



BACKGROUNDER

Genomic Applications Partnership Program Funded Projects – Rounds 11, 12, 13 & 14

The Genomic Applications Partnership Program (GAPP) funds translational research and development projects that address real-world challenges and opportunities as identified by industry, government, not-for-profits, and other receptors of genomics knowledge and technology. GAPP equips diverse users to deploy genomics knowledge into applications that can help them develop innovative solutions to their most pressing challenges and priorities.

The following 11 projects have been selected for funding over the last four rounds of funding (GAPP Rounds 11, 12, 13 and 14) for a total investment of \$40.3 million (\$12 million from Genome Canada and \$28.3 million from co-funding partners including provincial governments, private sector and not-for-profit organizations).

ROUND 11

Ontario

Title: Targeted Next Generation Sequencing Panels for Clinical Disease Management

Project leaders: John Bartlett (Ontario Institute for Cancer Research), Seth Sadis (Thermo Fisher Scientific)

Lead Genome Centre: Ontario Genomics

Total funding: \$6 million

Over the past 2-3 years, the Ontario Institute for Cancer Research (OICR) and Thermo Fisher Scientific (TFS) have partnered in developing genomic solutions for rapid adoption into the clinic. OICR's collaboration with TFS resulted in the commercial launch of the OncoPrint™ Comprehensive Assay (v3). The current project is focused on developing new biomarker signatures based on combined RNA and DNA sequencing with clinical utility in well-characterized patient cohorts to develop clinical diagnostic tests in cancers for pancreatic, prostate and breast cancer patients, and provide a model for adoption in other disease settings.

Title: NanoString nCounter Vantage 3D platform-based complementary diagnostic tests for precision medicine in pediatric cancers

Project leaders: Cynthia Hawkins (The Hospital for Sick Children), Sean Ferree (NanoString Technologies)

Lead Genome Centre: Ontario Genomics

Total funding: \$4 million

DNA-based next generation sequencing provides important information about DNA alterations however, most oncology drugs are designed against defined molecular targets at the protein level. There is a pressing need for novel diagnostics that interrogate all levels of cellular information, protein, RNA and DNA, in order to best guide therapeutic choices. This project aims to amalgamate proteomic data with genomic and transcriptomic information to develop laboratory developed (LDT)-complementary diagnostics for the most common pediatric cancers. Furthermore, the partnership between NanoString Technologies and the SickKids Department of Paediatric Laboratory Medicine will leverage their combined technological, clinical and business expertise.

ROUND 12

Ontario

Title: Field Validation of Technologies for Anaerobic Benzene and Alkylbenzene Bioremediation

Project leaders: Elizabeth A. Edwards (University of Toronto), Sandra Dworatzek (SiREM, a Division of Geosyntec Consultants International Inc.)

Lead Genome Centre: Ontario Genomics

Total funding: \$3 million

There are thousands of sites in Canada contaminated with benzene, and the alkylbenzenes toluene, ethylbenzene, and xylenes (collectively known as BTEX), negatively impacting soil and groundwater resources. Current BTEX remediation technologies are often too costly and not applicable at the many sites with prevailing anoxic conditions. Building on previous research that developed, characterized and scaled-up a single methanogenic benzene-degrading culture, this GAPP project's goal is to demonstrate the efficacy of a broader set of novel and specialized anaerobic bioaugmentation cultures in pilot trials at three different benzene contaminated sites. The team will use metagenome-enabled analysis, groundwater modeling, and tracking of the microbial populations and functional genes associated with anaerobic BTEX biodegradation in the subsurface to improve overall remediation outcomes and to restore ecosystem health.

Quebec

Title: Developing the Next Generation PD-L1 Assays Using Precision Mass Spectrometry

Project leaders: Christoph Borchers and Alan Spatz (Lady Davis Institute, Jewish General Hospital), Claude Leduc (MRM Proteomics Inc.)

Lead Genome Centre: G nome Qu bec

Total funding: \$1.4 million

Lung cancer accounts for 14% of all diagnosed cancers in Canada from which 80% of patients will be tested for programmed cell death protein 1 (PD-L1) through the course of the disease. This project aims to develop PD-L1 Mass Spectrometry (MS)-based assays for use in immune-oncology. The Receptor, MRM Proteomics, in partnership with the academic leaders will develop two alternative analytical pipelines based on multiple reaction monitoring (MRM, for research purposes) and immuno MALDI (iMALDI technology, suitable for clinical diagnostics). The anticipated revenues for MRMP's new PD-L1

kit is projected as \$3.5 million over the first five years post project and with the addition of the iMALDI technology to 20% of the PD-L1 test kits would generate more than \$250 million.

Atlantic

Title: Genomics for Developing the first Canadian production ready strain of selectively bred Eastern Oyster

Project leaders: Louis Bernatchez (Université Laval), André Mallet (L'Étang Ruisseau Bar Ltée.)

Lead Genome Centre: Genome Atlantic, Génome Québec

Total funding: \$3.8 million

The oyster industry in Atlantic Canada is expanding rapidly and this growth cannot be sustained by relying solely on wild-caught oyster spat, a risky strategy due to large annual variations in recruitment. The incorporation of a rigorous selective breeding program for the Eastern oyster, which would increase the profitability of oyster farms, is constrained by the lack of genomic tools (such as high-density SNP chip) which would allow implementing genomic-based selection. The overall goal of this project is to enable L'Étang Ruisseau Bar Ltée, Eastern Canada's largest seed supplier, to produce the first production-ready strain of selectively bred Eastern oyster.

ROUND 13

Prairie

Title: Floating Wetland Treatments to Enhance Remediation (FLOWTER)

Project leaders: Vince Palace (IISD – Experimental Lakes Area), Patrick Smyth (Canadian Association of Petroleum Producers)

Lead Genome Centre: Genome Prairie, Génome Québec

Total funding: \$4.5 million

Environmental impacts of oil spills are a major public concern, impeding social license for the development of the petroleum sector and Canada's economic development. Furthermore, there is uncertainty around the best methods to employ when cleaning oil spills in sensitive freshwater ecosystems. The International Institute for Sustainable Development-Experimental Lakes Area (IISD-ELA) has begun a large, collaborative, and multi-phased program to: a) determine the effectiveness of non-mechanical and biological methods for cleaning spilled oil from freshwater aquatic environments, and b) develop non-lethal and minimally invasive monitoring techniques to measure oil exposure and recovery in aquatic wildlife populations. The FLOWTER project builds upon this program in order to i) optimize Engineered Floating Wetlands (EFWs) to enhance the associated rhizome microbiome to achieve rapid oil degradation, and ii) validate fin clips and mucus swabs as non-invasive biological assessment tools for monitoring cleanup performance. More effective treatment and monitoring of oil spills are expected to increase social license and regulatory approval for oil infrastructure, which could add an estimated \$3.2 billion to Canada's gross domestic product. These optimized tools will also benefit industry and Canadians by significantly reducing response costs, follow-up resource and property damage claims, and by restoring ecosystem services more quickly.

Ontario

Title: Systematic evaluation and optimization of immune-targeting modalities for GBM and brain metastases

Project leaders: Jason Moffat (University of Toronto), Sheila Singh (Empirica Therapeutics)

Lead Genome Centre: Ontario Genomics

Total funding: \$4.6 million

There are currently no successful therapeutic regimens for patients with recurrent/refractory glioblastoma (GBM), and brain metastases (BM). Partnering with Dr. Jason Moffat at the University of Toronto and collaborators at McMaster University, Empirica has used genomic screening technology to identify CD133 as a promising target for effective treatment in both in vitro and in vivo models using Chimeric Antigen Receptor (CAR)-T cell therapy. The overall goal of the project is to design and validate next-generation CD133 CAR-Ts that are genetically engineered to be manufactured “off-the-shelf”- thus less costly - and are less susceptible to immune suppression. GBM accounts for more than 50% of the approximately 22,850 cases of brain and other nervous system cancers that were diagnosed in 2015. As one of the most aggressive cancer types, with inevitable recurrence, the global GBM market was US \$416.8 million in 2015 and is forecast to reach US \$1.15 billion by 2024 as the global population increases. In Canada, costs of cancer care have been steadily on the rise, and this project aims to provide more effective and universal treatments for recurrent GBM that can alleviate this economic burden.

Quebec

Title: Genomic-based approach to optimize the development of texturizing bacterial strains in yogurt

Project leaders: Steve Labrie (Université Laval), Sébastien Fraud (General Mills)

Lead Genome Centre: Génome Québec

Total funding: \$1.2 million

Yoplait Liberté Canada Co. holds 30% of the yogurt market share in Canada and employs 800 Canadians across the country. The food industry continually struggles to reduce food additives (e.g., texturizing additives such as starch and gelatin) and for 70% of consumers, dairy and bakery products where additives were eliminated positively influenced their buying decisions. Eliminating texturizing additives from yogurts is a solution to meet these expectations. The most promising strategy to reduce texturizing ingredients is the incorporation of bacterial cultures that have an intrinsic capacity to modulate the texture of fermented milk through production of exopolysaccharides (EPS).

Yoplait has sequenced the genomes of 556 lactic acid bacteria (LAB) strains that could be introduced as starters or adjunct cultures in yogurt and the proposed project aims to perform functional analyses to unravel the commercial potential of these strains. This project will establish a genomic-based pipeline to select EPS-producing LAB and to assess the texturizing properties of representative strains of each selected EPS-cluster at the pilot/industrial scale. Based on Yoplait’s recent product launches ingredient simplification increased sales by 7 to 9% which would translate into increased production within the Canadian borders and more Canadian jobs.

Atlantic

Title: Validation and Integration of Genomics Solutions for Offshore Oil Exploration in Nova Scotia and Beyond

Project leaders: Casey Hubert (University of Calgary), Todd Ventura (Saint Mary’s University), Adam MacDonald (Nova Scotia Department of Energy)

Lead Genome Centre: Genome Atlantic, Genome Alberta

Total funding: \$6.5 million

This project focuses on de-risking exploration and development in offshore Nova Scotia (NS) by the validation and integration of new genomics-based technologies with traditional exploration approaches. The primary goals of the proposed GAPP project are to (1) further decrease risk in oil exploration in offshore NS; (2) attract offshore petroleum exploration and development investment to NS in a globally competitive sector; and (3) differentiate Nova Scotia Department of Energy and Mines' geoscience package by including innovative genomics solutions and showcasing them to the world. The main deliverable will be integration of different omics data layers with geochemistry and other geoscience into an easily accessible and marketable database for mapping target sites to enumerate the existence and type of reservoir leakage at prospective target sites. By providing novel, genomics-enabled data the province will significantly increase interest from oil majors and simultaneously produce intellectual property (IP) and potential for commercialization via spin off companies or licensing of the IP to industry service providers.

ROUND 14

Ontario

Title: Validating and Improvement of *in silico* Proteome Screening and Drug Design Technologies by Experimental Drug Discovery for Neurodegenerative Diseases

Project leaders: Angus McQuibban (University of Toronto), Zheng Li (Cyclica Inc.)

Lead Genome Centre: Ontario Genomics

Total funding: \$2.3 million

An important contributor in the decline of productivity in pharmaceutical development is the traditional focus on single target drug design, in which molecules are designed for one protein target. In practice, however, a drug is likely to interact with a number of proteins, sometimes up to 300 in the body, leading to unforeseen and adverse side effects. Cyclica intends to mitigate this problem by using their proprietary [Ligand Design™](#) and [Ligand Express®](#) drug discovery platform. Ligand Design is a multi-targeted and multi-objective *in silico* drug design platform, and Ligand Express is a cloud-based and AI-augmented off-target profiling and target deconvolution platform that computationally determines polypharmacological profiles. Taken together, [Ligand Design and Ligand Express](#) offer an integrated platform to design advanced lead like molecules that minimize off-target effects, while providing insights into structural pharmacogenomics. The team at [Cyclica](#) and [McQuibban Lab](#) will seek to identify novel solutions for Parkinson's disease, which will be commercialized jointly by Cyclica and [Rosetta Therapeutics](#). The McQuibban Lab has established assays to substantiate the Cyclica AI predictions. It is expected that these validated platforms will assist Cyclica in further quantifying the benefits of their platforms, including the potential time and resources saved during drug development.

Quebec

Title: Crowdsourcing sequence alignments in a AAA game for Microbiome research

Project leaders: Jérôme Waldispühl (McGill University), Attila Szantner (Massively Multiplayer Online Science)

Lead Genome Centre: Génome Québec

Total funding: \$3.0 million

MMOS is developing crowdsourcing solutions with video game companies to help tackle research challenges. The team plans to utilize crowdsourcing on a gaming platform to offer a solution to the production of high-quality multiple sequence alignments for very large read data sets for microbiome research. Automated data analysis pipelines have limited success in generating high quality gene alignments, the time required for analysis by genetics experts is prohibitive and there is no accepted metrics to decide what the best alignment is. To solve this problem, the project team will embed small alignment puzzles into a new popular video game and collect the solutions generated by the games. The millions of solutions generated by the gamers will be used to create custom algorithms to build an improved alignment of the initial sequence data. The novelty of this citizen science approach will generate significant news coverage and media exposure leading to increased game sales for MMOS and Gearbox. In addition, the crowdsourcing pipeline developed will be used to accelerate the productivity of Canadian microbiome initiatives and promote public understanding of the impact of the microbiome on our health.