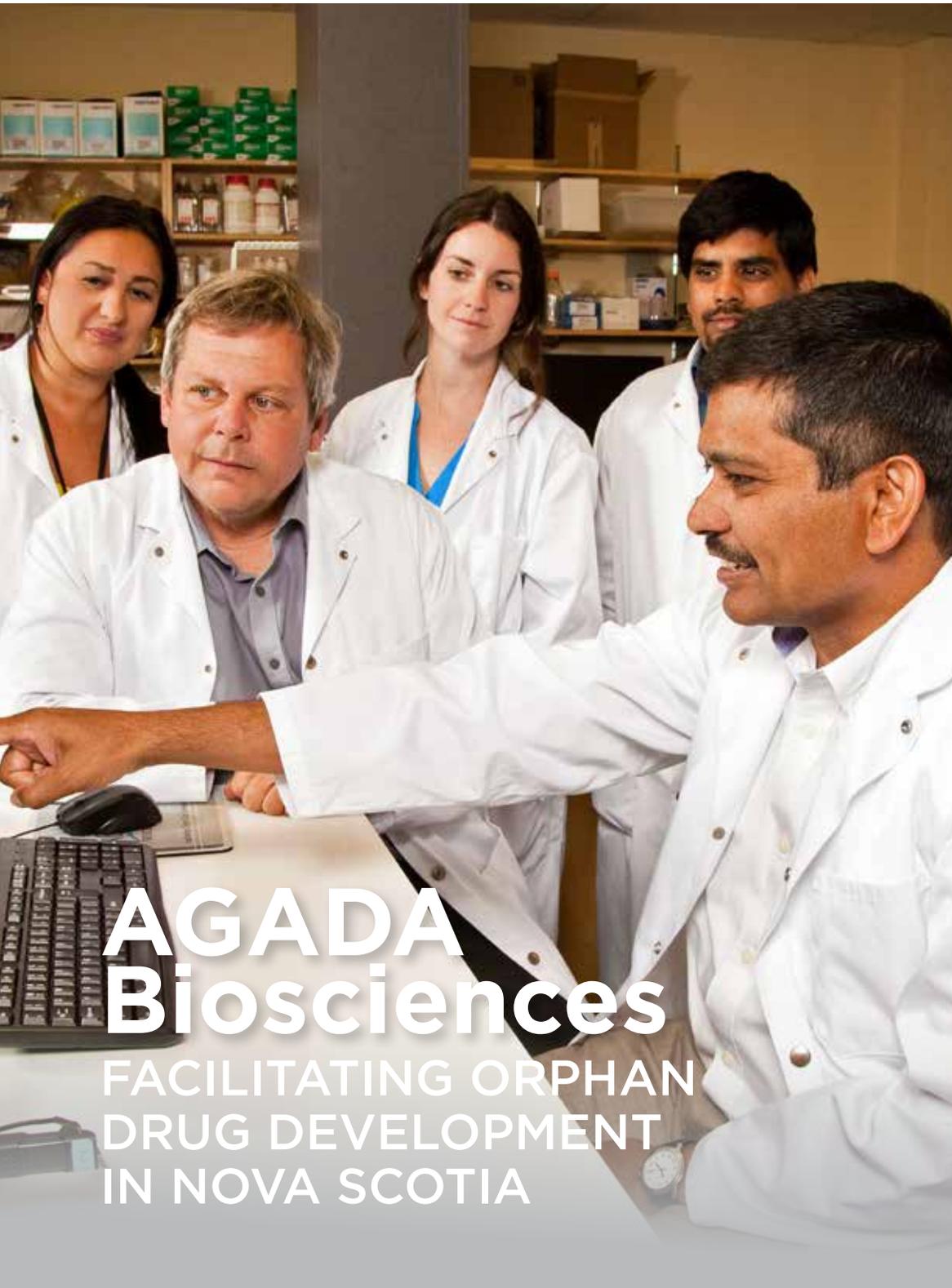


LINK

Moving
Life
Sciences
Forward



AGADA Biosciences

FACILITATING ORPHAN
DRUG DEVELOPMENT
IN NOVA SCOTIA



TruLeaf
LEADING
THE WAY IN
SUSTAINABLE
AGRICULTURE

**BIONOVA'S
GROWTH
PLAN,
PAGE 3**

A Message from BioNova's MANAGING DIRECTOR

To our readers,

You may have noticed some changes happening at BioNova lately; on our social media channels, our website and in our direct messaging. We are very pleased to present our new brand and logo.

As Nova Scotia's life sciences sector has grown and evolved, BioNova has grown along with it, and we felt it was time to reflect that growth.



In the last year we've experienced a lot of changes with the implementation of BioNova's Growth Plan (which can be found on the facing page) and will continue to see changes as we move towards building a bigger and better ecosystem to grow the life sciences in Nova Scotia.

Later this month, BioNova will host the 15th annual

BioPort Atlantic conference, the premier life sciences industry event in Atlantic Canada. BioPort provides a forum to educate, inform and inspire the life sciences community to develop their ideas, commercialize their technologies and build links within the region and internationally.

BioNova will also be hosting the BioInnovation Challenge (BIC) on October 25 & 26. BIC is an opportunity for early stage start-ups from NS, NB and PEI to capitalize on valuable coaching and exposure for their new, innovative life sciences idea while competing for funds and services to help them grow. This year's event has a cash prize, in-kind services packages and professional pitch training valued at more than \$45,000.

We have a lot planned in the coming months so I encourage you to get engaged and follow us. We hope you enjoy this issue of LINK and learn about the innovative work being done in our province, that will not only benefit you but our economy.

All the best,

Scott Moffitt

LINK – Moving Life Sciences Forward is published by BioNova, Nova Scotia's Life Sciences Industry Association.

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GROWTH PLAN | 2016-2019

Leadership in developing life sciences as a pillar of the new economy

BioNova catalyzes value creation as a responsive knowledge hub for start-ups, scale-ups and strategic partners in the life sciences.

As the sole organization with the expertise and knowledge to lead the development of the life sciences sector, BioNova has an important role to play in Nova Scotia's economic growth. This year marks the launch of BioNova's Strategic Growth Plan, outlining below the key areas of focus and how we intend to educate, accelerate and lead life sciences to become a strong and globally competitive sector.

ACCELERATION



- Creating acceleration programs
- Building strategic partnerships
- Championing commercialization
- Providing benefit programs

ADVISORY



- Information and connections
- Facilitating networking events
- Delivering industry and sector knowledge

ADVOCACY



- Building a supportive business ecosystem
- Attraction of capital and talent
- Demonstrating sector value
- Influencing the innovation agenda
- Sharing our success stories

BioNova's Growth Plan will directly benefit the sector, continuing support for high growth companies and our partners. Moving forward, as the leader in life sciences, BioNova will work with committed organizations to develop a strategic Sector Growth Plan which will provide the direction and further initiatives to build on successes to date, ensuring our improved prosperity.

AGADA Biosciences

Facilitating Orphan Drug Development *in Nova Scotia*

Drs. Eric Hoffman and Kanneboyina Nagaraju could have chosen a number of cities to relocate their growing business when they began to outgrow their lab space in Washington, D.C. With its established lab spaces, educated young talent, and business acceleration programs, Halifax was the clear winner.

ReveraGen BioPharma was operating out of the Children's National Medical Center in Washington, DC, where Dr. Hoffman and his team were developing a new drug, Vamorolone, for Muscular Dystrophy. However, with traditional approaches to drug development taking upwards of 15 years and a billion dollars to produce they faced many barriers.

The industry was also experiencing changes at the time, that caused Dr. Hoffman to re-evaluate the research models. "Common diseases are becoming stratified into smaller and smaller groups and each group requires its own treatment regimen. There has been a lot of emphasis on rare diseases and orphan drug development over the last number of years," says Dr. Hoffman.

In recent years, there has been an increase in the number of incentive programs available for rare diseases research and with the Internet's ability to consolidate those stakeholder communities internationally, it has created new opportunities for researchers. But, this also creates a fundamental problem; because these drugs are very targeted and if each drug costs a billion dollars and 15 years to make, the costs to patients will be astronomical.

Realizing the shift in the industry and the need for better services, Drs. Hoffman and Nagaraju opened AGADA Biosciences in the Life Sciences Research Institute in 2013. The company's primary goal is to meet the rapidly growing need for services that

accelerate drug development for orphan diseases, with specific expertise in preclinical efficacy studies with biomarkers support.

ReveraGen BioPharma recently developed a drug for Muscular Dystrophy that AGADA was able to bring to phase II clinical trials with Muscular Dystrophy patients. "At this point in time, it looks like we will receive approval in about eight years and for 30 million as opposed to 15 years and a billion dollars," says Dr. Hoffman.

AGADA's success can be attributed to their first step of de-risking drugs and avoiding late stage failures. To do this, AGADA uses

Dalhousie University's state of the art mouse lab facility, also located in the Life Sciences Research Institute. Mice who develop muscular dystrophy have the same genetic mutation as human patients do, so if you develop a drug that makes the mice better, then you have de-risked that drug considerably.

Dr. Hoffman states that proof of principle in an animal model is becoming increasingly requested by regulators, particularly in orphan diseases. "Traditionally, animal testing was used for toxicity, making

sure you weren't making an animal terribly sick before making a human terribly ill," says Dr. Hoffman. "But, the whole paradigm is shifting – at AGADA we are working to make the mice better which anticipates making the human better."

AGADA has become the top tester of drugs in muscular dystrophy models and has grown quickly over the past three years. The company has seen a 60 percent growth rate each year and currently employs 13 people, with more than half coming from Nova Scotia universities.



L-R Dr. Kanneboyina Nagaraju and Dr. Eric Hoffman

“We participate in the co-op programs at Dalhousie and Acadia because we see the value in keeping talent in the province.”



“One of the reasons we chose Halifax was because of the quality of a young, educated workforce,” says Dr. Hoffman. “We participate in the co-op programs at Dalhousie and Acadia because we see the value in keeping talent in the province.”

Most recently, AGADA invested one million dollars along with three million from ACOA and half of a million from Dalhousie to develop “A Scientific and Clinical Hub for Orphan Drug

Development” in Halifax that will help to accelerate orphan drug development beginning with developing treatments for three indications. The diseases in question are labeled “orphan diseases” but they occur in one in 5,000 to one in 10,000 babies. Preclinical research with the new therapies in zebrafish and mice have shown promising results that are expected to propel these programs

through the clinical research stage. The project is expected to put Halifax and Nova Scotia on the map as the best place in Canada and one of the best sites in the world for such research and clinical work.

Learn more about AGADA Biosciences at agadabio.com



TruLeaf

LEADING THE WAY IN SUSTAINABLE AGRICULTURE

Gregg Curwin has worked in healthcare innovation industries for over two decades. The first part of his career he focused on reactive measures to health when he decided it was time to take a proactive approach to healthcare.

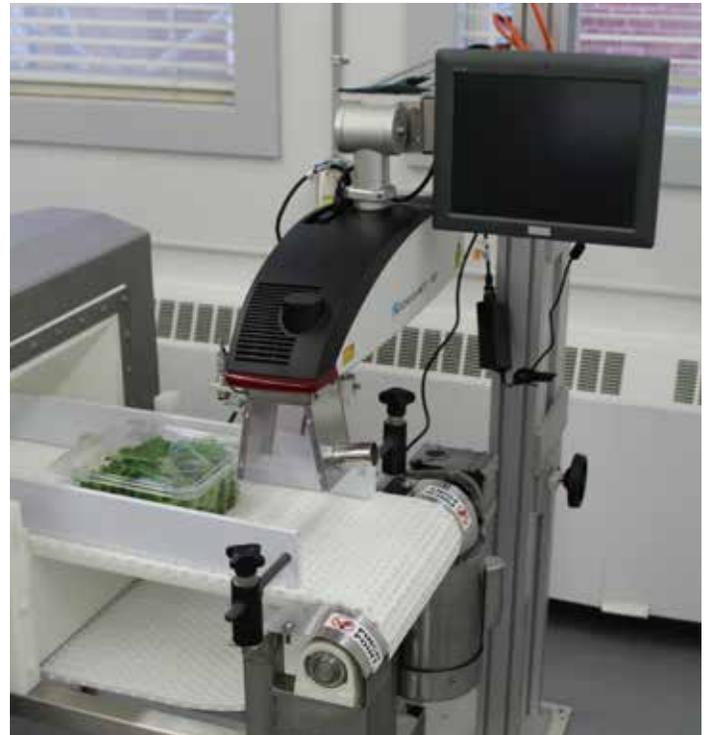
While flipping through a magazine, Curwin stumbled upon a photo from Japan of a plant under a light, and the wheels began to turn. With a long-standing passion for agriculture and having successfully owned and operated several businesses in the medical device and biologics industry in the Atlantic Canadian region, Curwin developed the idea for TruLeaf with a vision of enabling communities to grow the world's healthiest food locally and sustainably.

In 2011, with the help of various partners including Innovacorp, ACOA, NRC, and the Perennia Innovation Centre, Curwin opened the first R&D facility for TruLeaf in Truro, Nova Scotia. The company then spent the next few years further refining its farming system, and fully understanding the economics of the indoor farming model.

The TruLeaf Smart Plant System® integrates proprietary innovations in equipment design, farm layout, and plant production formulas to produce clean, pesticide-free nutrient-rich leafy plants year-round in any climate.

In 2013, the company signed its first deal with a major national retailer to grow and sell packaged leafy greens in the marketplace. With that agreement, TruLeaf created a wholly owned subsidiary, GoodLeaf Farms, and began building its first commercial farm. The commercial farm was completed earlier this year, and sales of the leafy green products began in March.

Goodleaf Farms' commercial farm uses a vertical farming model, which allows for more food to be produced in smaller spaces and closer in proximity to the consumer. The company's 10,000 square



foot facility produces about 200,000 pounds of greens annually – which would take almost a million square feet of outdoor land in Nova Scotia.

This is only the first step for the company, which hopes to expand its indoor farming technology to communities across Atlantic Canada, Ontario, and around the globe. Ultimately TruLeaf will develop farms in rural communities that have limited access to fresh produce.

Food security is becoming a major problem across Canada and not just in rural and remote communities. According to Mount Saint



“Our company has come a long way in taking an idea and building a strong business that is sustainable in every sense of the word.”



Vincent University’s Canada Research Chair in food security, Nova Scotia is among the worst in the country when it comes to food security, with only Nunavut at a higher rate. The paradox being that there is tremendous access to food; however, low-cost, fast food does not provide sustenance for a healthy life. TruLeaf is one of the first companies revolutionizing the way in which people around the world can ensure they are eating the most nutritious food available, grown locally, and priced economically.

Take for example that the average pound of California lettuce requires a whopping 160 liters of water. By combining that same water with collected rainwater and rigorous filtration, TruLeaf’s indoor farms can grow 80 pounds of leafy greens, demonstrating that indoor multi-level farming has moved from concept to reality.

“Our farm is extremely efficient in its use of resources, but more importantly, it creates access to clean healthy food for Atlantic Canadians. It is stimulating the local economy, challenging the status quo, and is working to improve food security in our region,” said Curwin.

Most recently, Curwin received the Clean50 award presented by the Delta Management Group for developing and scaling TruLeaf’s Smart Plant System®. The award recognizes individuals across Canada who have developed new technologies or instituted company-wide changes that create a positive net environmental impact from business operations.

“I was truly honoured to be nominated to receive this prestigious award from Delta Management Group,” said Curwin. “Our company has come a long way in taking an idea and building a strong business that is sustainable in every sense of the word.”

With future growth plans that include expanding to Toronto, conducting feasibility studies for remote locations and biomedical plant trials, TruLeaf is leading the way in indoor farming and agriculture.

To learn more about TruLeaf visit truleaf.ca

HEADLINE HIGHLIGHTS

A wrap up of what's been happening in the life sciences industry



STI Technologies CEO Named in Top 50 in Atlantic Canada

Atlantic Business Magazine's Top 50 CEOs for 2016 were announced on May 12 in Moncton, New Brunswick. Among the list of recipients was BioNova member STI Technologies' CEO, Tim Gillis. Congrats, Tim!

PrecisionBioLogic

Precision BioLogic Becomes First Diagnostics Company to Commit to Supporting the World Federation of Hemophilia Humanitarian Aid Program

Precision BioLogic announced in June the donation of coagulation diagnostic products through the World Federation of Hemophilia (WFH) Humanitarian Aid Program. This important donation means that Precision BioLogic is the first diagnostics company to commit to supporting the WFH's efforts to ensure that people with inherited bleeding disorders in the developing world have access to effective diagnosis and treatment.

The donation will provide much-needed calibrators, controls and reagents to the University Teaching Hospital in Yaoundé, Cameroon. Globally 1 in 1,000 people has a bleeding disorder. Most are not diagnosed and do not receive treatment. The donation is the first of its kind and an important step in the effort to improve and sustain care for people with bleeding disorders such as hemophilia.



PhotoDynamic Inc. Lands Funding from FAN

By Peter Moreira, Entrevestor

PhotoDynamic Inc. has raised funding from members of the First Angel Network, which will help bring its oral hygiene product to market.

PhotoDynamic has developed a system that kills plaque buildup on teeth through a combination of light and an extract from a plant that grows wild in Nova Scotia. The company plans to launch the product in the Canadian orthodontic market in early 2017.

The Company said the funds raised from FAN members will be used mainly for user testing, consumer product development, and preparation for the product launch. PhotoDynamic is working with Dalhousie University's Faculty of Dentistry and the Forsyth Institute in Cambridge, Mass. to conduct human clinical trials.

innoviCares Partners with PopRx to Help Patients Access Medications with Fewer Barriers

PopRx, the Canadian leader in mobile pharmacy applications, has partnered with STI Technologies Limited's innoviCares program to offer Canadians a comprehensive mobile solution to their healthcare needs.

PopRx, the Canadian on-demand pharmacy app that connects you to a local independent pharmacist to manage, order and deliver your medication, has taken significant strides in reducing

prescription medication costs to Canadians and Canadian employers by partnering with innoviCares. This partnership ensures that patients across the country are able to save money on the prescription medications their physician has prescribed.

InnoviCares is a free prescription savings card that helps Canadian patients save money on select prescription medications at pharmacies. Funded by participating pharmaceutical manufacturers, innoviCares works like any insurance card to provide savings at the point of purchase at pharmacies. It also delivers electronic tools to help users manage their healthcare through refill reminders, medication tracking and more.

Through the partnership, PopRx and innoviCares ensure Canadians are able to receive the prescription medications prescribed by a physician with fewer barriers, including a reduction in cost and access to a pharmacy. When a patient fills or refills a prescription with PopRx, they can use their innoviCares card to save money, live-chat with a pharmacist if needed, and take advantage of free, same-day delivery in major markets across the country.



Spring Loaded Technology Delivers 60 UpShot Bionic Knee Braces to Help Canadian Soldiers Optimize Performance and Avoid Injury

Spring Loaded Technology announced in July that it had completed its initial delivery of 60 UpShot™ bionic knee

STI Technologies CEO Named in Top 50 in Atlantic Canada

DMF Medical Preps for 2017 Launch

Nova Scotia Launches New System to Deliver Health Test Results Via Smartphone

Researchers to Present Data on Immunovaccine's Infectious Disease Pipeline at Three International Conferences

braces to the Department of National Defence as part of its \$1M (CAD) contract. This contract was awarded under the Build in Canada Innovation Program with the Canadian Army as the testing department. Powerful enough to help lift more than 100 pounds of body weight when worn on both knees, the military-grade braces use a liquid spring technology that absorbs shock and reduces impact on soldiers' knees. Upon full completion of its contract, Spring Loaded Technology will have provided a total of 190 knee braces to the Canadian military for field testing.



DMF Medical Preps for 2017 Launch

By Peter Moreira, Entrevestor

DMF Medical plans to release its signature product, Memsorb, in the next year and hopes it will improve the process of removing carbon dioxide from the system that puts patients to sleep during operations. Memsorb is a membrane-based device that replaces the collection of chemicals that is now used to remove CO₂ from the process. The new device, which will go through regulatory processes in Canada and/or the European Union this winter, is safer, better for the environment and can save hospitals money.

DMF Medical now has a working prototype of Memsorb and has done clinical trials on 20 patients. The first jurisdiction to grant approval will be the first market it will enter.

Assuming the manufacturer can produce Memsorb in the quantities the market

demands, the group hopes to have the product on the market in 2017.

Nova Scotia Launches New System to Deliver Health Test Results Via Smartphone

By Keith Doucette, The Canadian Press

A new online portal that will deliver medical test results to Nova Scotians via smartphones is the kind of innovation that's long overdue in Canadian health care, says the federal health minister.

Jane Philpott was in Halifax in August for the launch of the MyHealthNS portal, which has been tested for the past three years in a pilot project involving 30 family doctors and 6,000 patients.

Philpott, who worked as a family doctor, said using technology to create a single patient record is part of improving overall primary care.

"This is exactly the kind of innovation that we need to see more of. This is an important step along the way and Nova Scotia is clearly at the cutting edge on this."

The initial rollout will serve the Halifax, South Shore and West Hants areas with plans to expand the system province wide beginning early next year — making Nova Scotia the first in Canada to do so.

The MyHealthNS system is being implemented through McKesson Canada's RelayHealth.

David Mosher, the company's program director, said the secure portal can be reached through any device that has Internet access. He said patients would see a dashboard divided into sections for

health records, messaging doctors, and for downloading data.

Nova Scotia's Health Department says the system will allow patients to manage their own health information to the point of reducing the number of visits to health clinics to obtain test results.



Researchers to Present Data on Immunovaccine's Infectious Disease Pipeline at Three International Conferences

In September, Immunovaccine Inc. announced planned data presentations at major upcoming scientific meetings in conjunction with collaborators at VIB, the Flemish life sciences research institute, and the Canadian Center for Vaccinology (CCFV). These presentations will focus on DPX-RSV, Immunovaccine's lead infectious disease candidate in development for the prevention of respiratory syncytial virus (RSV).

In addition, researchers will present the first results from the company's preclinical collaboration with the University of Edinburgh's Center for Immunity, Infection and Evolution (CIIE) on life-threatening malaria.

Presentations will be held at the 10th International Respiratory Syncytial Virus Symposium in Argentina, World Vaccine Congress Europe in Spain and IDWeek in Louisiana.

START-UP SPOTLIGHT



Providing Novel Agents for the Treatment of Infectious Disease

Despite numerous achievements in the development of anti-infectives, infectious disease remains a leading cause of death worldwide. The World Health Organization declares superbugs a fundamental threat to humans. Many germs and bacteria are becoming increasingly resistant to standard anti-infective drugs, making treatment difficult or even impossible. Appili Therapeutics is looking to win the war on infectious disease by developing novel approaches to fight drug-resistant infections.

Antimicrobial resistance is driven by the overuse and improper use of antibiotics and anti-infectives. While historically there have been many alternative antibiotics available for treatment of bacterial infections, today the development of antibiotics has slowed dramatically. Appili Therapeutics is developing novel strategies to bring new classes of antibiotics and anti-infectives to the clinic to improve treatment and health of patients suffering from infection.

The company, which is just over a year old, has already made big strides towards its goal in the fight against infectious disease. In April, it was awarded Orphan Drug designation by the U.S. Food and Drug Administration (FDA) for its lead drug candidate, ATI-1501. ATI-1501 is a taste-masked reformulation of metronidazole with the potential to effectively treat *Clostridium difficile* infection (CDI) in children.

CDI is one of the U.S. Centers for Disease Control's most urgent antibiotic-resistant



L-R Stephen Duff (Innovacorp), Kevin Sullivan (Appili), Andy Fillmore (Member of Parliament for Halifax) & Scott Moffitt (BioNova)

bacterial threats. CDI affects over half a million Canadians and Americans each year. Annually, it reoccurs in 83,000 patients and is responsible for 29,000 deaths. The incidence of CDI in children has been steadily increasing over recent years, and thus a taste-masked metronidazole formulation is urgently needed.

In May, the company announced that it had raised \$3.2 million in a seed round to advance research and development of its anti-infective drug candidates and open a medicinal chemistry lab in Halifax.

The company plans to take its lead candidate, ATI-1501, into clinical trials in 2017. Appili's drug development team will also continue to work on its second product, ATI-1503. ATI-1503 is a novel antibiotic with broad potential to treat deadly Gram-negative infections. The U.S. Centre for Disease Control has identified Gram-negative infections as those which pose the highest threat to human health, making ATI-1503 a drug treatment with potential blockbuster status for Appili.



Appili Therapeutics – Providing Novel Agents for the Treatment of Infectious Disease

Panag Pharmaceuticals Inc. – Revolutionizing the Use of Cannabinoids for the Treatment of Pain and Inflammation



Revolutionizing the Use of Cannabinoids for the Treatment of Pain and Inflammation

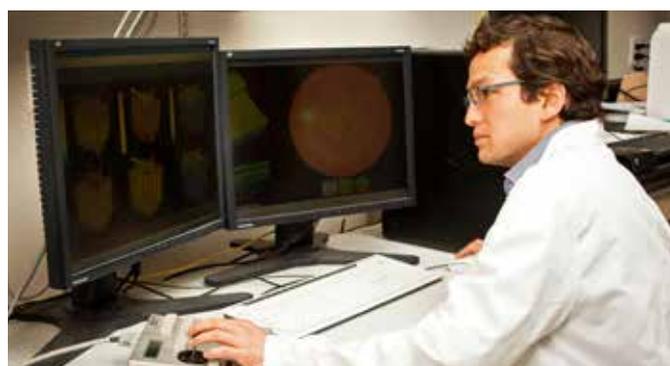
According to the Canadian Pain Society, one in five Canadians suffer from chronic pain and it costs more than cancer, heart disease, and HIV combined. Estimates place direct healthcare costs for Canada to be more than \$6 billion per year and productivity costs related to job loss and sick days at \$37 billion per year.

Panag Pharmaceuticals Inc., located in Halifax, is seeking to alleviate the chronic pain of many Canadians with its novel cannabinoid-based formulations for treatment of pain and inflammation. Its first product that will be available over the counter later this year will be a topical ointment aimed at treating pain and inflammation by activating the endocannabinoid receptors in the skin.

The endocannabinoid system is part of the body's built in defense network that fights pain and inflammation, and the agents that activate it are cannabinoids that are similar to the active agents in marijuana. However, Panag's topical ointment can activate this system using the receptors that will not elicit the same psychotropic "high" effects as using marijuana but will relieve pain and inflammation.

Initial pre-clinical trials in humans have shown instant relief of symptoms for patients and that pain seems to dissipate instead of only dulling, as many of the current products on the market do since these medications are targeted for acute pain and not chronic pain.

The team at Panag Pharmaceuticals Inc. has a great deal of experience in the field of cannabinoids and pain research. President, Dr. Mary Lynch has spent more than two decades' experience as a clinician assisting patients with chronic pain and is the Director of Research at the Pain Management Unit at the



QEII and is the founding Director of the Canadian Consortium for the Investigation of cannabinoids. The core team of scientific researchers for the Company has more than 100 years of combined experience in the field of cannabinoids and pain research.

To learn more, visit panagrx.com



BIONOVA BOOST

BIONOVA BOOST

We created this workshop series to accelerate the innovation and productivity of Nova Scotia's businesses while boosting the bioeconomy. We offer various business topics including intellectual property and patent system changes, marketing and communications, workforce enhancement and more. The sessions bring together BioNova members, business professionals, industry representatives, students and other key stakeholders.

BOOST YOUR BUSINESS

- Informational seminars to boost your chances of achieving your business goals, such as accessing new sources of funding and emerging business needs.
- Educational events to facilitate business development, such as Intellectual Property and Patent system changes, Marketing and Communications workshops to improve outreach and Talent Recruitment & Management training to enhance your workforce.
- Industry related workshops to address known challenges and emerging issues, such as regulatory changes within the FDA & Health Canada, CE Marking and reimbursement strategies.

PARTNER WITH US

Our events offer a unique opportunity for your organization to connect with Atlantic Canada's life sciences industry and a wide variety of influencers from industry and research, government officials, investment community and healthcare. Sponsoring one of our workshops can provide your organization with an opportunity to build or reinforce strategic relationships, brand awareness and demonstrate your support for life sciences in Atlantic Canada.

Visit our Events page at BioNova.ca to register for our upcoming BioNova Boost events

*BioNova Members attend for free, all non-members attend at discounted rates