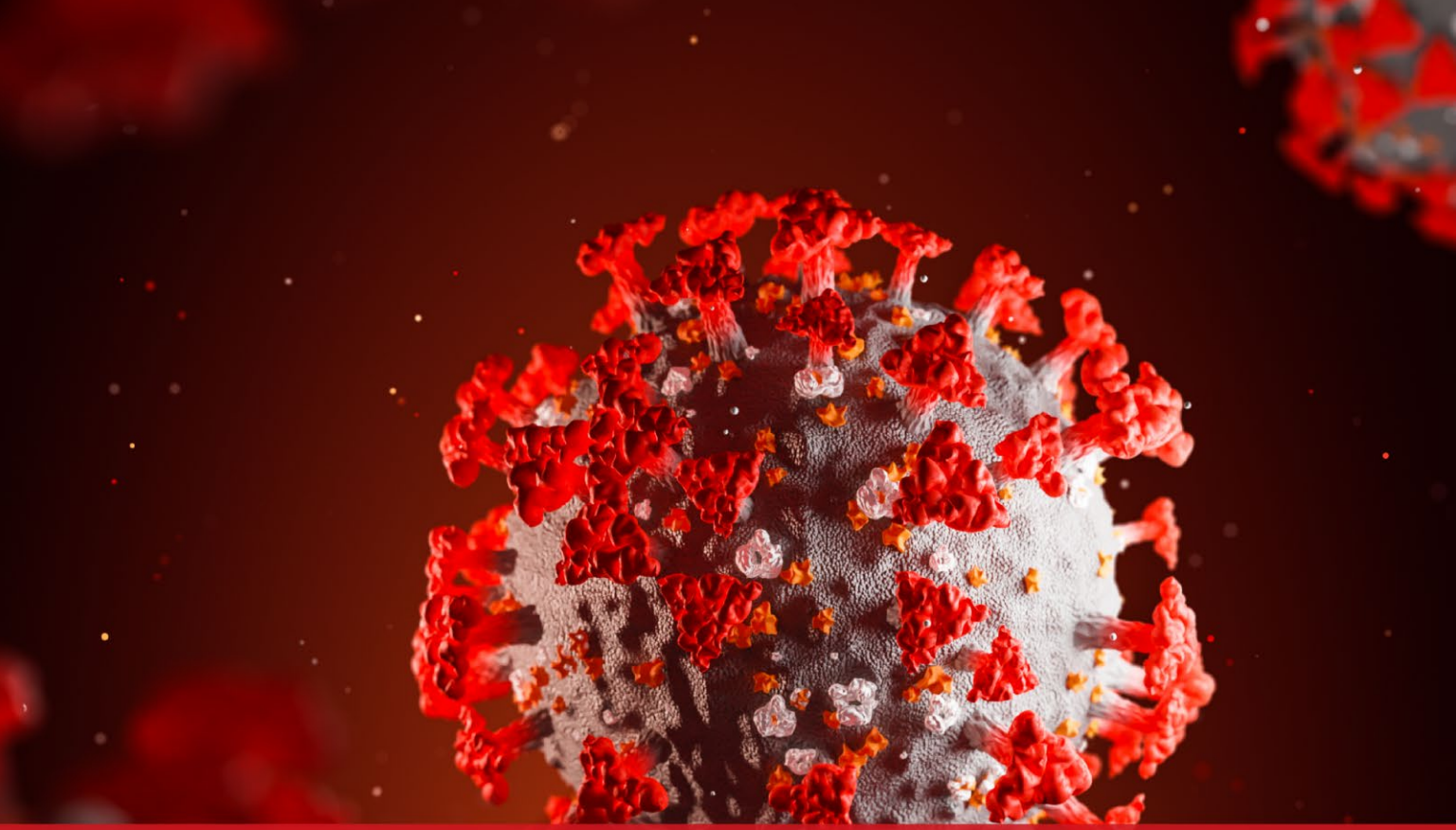
COMMUNICATIONS

1,670
Twitter followers

1,248
GlycoNet newsletter subscribers

1,058
LinkedIn followers

35K+
YouTube video views



RESEARCH IMPACT

GlycoNet research is solution-driven. Every project is expected to create one of more tangible technologies, knowledge, or applications. The outcomes must address healthcare and help Canadians from all walks of life, while delivering social and economic benefits.

Since 2015, the Network has supported 125 research projects with tailored programs that target specific stages of a project life cycle, from early-stage to commercialization, leading to a pipeline of novel technologies, therapies, drug candidates for cancer and infectious, neurodegenerative, and chronic diseases.

GLYCOMICS IS ESSENTIAL IN UNDERSTANDING AND BATTLING COVID-19

The COVID-19 pandemic has led to over 1.4 million confirmed infections in Canada with a fatality rate of approximately 1.9% since the first report of a severe acute respiratory syndrome (SARS) infection by a novel coronavirus (SARS-CoV-2) at the end of 2019. Glycomics serves an important role in the viral structure, viral entry, as well as how the virus escapes from the host's immune system.

Infection by the COVID-19 virus is facilitated by a viral surface protein called the "spike protein," 40% of the surface of which is covered with glycans. These glycans not only shield the virus from the human immune system, but they also are involved in the virus replication cycle. Once the body is infected, symptoms such as pneumonia, acute respiratory distress syndrome (ARDS), sepsis, and other deadly outcomes can all be traced to glycan-protein interactions in the body.

Given the crucial importance of glycans in the biology of the COVID-19 virus and how the body reacts, a better understanding of glycomics greatly accelerates efforts to achieve medical countermeasures. This past year, 57 GlycoNet Investigators have joined the national response for COVID-19 and worked to address pandemic-related issues. GlycoNet has also made strides by assembling network talents to improve the quality of life of COVID-19 patients.

Taming respiratory distress from COVID-19

More than 40% of hospitalized patients with COVID-19 develop ARDS, where a hyperinflammation in the lung damages lung tissue and makes patients unable to breathe on their own. **Drs. Yvan Guindon (IRCM), Andre Veillette (IRCM), and Mona Nemer (University of Ottawa)** are synthesizing small molecules to antagonize the glycan-binding proteins E-selectin and P-selectin, both of which are responsible for developing severe inflammatory responses in ARDS patients. Preliminary results show that these small molecules could inhibit E- and P-selectin and reduce hyperinflammation, thereby making them potential therapeutic agents to treat ARDS.

Controlling blood sugar level with carbohydrate-based molecules

Type 2 diabetes (T2D) is affecting almost half a billion people worldwide, and many more people suffer from obesity. With current treatments causing unpleasant gastrointestinal side effects, novel treatment options for T2D are needed. Montbretia plants produce a carbohydrate-decorated, naturally occurring metabolite, called montbretin A (MbA), which has been shown to control blood sugar levels in animal studies and is now approved for clinical trials in T2D patients. However, MbA is challenging to obtain in sufficient quantities from montbretia or by chemical synthesis for drug development. A team led by **Dr. Joerg Bohlmann (University of British Columbia)** uncovered how montbretia plants synthesize MbA, and are using a metabolic engineering approach to reconstruct the biosynthetic pathway in another plant species, tobacco. The goal is to achieve industry-scale production of MbA in a readily renewable and fast growing plant to deliver a potential new drug cost-effectively to treat T2D and obesity.

Lowering the risk of chronic heart disease

The glycan-processing enzymes "neuraminidases" are associated with the onset and progression of vascular diseases like atherosclerosis. Specifically, when certain neuraminidases exert a high level of activity, they promote the accumulation of fatty streaks in arteries. In a GlycoNet project, **Drs. Christopher Cairo (University of Alberta), Alexey Pshezhetsky (Ste-Justine), and Don Sheppard (McGill University)** studied the mechanism by which neuraminidases contributed to the formation of arterial plaques, and developed inhibitors that could reduce disease progression in mouse models. The outcome of the project provides a clear foundation for the development of novel, small-molecule, therapeutic strategies for atherosclerosis and may identify new predictors of arterial disease.

Treating enteric inflammatory disease with GlycoCaged drugs

Uncontrolled inflammatory gastrointestinal responses can occur in both human and poultry and lead to enteric inflammatory disease (EID). Although there are several treatment options for humans, some require frequent hospital visits, while others may have side effects or not be effective at all. For poultry like chickens and turkeys, mass antibiotics administration was the standard treatment, but increasing restrictions on antibiotic use in livestock production necessitates the development of effective alternatives. **Drs. Harry Brumer (University of British Columbia), Douglas Inglis (Agriculture and Agri-Food Canada), Wade Abbott (Agriculture and Agri-Food Canada), and Laura Sly (BC Children's Hospital)** are developing "GlycoCaged" drugs to improve current treatments. These drugs consist of carbohydrates coupled with anti-inflammatory agents. By coupling them together, the drug could precisely reach the inflammation site in the lower gastrointestinal tract, eliminating the chance of adsorption by other parts of the body. The GlycoCage technology could offer new treatment options for human EIDs (e.g. Inflammatory bowel disease) that affects 1 in 140 Canadians, and may deliver effective alternatives to antibiotics to enhance livestock health and alleviate the threat of antibiotic resistance.

Extending half-life of therapeutic proteins

The vast majority of clinically relevant proteins are glycosylated and are capped with a sugar called sialic acid, which keeps the protein in the bloodstream long enough to elicit its therapeutic effects. However, enzymes in the blood often chop off the linkage between this sugar and the protein, making the protein leave the body prematurely. **Drs. Warren Wakarchuk (University of Alberta) and Stephen Withers (University of British Columbia)** discovered that a simple chemical modification of the sialic acid could stop enzymes from breaking the linkage—prolonging the half-life of therapeutic proteins. The modification also retains the protein's normal biological function in the body.

Protecting against neurodegeneration

Huntington's disease (HD), a genetic early onset neurodegenerative disorder, is associated with decreased production of a family of glycolipids, called gangliosides, in the brain. **Drs. Simonetta Sipione, Matthew Macauley and John Klassen of the University of Alberta** are studying the role of gangliosides in neuroinflammation and using this knowledge to develop effective treatments for patients with HD. The team discovered that gangliosides could dampen brain inflammation in models of HD and other neurodegenerative diseases and could help with the clearance of toxic proteins that cause neural death. In addition, a method to track therapeutically administered ganglioside has been established in animal models to help the researchers determine the best route for ganglioside administration in future clinical trials for patients with HD.

Reversing the symptom of muscular dystrophy

Patients with Duchenne muscular dystrophy (DMD) lack a functional protein called dystrophin, which is essential in maintaining muscle health and repairing muscle damage through interactions with glycoproteins in the body. **Drs. Sachiko Sato, Masahiko Sato, and Jérôme Frenette of the Université Laval** are developing a glycobiological therapy for DMD patients using an orally administered carbohydrate derivative. Compared to other treatments under development, such as gene and stem cell-based therapies, the glycobiological therapy offers a greater advantage as it is less technically demanding, less expensive, and could be used for all DMD patients regardless of their genetic background. The team has demonstrated the safety and efficacy of the drug in mouse models, and further preclinical studies are underway.

Penetrating drug resistance

Antibiotic-resistant bacteria are a huge threat to public health. It is estimated that 1 in 16 Canadians develops an infection from a resistant superbug. **Drs. Eric Brown (McMaster University), Dawn Bowdish (McMaster University), and Christopher Whitfield (University of Guelph)** screened 285,000 compounds and identified two leads that could fight resistant bacteria, especially Gram-negative bacteria—the type that has an outer membrane acting as a shield to antibiotics. The compounds do not efficiently kill the bacteria or halt growth on its own like normal antibiotics. Instead, they penetrate bacteria's outer membrane, weakening the bacteria's defense, and when combined with a common class of antibiotic, they become potent. The leads are now under optimization for toxicity and mechanistic studies.

KNOWLEDGE MOBILIZATION AND COMMERCIALIZATION

GlycoNet has developed a unique approach to evaluating the progress of our projects, which ensures that our teams are on track to pursue commercialization and knowledge mobilization.

BUILDING THE CANADIAN BIOTECH INDUSTRY THROUGH THE CREATION OF START-UP COMPANIES

GlycoNet supports five Canadian start-ups in translating Network-developed technologies and commercializing products. By doing so, GlycoNet contributes to the growth of the Canadian biotechnology industry.

GLYCA BIOSCIENCES

Perfecting the diagnostic pathway for men with suspicion of prostate cancer

Right now, a diagnosis of prostate cancer has an error rate of approximately 20%. GlyCa Biosciences Inc., co-founded by **Drs. Hon Sing Leong (Sunnybrook Research Institute) and Karla Williams (University of British Columbia)**, has developed a next-generation blood test to fix this. This blood test detects cancer cell fragments that contain cancer-specific sugar molecules. According to the team, high levels of these cancer-specific sugar molecules imply high-risk prostate cancer whereas low levels indicate low-risk prostate cancer. When combined with magnetic resonance imaging, this blood test has the potential to identify patients who should receive upfront treatment while sparing men with low-risk prostate cancer the unnecessary consequences of surgery.

48HOUR DISCOVERY

Accelerating drug discovery from billion-scale libraries of molecules

Many large pharmaceutical and biotech companies pay anywhere between $500,000 to $1 million to discover a single viable pre-clinical molecule of interest. An Edmonton-based company, 48Hour Discovery, founded by **Dr. Ratmir Derda (University of Alberta)**, can do the same drug discovery process in just a few days for as little as one-tenth of the cost. Unlike traditional molecular discovery companies that operate without sharing their findings, 48Hour Discovery has a searchable, cloud-based molecular database accessible to its clients, which informs clients if the drug lead is unique or if it has been discovered before. Since its founding in 2017, the company has grown to 15 employees in Edmonton and revenue continues to double each year. It is now working with more than five of the top 20 pharmaceutical companies for drug discovery and diagnostics. In 2021, the company established two international subsidiaries, one in Korea and one in the United States.

CARBAFORM BIOSCIENCE

The "Less-is-more" in anticancer antibodies

Antibody-based treatment of cancer is one of the most successful therapeutic strategies. The manufacturing of anticancer antibodies, however, is not trivial. Most often, the antibodies are produced in the lab and under a condition such that they inevitably contain "fucose," a type of carbohydrate, on their surface. Having fucose taints the potency of the antibodies, yet there are not many cost-effective methods on the market to remove fucose or prevent its incorporation. Carbaform Bioscience, founded by **Drs. Robert Britton (Simon Fraser University) and David Vocadlo (Simon Fraser University)**, employs a technology that uses a small molecule to inhibit the process of attaching fucose to antibodies during their production. The technology would significantly accelerate the manufacturing timeline, thereby lowering manufacturing costs.

PANTHERA CRYOSOLUTIONS

A game-changer for stabilizing cell-based therapies

Freezing cells or tissues can lead to cell death and decrease in cell function. An Edmonton- and Ottawa-based company, PanTHERA CryoSolutions, co-founded by **Drs. Robert Ben (University of Ottawa) and Jason Acker (University of Alberta/Canadian Blood Services)**, developed a technology to improve the cooling and stabilization processes (cryopreservation) by using carbohydrate-based molecules that inhibit the formation of ice crystals, which enhances the storage of cells and tissues at very low temperatures. The technology will benefit patients who are in need of cell transplants and gene therapies. To date, the company has tested its products for use in the preservation of blood and stem cells, and other cell-based immunotherapies (e.g. CAR-T cells). In addition, over 35 companies have evaluated this technology for the cryopreservation of cell-based products in commercial and clinical development. In 2020, the company raised $4M USD investment from US-based firms, BioLife Solutions and Casdin Capital.

ABOZYMES BIOMEDICAL INC.

Making blood types obsolete

Founded in 2020, ABOzymes Biomedical Inc. is developing an enzyme technology to ensure that blood type is no longer a constraint for those in need of a life-saving blood transfusion or organ transplant. Built upon the discoveries of **Drs. Stephen Withers and Jayachandran Kizhakkedathu of the University of British Columbia**, the innovative technology utilizes enzymes originally derived from the human microbiome to convert the cell surface antigens that determine blood type to the universal donor type. ABOzymes is developing the technology so that the enzymes will be added to a standard blood collection bag and an organ perfusion solution. The company raised $1.3M of equity investment in a seed round.

SUPPORTING CANADIAN SMALL AND MEDIUM-SIZED ENTERPRISES (SMES)

Through the GlycoNet Strategic Initiative program, the Network partners with SMEs and assist and support them in their development. A number of GlycoNet-affiliated entrepreneurs have benefited from this program. Three of them are highlighted here.

More sustainable and safer delivery for post-operative pain

Dr. Molly Shoichet (University of Toronto), is developing a novel post-operative, nonopioid pain therapy for patients who undergo surgeries. This new biomaterial can deliver anesthetics to surgical sites without causing side effects typical of opioids, such as addiction. In collaboration with GlycoNet and AmacaThera Inc., a spin-off from her lab, Dr. Shoichet is advancing an improved hydrogel-based drug delivery system that targets specific surgical sites and provides pain relief for up to three days. Common local anesthetics typically wear off four to 12 hours after being administered and then patients often resort to opioids to overcome pain. The company has recently completed a $10.3M Series A financing to support the company's lead clinical asset and pipeline expansion.

Natural food at its finest to treat kidney stones

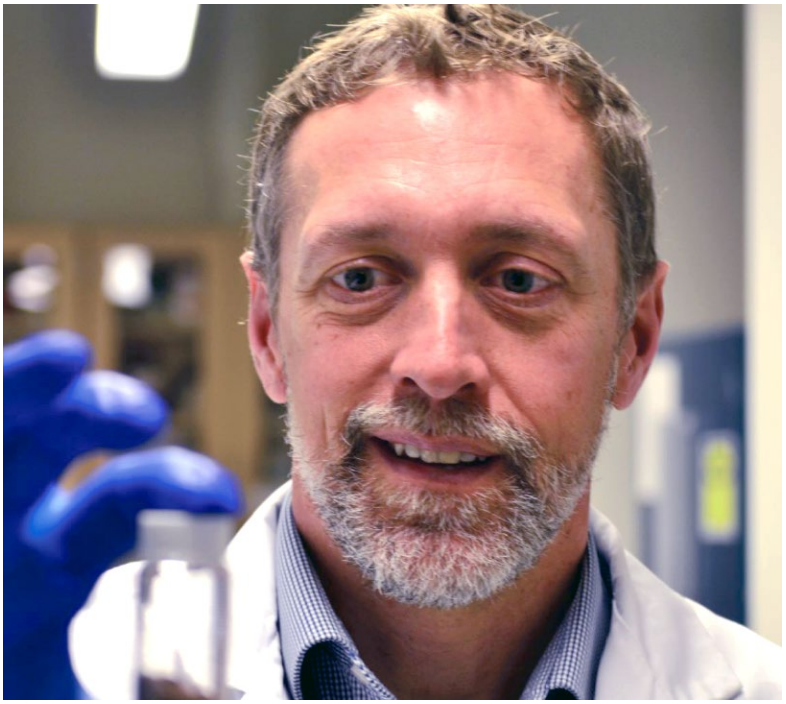
SP Nutraceuticals, founded by **Dr. Paul Spagnuolo (University of Guelph)**, extracts molecules from food or plants and examines if any of the molecules have an effect on a specific disease. The company has discovered a carbohydrate derivative from plants that could break down kidney stones. With GlycoNet's support, a Phase I clinical trial with 39 healthy adults successfully established the safety of daily oral consumption of the drug. The team is currently looking for partners to conduct a Phase II clinical trial.

Once-daily therapeutic for diabetic patients

Zucara Therapeutics, a diabetes life science company previously supported by GlycoNet, partnered with **Dr. Michael Riddell (York University)** to advance a novel therapeutic agent to reduce insulin-induced hypoglycemia (low blood glucose levels) in people living with Type 1 Diabetes (T1D). The company recently completed a Phase I trial for T1D and demonstrated the safety and tolerability of the developed therapeutic candidate. With GlycoNet's support, the team is now expanding the development of this drug candidate to Type 2 Diabetes.

NETWORKING AND PARTNERSHIPS

What underlines and supports all GlycoNet activities is the power of our strong and varied partnerships. In six short years, the Network has grown significantly. We started with 32 partners and today it has increased to 278. We are building non-conventional partnerships to expand research capacity and collaborations from different disciplines. Our partners come from investor firms, health foundations, technology receptors, research consortia, industry, government, and a range of public and private sectors. By forging strategic alliances, we not only provide our Network members with access to world-leading expertise, but also ensure that we are targeting areas of priority and relevance to the community.



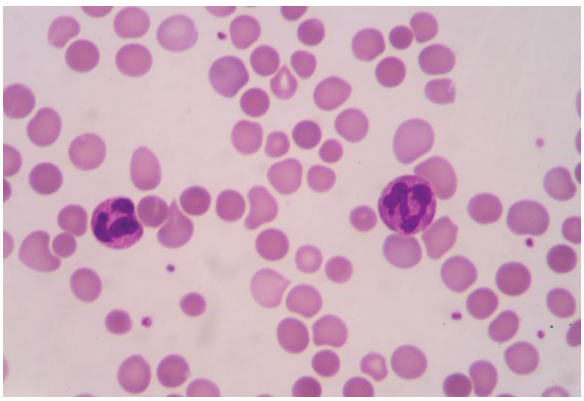
INDUSTRIAL COLLABORATION TO FAST-TRACK DRUG DEVELOPMENT

GlycoNet and its partner Consortium de recherche biopharmaceutique (CQDM) initiated a three-year, $1.25M collaboration with Merck, Servier, and Amgen. Lead Investigator **Dr. Robert Britton (Simon Fraser University)** is advancing a platform technology for the rapid synthesis of nucleoside analogues as potential anticancer or antiviral agents. This project builds on previous work that cut down 20-plus step syntheses to a three-step scalable synthetic route in which economical starting materials can be converted directly into nucleoside analogues, opening new avenues in drug development.

TRANSLATING DISCOVERY TO CLINICAL OUTCOME

Gene therapy for neurological disorders

Tay-Sachs disease (TSD) and Sandhoff disease (SD) are inherited neurological disorders and are most common in French-Canadians from eastern Quebec and Métis in Saskatchewan, respectively. The two diseases share many clinical and biochemical features and affect the function of the same enzyme. **Dr. Jagdeep Walia (Queen's University)** is developing a gene therapy to correct the enzyme deficiency in patients of TSD and SD. After successful preclinical studies in mouse models, the team is leading a phase 1/2a clinical trial with the support from GlycoNet and Taysha Gene Therapies.



Un-orphaning autoimmune diseases

Immune thrombocytopenia purpura (ITP), a rare blood disorder that causes the immune system to attack and destroy normal platelets, affects approximately five in 100,000 children per year. Through a partnership with IRICoR, a Centre of Excellence in Commercialization and Research specialized in drug development, **Drs. Christopher Cairo (University of Alberta) and Alexey Pshezhetsky (Ste-Justine)** are optimizing and commercializing drug candidates—selective, potent small molecule inhibitors for the glycan-processing enzyme "neuraminidase"—as therapeutic treatments for ITP.

SHOWCASING GLYCOMICS AS THE NEXT FRONTIER FOR GLOBAL PHARMA

Connecting idea-generators with policy-makers

GlycoNet Investigators are making cases for glycomics inventions to decision makers. As a member of Research Canada, a national alliance advocating for health research in Canada, GlycoNet Investigators **Drs. Michael Riddell (York University) and Yves St-Pierre (Institut national de la recherche scientifique)** were selected to present the impact of glycomics research to elected officials, policy makers, and industry stakeholders at two virtual reception events: *Celebrating the 100th anniversary of the discovery of insulin: diabetes research innovation in the making*, and *Cancer gone: the research and innovation that thinks it can.*

Disseminating knowledge across North America and Europe

The GlycoNet webinar series launched in April 2020 and has attracted an international audience. In September 2020, The American Chemical Society (ACS) Carbohydrate Division and GlycoNet partnered for the "joint webinar series," which featured speakers from US, Canada, and Europe. The webinars gave HQP opportunities to present their research in front of an international audience. In total, 62 speakers, including investigators and HQP from Canada, US, UK, and Germany presented their research. In addition, this partnership between the ACS and GlycoNet has facilitated conversations and potential research collaborations between Canada and the US.

Raising Canada's international profile in glycomics

GlycoNet is creating world-class research centres across the globe. As a stakeholder under Japan's Core-to-Core Program, GlycoNet is partnering with Academia Sinica (Taiwan), Institute for Glycomics (Australia), Université de Lille (France), as well as Nagoya University (Japan) and Gifu University (Japan) to facilitate the exchange of knowledge and training through joint meetings and reciprocal research exchange.

TRAINING AND EDUCATION

GlycoNet has distinguished itself with a well-rounded training program with the goal to train the next generation of glycoscientists. To date, the training program has made an impact on the lives of more than 550 trainees from 35 institutions across Canada.

INSPIRING THE NEXT GENERATION OF SCIENTISTS

The GlycoNet training program brings early-stage researchers, professionals, and HQP together and provides them with the knowledge and skills to drive innovation in their careers, both within and beyond academia.

Building Successful Careers

GlycoNet HQP alumni are embarking on positions in industry, academia, government, and non-profit organizations. Some are joining start-ups or launching their own. They are winning awards, competitions, and establishing themselves as future leaders and experts in the field.

GlycoNet's impact on my training extended beyond research. I served on the inaugural GlycoNet Trainee Association Executive Committee, where I worked collaboratively with my colleagues to serve and represent our trainees across Canada. We helped organize the first GlycoNet Annual General Meeting and proposed new training initiatives such as the ATOP. This experience provided me with key leadership and community service skills that are important for my academic career.

Dr. Omar El-Halfawy, Assistant Professor, University of Regina

As a former GlycoNet trainee, I was synthesizing challenging glycoconjugates and oligosaccharides as potential biomarkers. GlycoNet provided me with fantastic opportunities to collaborate with other research institutes with versatile backgrounds. Now, as a Senior R&D scientist in a start-up company, I appreciate all the GlycoNet experiences that helped me bridge the gap between projects involving clients with and without scientific background.

Dr. Ke Shen, former GlycoNet trainee and current Senior R&D scientist at Nova Medical Testing

Through my internship with Dr. Yves St-Pierre at INRS, I was given the opportunity to put into practice the theoretical knowledge learned during the course of my Undergraduate degree. My experience in research was enriching, not only because of all the hard skills I developed, but also because I emerged with a greater sense of confidence and autonomy in the lab.

Alyssa Dumoulin, Recipient of Summer Awards for Undergraduate Students

As an HQP interested in eventually holding a leadership position within a lab, I found that the Advanced Training Opportunity Program (ATOP) was a great opportunity to practice grant writing, project management, and mentorship. Mentoring a student boosted my confidence and my ability to transfer knowledge to others. It was rewarding to see my student gain experience and become enthusiastic about science.

Dr. Jolene Garber, Recipient of ATOP and Member of 2020-2021 GlycoNet Trainee Association Executive Committee

ENGAGING COMMUNITY STAKEHOLDERS

Innovation and success are not just about technologies, but about people. GlycoNet encourages engagement with science across the whole of society and we are especially keen to nurture the innate curiosity of young people.

In 2021, GlycoNet's ongoing outreach partnership with University of Alberta's Centre for Mathematics, Science and Technology Education (CMASTE) focused on professional development and curriculum training for high school and middle school teachers. The outreach team hosted a full-day "virtual carbohydrate classroom" for more than 20 teachers from across the Northwest Territories and Northern British Columbia.

"I am the only science teacher at my school, so we don't really have science professional development opportunities here," says Jillian Brown, a science teacher from Mackenzie Mountain School in Norman Wells, Northwest Territories. "The experience is great and certainly would be interesting to try to take it to my students."

The day-long workshop included presentations on GlycoNet's current research projects including blood transfusion, flu virus, and diabetes. GlycoNet trainees at the University of British Columbia showed the teachers lab techniques and instruments through virtual lab tours.

"I really enjoy the virtual lab tours and the science presentations," says Lindsay Lynn, science teacher from North Peace Secondary School in Fort St. John, British Columbia. "In my class, we've discussed separating different substances. Being able to see how it's done in action during the virtual tour is very neat."

For inclusive learning and to ensure that all teachers could participate in the hands-on workshop, science kits were assembled and shipped to all participants prior to the event. The facilitator demonstrated a water filtration experiment using tap water, dirt, and various filtration systems such as rice, paper, and wood chips. The teachers also learned about the basic structure of proteins by using wire and tape in a protein-folding exercise.

"I like the fact that the experiments are so hands-on and simple to prepare," continues Lynn. "Everything in the kit we received—glitter glue, tape, chickpeas, coffee filter—we can get it from local shops. I could really see myself doing the experiments with the students."

Teachers can draw on this experience and adapt the resources to their biology, chemistry, environmental science, and anatomy classrooms. Resource materials include videos, case studies, webquests, and are available on the GlycoNet website in both English and French.

In the past, GlycoNet and CMASTE have hosted similar in-person workshops in cities in Alberta such as Edmonton, Lethbridge, and Lloydminster, as well as in Saskatchewan including Saskatoon and North Battleford.

LEADERSHIP AND MANAGEMENT

Effective Management and Strong Governance

GlycoNet's Board of Directors plays an important role in guiding the Network. The Board and management team aim to deliver strong and sustainable legacy for the healthcare sector in Canada comprised of world-leading researchers, innovative technologies to address medical needs, an engaged stakeholder community, and a roadmap to a healthier Canada.

Board of Directors transition

In the fall of 2020, GlycoNet welcomed five new Board members: **Dr. Samuel Abraham (Strategic Advisor, Western Economic Diversification), Dr. Walter Dixon (Associate Vice President Research and Innovation, University of Alberta), Dr. Lisa Kalynchuk (Vice President Research, University of Victoria), Dr. David Rabuka (Founder and CEO, Acrigen Biosciences), and Dr. Donald Sheppard (Director of McGill Interdisciplinary Initiative in Infection and Immunity)**. These individuals have collective expertise in IP, operations, strategic partnerships, commercialization, knowledge mobilization, ethics, research, and governance, as well as many years of experience in the academic, clinical, provincial, federal, and industry sectors.

BUILDING A GLYCONET LEGACY

Accruing the success from the Network since 2015, GlycoNet continues to propel Canada's leadership in glycomics and make a positive impact on the lives of people in Canada and worldwide. Our legacy is not only built on the commitment to serving the needs of our people and our society, but also forging a sustainable path to drive the growth of the Canadian bioeconomy. In addition to accelerating glycomics research and commercializing technologies of priority to Canadians, GlycoNet is supporting SMEs and creating domestic employment opportunities in the biotechnology and life sciences sectors. On a global scale, GlycoNet is increasing Canada's competitive edge by enabling company formation, building international public-private partnerships, and attracting foreign investments. To achieve our vision of improved quality of life through glycomics, GlycoNet is working with key stakeholders in industry, government, and academia to plan and implement strategies, ensuring that our legacy supports a strong and sustainable economy for future generations.

NETWORK COMMUNITY

NETWORK MEMBERS

- CHU Ste-Justine
- Concordia University
- Dalhousie University
- Hospital for Sick Children
- Institut de recherches cliniques de Montréal
- Institut national de la recherche scientifique
- Lawson Health Research Institute
- London Health Sciences Centre
- McGill University
- McMaster University
- Queen's University
- Research Institute of the McGill University Health Centre
- Ryerson University
- Simon Fraser University
- Sir Mortimer B. Davis Jewish General Hospital
- Sunnybrook Research Institute
- Université de Sherbrooke
- Université Laval
- University of Alberta
- University of British Columbia
- University of British Columbia - Okanagan
- University of Calgary
- University of Guelph
- University of Lethbridge
- University of Manitoba
- University of Montréal
- University of Ottawa
- University of Quebec at Montreal
- University of Saskatchewan
- University of Toronto
- University of Victoria
- University of Waterloo
- University of Western Ontario
- University of Windsor
- Wilfrid Laurier University
- York University

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Universities and Research Institutions

- Academia Sinica
- Alberta Glycomics Centre
- Alberta Machine Intelligence Institute
- BC Children's Hospital
- California Institute of Technology
- Campus Alberta Neuroscience
- Centre for Health Evaluation & Outcome Sciences
- Cross Cancer Institute
- Harvard/Massachusetts General Hospital
- Immunology Drug Discovery Group for CNS Disorders
- Integrated Biobank of Luxembourg
- Krembil Research Institute
- Memorial Sloan Kettering Cancer Center
- Oxford University
- Scripps Research Institute
- SPARC BioCentre
- Stanford University
- The Ferrier Research Institute
- University of California
- University of Maryland
- University of Oklahoma
- University of Texas
- Wisconsin College of Medicine

Industry and Technology Receptors

- 48Hour Discovery Inc.
- ABOzymes Biomedical Inc.
- Acrigen Biosciences
- adMare BioInnovations
- Alectos Therapeutics
- Amgen
- Appili Therapeutics
- Aspect Biosystems
- Atara Biotherapeutics
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- BioTalent Canada
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- Juno Therapeutics
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- LCB Pharma
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- Merck
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- Mitacs
- Moderna Therapeutics
- Molecular Forecaster
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- Ossium Health
- Ovensa Inc.
- PanTHERA CryoSolutions
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- Quark Venture
- Roche
- Satellos Bioscience Inc.
- Scientia Advisors
- Servier
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- StemCell Therapeutics
- SynAD
- Taysha Gene Therapies
- TRB Chemedica
- TRIUMF
- Waters Corporation
- Wellesley Therapeutics
- WuXi App Tec
- Zucara Therapeutics
- Zymeworks

Canadian & International Government Departments/ Agencies

- Agriculture and Agri-Food Canada
- Alberta Health Services
- Alberta Innovates
- Alberta Livestock and Meat Agency
- BC Knowledge Development Fund
- Canadian Poultry Research Council
- CNRS France
- National Cancer Institute
- National Institute of Health
- National Research Council
- Ontario Research Fund
- US Department of Defense
- Western Economic Diversification

Foundations & Funding Agencies

- Australian Red Cross
- Austrian Science Fund
- Canadian Blood Services
- China Scholarship Council
- CIFAR
- Crohn's and Colitis Canada
- Cystic Fibrosis Canada
- David Braley Centre
- Fondation Armand-Frappier
- Fondation du cancer du sein du Québec
- Komen Foundation
- Michael J. Fox Foundation for Parkinson's Research
- Michael Smith Foundation for Health Research
- Sanfilippo Children's Research Foundation
- Societé canadienne du cancer
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- **Zhou Xing**, McMaster University
- **Ziv Gan-Or**, McGill University

FINANCIAL STATEMENTS

Canadian Glycomics Network

STATEMENT OF FINANCIAL POSITION

As at March 31, 2021

	2021 $	2020 $
Assets		
Current assets		
Cash	138,180	96,749
Short-term investments (note 3)	241,770	356,514
Accounts receivable	28,397	99,092
GST receivable	93	6,381
Prepaid expenses	10,152	8,835
Due from Network Host (note 4)	6,575,864	5,780,486
	6,994,456	6,348,057
Long-term investments	25,000	-
	7,019,456	6,348,057
Liabilities		
Current liabilities		
Accounts payable and accrued liabilities	84,155	162,877
Deferred revenue (note 5)	6,455,241	5,724,704
	6,539,396	5,887,581
Net Assets		
Unrestricted net assets	480,060	460,476
	7,019,456	6,348,057

Approved by the Board of Directors

Director Director

The accompanying notes are an integral part of these financial statements.

FINANCIAL STATEMENTS

Canadian Glycomics Network

STATEMENT OF OPERATIONS

For the year ended March 31, 2021

	2021 $	2020 $
Revenues		
Grants (note 5)	5,740,716	4,812,326
Contributed services (note 6)	150,000	110,000
Services	78,116	40,991
Interest income	4,501	9,358
Symposium	550	49,643
	5,973,883	5,022,318
Expenditures		
Research project funding	5,005,552	3,219,502
Salaries and employee benefits	669,860	758,516
Training programs	92,492	89,893
Communications	61,876	96,438
Other	41,725	65,774
Professional fees	24,593	33,585
Patent costs	12,238	209,842
Insurance	10,866	10,183
Seminars, workshops and networking	8,653	14,501
Office	8,597	12,043
Travel	6,239	122,895
Consulting fees	5,238	43,204
Equipment	5,202	2,529
Symposium	1,168	294,357
	5,954,299	4,973,262
Excess of revenues over expenditures for the year	19,584	49,056

CANADIAN GLYCOMICS NETWORK

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