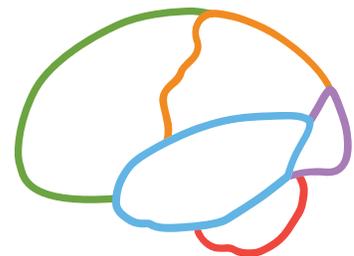
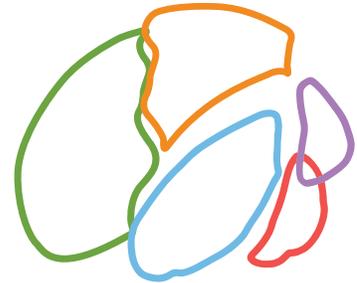
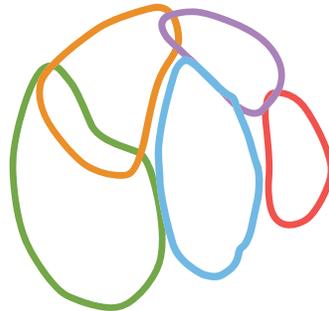
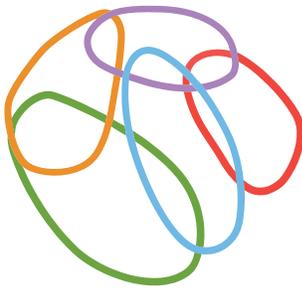
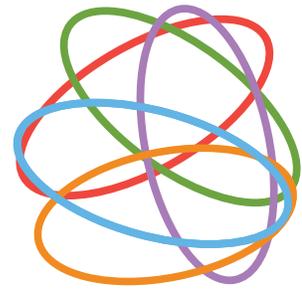
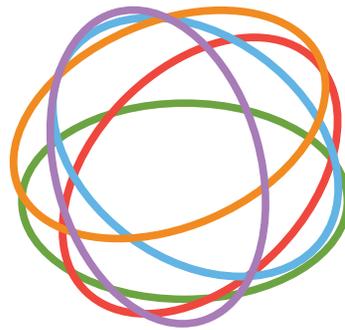
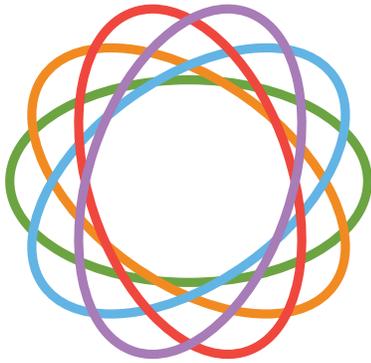


ONTARIO INSTITUT
BRAIN ONTARIEN
INSTITUTE DU CERVEAU



Phase 1 Report

2010-2013





CONTENTS

- 2** **Executive summary**
- 3** **Messages**
- 4** **Our history**
- 8** **Charting the course**
- 9** **What we do**
 - Integrated discovery: research
 - Brain-CODE
 - Commercialization
 - Knowledge translation and communications
- 26** **An integrated approach to improving patient care and economic development**
- 28** **Looking ahead**
- 30** **Annex**
 - Acknowledgements
 - Board of Directors
 - Founders
 - Science Advisory Council
 - Industry Advisory Council
 - External Review Committee
 - International Science Advisory Council
 - OBI's investment by the numbers

EXECUTIVE SUMMARY

One in three of us will be directly affected by a brain disorder in our lifetime.¹ This alarming statistic guides our focus on improving the lives of people living with brain disorders through a single vision: “Ontario as a world leader in brain research, commercialization, and care”.

We do this by catalyzing pan-Ontario, integrated, patient-centred, collaborative **research programs**, which are enabled to standardize and share the data they collect in a **centralized informatics platform**. We facilitate the **commercialization** of neuroscience discovery and provide **training** programs that help cultivate the next generation of management talent. And we facilitate **knowledge translation and exchange** between stakeholder groups to ensure that evidence has impact.

This report provides an overview of the first three years, highlighting our history, early achievements, and our vision for the future.

Research

We have established three pan-Ontario, multidisciplinary research programs in the areas of cerebral palsy, epilepsy, and neurodevelopmental disorders. Combined, these programs include over 80 researchers, 35 institutions, 35 companies, and 20 patient advocacy groups that work collaboratively with the goal of conducting patient-centred research and informing evidence-based care in Ontario.

Informatics

The Centre for Ontario Data Exploration (Brain-CODE) is our virtual centre for the collection, storage, and eventual analysis of data streaming in from the research programs. Brain-CODE will allow researchers to share their discoveries and start asking novel, never-before-possible questions. It will also enable researchers to begin looking across brain disorders to better understand common underlying causes.

Commercialization

Commercialization is a critical step in translating research ideas into better patient care—and partnerships are at the root of this translation. We have fostered partnerships to help us realize the opportunity to increase access to capital and develop Ontario’s neurotechnology cluster. One example of this is our partnership with Canada’s Federal Economic Development Agency for Southern Ontario (FedDev Ontario). Together, we have fostered a cluster

development initiative called “NeuroTech Ontario” that supports 14 different neurotechnology projects aimed at developing new devices and treatments for brain disorders. To enhance the overall growth of the neurotechnology industry in Ontario we set up the Ontario Brain Innovation Council (OBIC), which will help Ontario become a leader in translating brain research into accessible health benefits and economic prosperity.

Training

There was an important opportunity to develop leadership expertise in the neuroscience sector. So we established the Experiential Education Initiative, focused on helping neuroscientists develop the skills required for a career “beyond the bench”. The initiative includes the OBI Entrepreneurs Program, in partnership with the Ontario Centres of Excellence, and the OBI Graduate Opportunity Internship Program. These programs provide financial support, mentorship and hands-on education aimed at cultivating the future leaders of Ontario’s neuroscience-related industries.

Knowledge translation and communications

An early and ongoing strategic priority is to facilitate the movement of research into action. We do this by raising awareness and bringing people together in an effort to both connect research and care as well as evaluate the impact of our work. One example of this is the establishment of Patient Advisory Committees for each of our research programs. These committees form a bridge between the research programs, patients, and the community.

The innovation system

Each of the components mentioned above play a specific and crucial role in driving research impact. The value of each arm of activity, however, folds into a larger system, which is more impactful than the sum of its parts.

Funding renewal

In March of 2013, the Ontario government announced the renewal of our funding at \$100 million over five years. This funding allows us to continue to provide support for existing research programs as well as expand our efforts into two new areas, depression and neurodegenerative disorders, which currently affect millions of Ontarians.

¹ Institute for Clinical Evaluative Sciences/Public Health Ontario. (2012). *Opening Eyes, Opening Minds: The Ontario Burden of Mental Illness and Addictions Report*



Joseph L. Rotman, O.C., LL.D. Chairman of the Board

We take this opportunity to express our appreciation and respect to the Province of Ontario for the vision and boldness required to establish the Ontario Brain Institute (OBI).

I am proud to serve as the founding Chairman of the Board of OBI—a not-for-profit research institution focused on maximizing the collective impact of Ontario’s existing neuroscience excellence and addressing the growing prevalence, and burden of brain disorders.

Ontario is uniquely positioned to take a global lead in brain research since it already has many of the assets required. It is home to over 800 brain researchers, whose global output and impact is internationally regarded. It has numerous academic institutions with strong clinical expertise. Ontario also has the advantage of significant investments from past and current federal and provincial governments in infrastructure and training.

But how can we make it work better? OBI was created to answer that very question. It starts by building a system that facilitates collaboration. OBI is tasked with connecting Ontario’s strengths and marshalling resources toward the prevention, treatment, and care of brain disorders—one of the most pressing health concerns of our time. The next step is to use this system to drive innovations in brain research and ultimately use these advances to improve brain health for the millions of individuals in Ontario affected by brain disorders. OBI sees itself as a catalyst working with the province and with all institutions and industries.

This report demonstrates that, in the few short years since the creation of OBI, significant progress has been made toward this goal. While there are many collective achievements to be proud of, we are just beginning to demonstrate the truly transformative impact OBI will have on the Province of Ontario.

I am confident that the expertise and commitment from all those involved in the creation of this province-wide system will position Ontario as a world leader in the global transformation occurring around brain research.

I would like to express my gratitude to the Board of Directors and to all of those who have contributed to the establishment of OBI.



Donald T. Stuss, Ph.D. President and Scientific Director

It is my pleasure to present this report, a summary of OBI’s activities from initiation to March 31, 2013. Funding for the institute was officially announced on November 15, 2010 and I was later hired as President and Scientific Director in February of 2011. Using either date as the official start of OBI, the actual period of operations is less than two and a half years. The initial funding of \$15 million (\$5M per year over three years) from the province of Ontario, in addition to \$5M in funds leveraged was employed to establish that OBI seizes an important opportunity to translate Ontario’s neuroscience excellence into better health and economic prosperity.

This report summarizes the development of OBI’s vision, the processes established to achieve the vision, and the initial successes achieved in research, commercialization and training, and health impact. The story of these early years will demonstrate how the vision of OBI evolved and was refined into our current concept of a truly integrated innovation system. I hope that this report captures, to some small degree, the excitement that all of those associated with OBI—from the Board of Directors to staff to researchers and clinicians and patient advocacy groups to our industry partners—have felt building this integrated approach to research, commercialization and health impact.

Ontario's potential to be a world leader in brain research, translation, and innovation



Imaging facilities at the Robarts Research Institute, Western University, London, Ontario

Back in 2008, Ontario leaders began connecting the dots between increasingly critical needs and the great potential to meet those needs. A global surge of attention towards brain research spurred a group of influential minds to ask where Ontario could stand on this front.

Correspondingly, the Ontario Innovation Trust funded a major study to assess the quality of brain research in Ontario, and Ontario's capacity to become a leader in discovering new knowledge about the brain, applying it to better care for those living with brain disorders, and commercializing it to create new wealth.

The extensive 2009 study was led by Dr. Joseph Martin, Dean Emeritus of Harvard Medical School and Mr. Joseph Rotman, industrialist and philanthropist—and was penned by Dr. Richard A. Murphy, former Director of the Montreal Neurological Institute and Dr. Fergus I.M. Craik, Senior Scientist at the Baycrest Rotman Research Institute. Further involving an International Science Advisory Committee and consultations with over 120 science and industry experts, the

"This is something I have been trying to do all my life. To integrate science and clinical work in a way that would be transformative, have an impact, cause change. Whatever I've done as a researcher, as a clinician, as an administrator, it's always been an attempt to close the loop and I saw the development of OBI as the best opportunity to do so."

Dr. Donald Stuss President and Scientific Director

study shone light on Ontario's potential to lead in patient-centred brain research and commercialization. The report itself proposed a call to action—the establishment of the OBI.

The Ontario Brain Institute: A Proposal to Mobilize Ontario's Excellence in Brain Research reinforced evidence that research excellence exists in Ontario: the province's universities and their affiliated hospital research institutes were recognized as centres of excellence in basic neuroscience research as well as in the medical disciplines that deal with clinical neuroscience, including neurosurgery, neurology, psychiatry, and psychology. Ontario-based academic scientists are among the world's experts in many aspects of brain research, including functional brain imaging, deep brain stimulation, neurophysiology and neuropsychology, stroke, neurogenetics, developmental neuroscience, stem cell biology, medical devices, and degenerative diseases of the brain. However, the study also pointed to existing gaps preventing the region from maximizing the positive impacts of its efforts in neuroscience—Ontario's research excellence exists in pockets. And even though Ontario's academic neuroscience research is fully competitive internationally, in order for the science to be translated effectively, an integration of efforts and focus would be necessary.

This study recommended the creation of a research institute dedicated to studying developmental and neurodegenerative disorders of the brain that give rise to disorders, including autism, Alzheimer's disease, and Parkinson's disease. It was suggested that the proposed institute bring together Ontario's leading basic and clinical neuroscientists in a collaborative effort to work on shared problems and goals. It was also advised that industry representatives participate in the research process as full partners to facilitate commercialization.

The burden of brain disorders

Our brains govern everything we do, from what we think and feel to how we communicate and move physically through the world. But just like any other part of the body, the brain is susceptible to various kinds of injury and disorder.

One in three of us will be directly affected by a brain disorder in our lifetime, and approximately one million

“The entire field of neuroscience now has the tools to make phenomenal advances. Ontario can lead a revolution in neuroscience, the goal being the healthy brain.”

Dr. Bryce Weir Goldblatt
Professor Emeritus of Surgery and Neurology, former Director of the Brain Research Institute, Interim Dean of the Biological Sciences and Pritzker School of Medicine and Vice-President for Medical Affairs, The University of Chicago

Ontarians are currently living with at least one of them. The burden they bear on affected individuals and their families and caregivers is unquantifiable, and measuring their economic burden is extremely challenging. It includes not only direct healthcare costs but also the indirect and opportunity costs of work missed by patients or their informal caregivers. For example, in Ontario, the direct and indirect costs of addictions and mental health conditions are estimated to cost \$39 billion a year—these are only two components of the larger picture of brain disorders.²

The spectrum of brain disorders is large—there are hundreds listed in either mental or neurological disorder chapters of established international classification systems. They affect people of all ages. Autism, learning disabilities, and other neurodevelopmental disorders pose individuals with enormous hurdles to overcome during their crucial, formative years of life. Those who have experienced head injuries have higher risks of depression and stress syndromes. Adults and children alike are affected by depression, addictions, and anxiety disorders—which have long-term effects on their ability to function effectively in society. Brain injury due to stroke, debilitating seizures arising from epilepsy, and neurodegenerative diseases such as Alzheimer’s disease and Parkinson’s disease, rob people of productive years of life.

While some disorders respond to treatment, there are no cures at the present time. However, this does not mean that there isn’t hope. Today’s scientists are standing at the threshold of understanding how the human brain works and how to treat it when it doesn’t.

The beginning of the Ontario Brain Institute

On November 15, 2010, the Ontario Government provided OBI with \$15 million in start-up funding for a three-year “proof-of-principle” period.

An interim Board of Directors was established with Mr. Joseph Rotman as its chair. In February of 2011, Dr. Donald T.



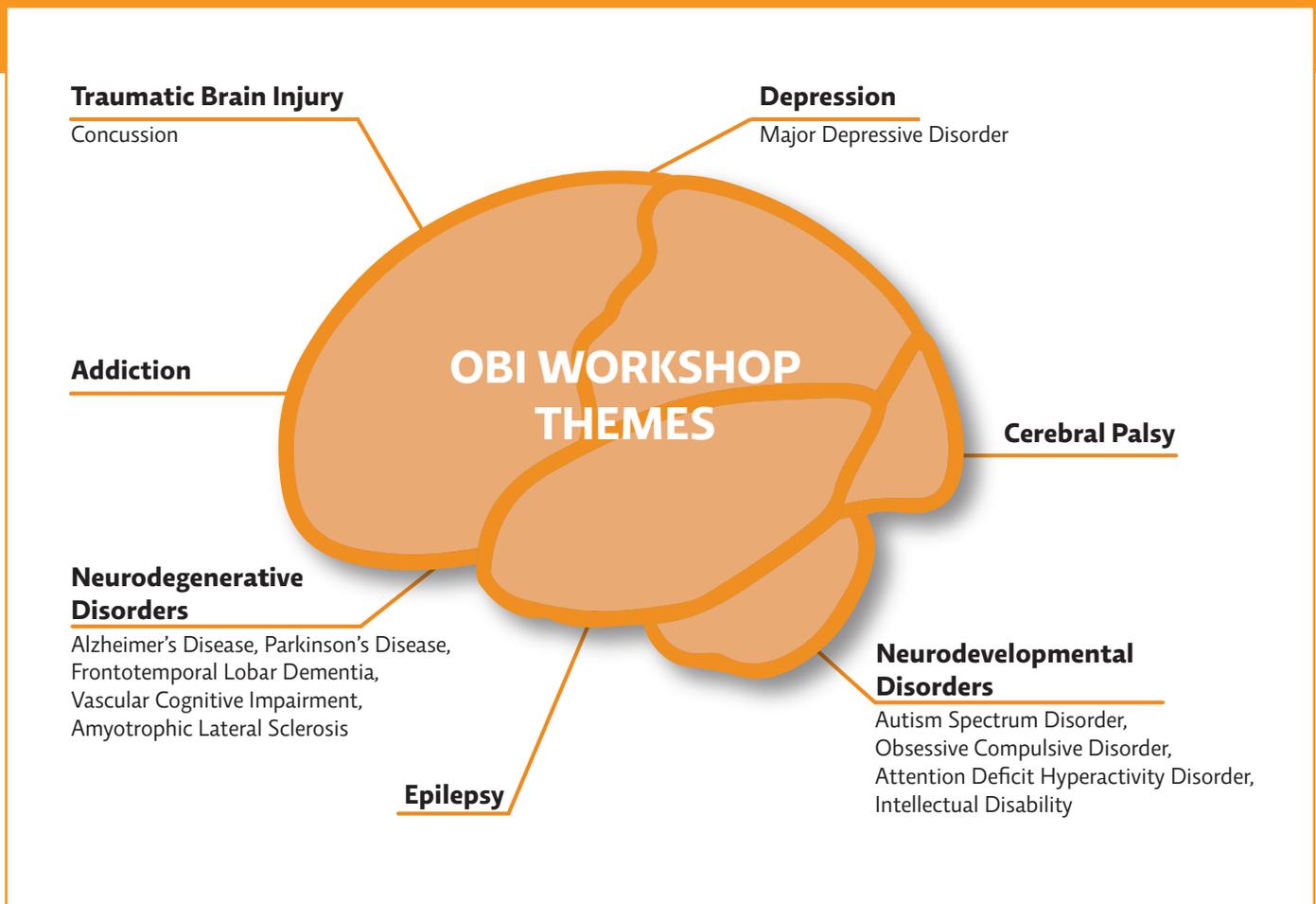
Stuss was recruited as OBI’s founding President and Scientific Director. Additionally, the OBI Foundation was established as a charitable organization to support OBI’s activities.

Recognizing that the three-year funding period would end on March 31, 2013, and with plans to complete an independent review before then, OBI implemented a rapid start-up agenda. From February to April, 2011, OBI embarked on a “Talk and Listen” tour across Ontario to engage the neuroscience community. Here, OBI provided details on its vision and announced interest in receiving letters of intent for pan-Ontario, collaborative research programs that integrate researchers, care providers, companies, and patients and their advocates. This tour reached out to eight Ontario universities and multiple hospitals and research institutions, involving over 425 participants from the neuroscience community.



Dr. Ravi Menon, Canada Research Chair in Functional and Molecular Imaging, Roberts Research Institute, Western University, London, Ontario

² Institute for Clinical Evaluative Sciences/Public Health Ontario. (2012). *Opening Eyes, Opening Minds: The Ontario Burden of Mental Illness and Addictions Report*



Establishing world-class advisory councils

To ensure that the chosen programs were focused on excellence and impact, OBI assembled both a Science Advisory Council (SAC) and an Industry Advisory Council (IAC). The SAC consists of acclaimed neuroscientists who would help ensure that the proposed research programs were of international calibre and were poised for patient impact. The IAC consists of multi-national companies and Ontario-based small and medium-sized enterprises that would help OBI identify opportunities for commercialization, give shape to OBI's commercialization strategy, and facilitate outreach to industry players that could become project participants.

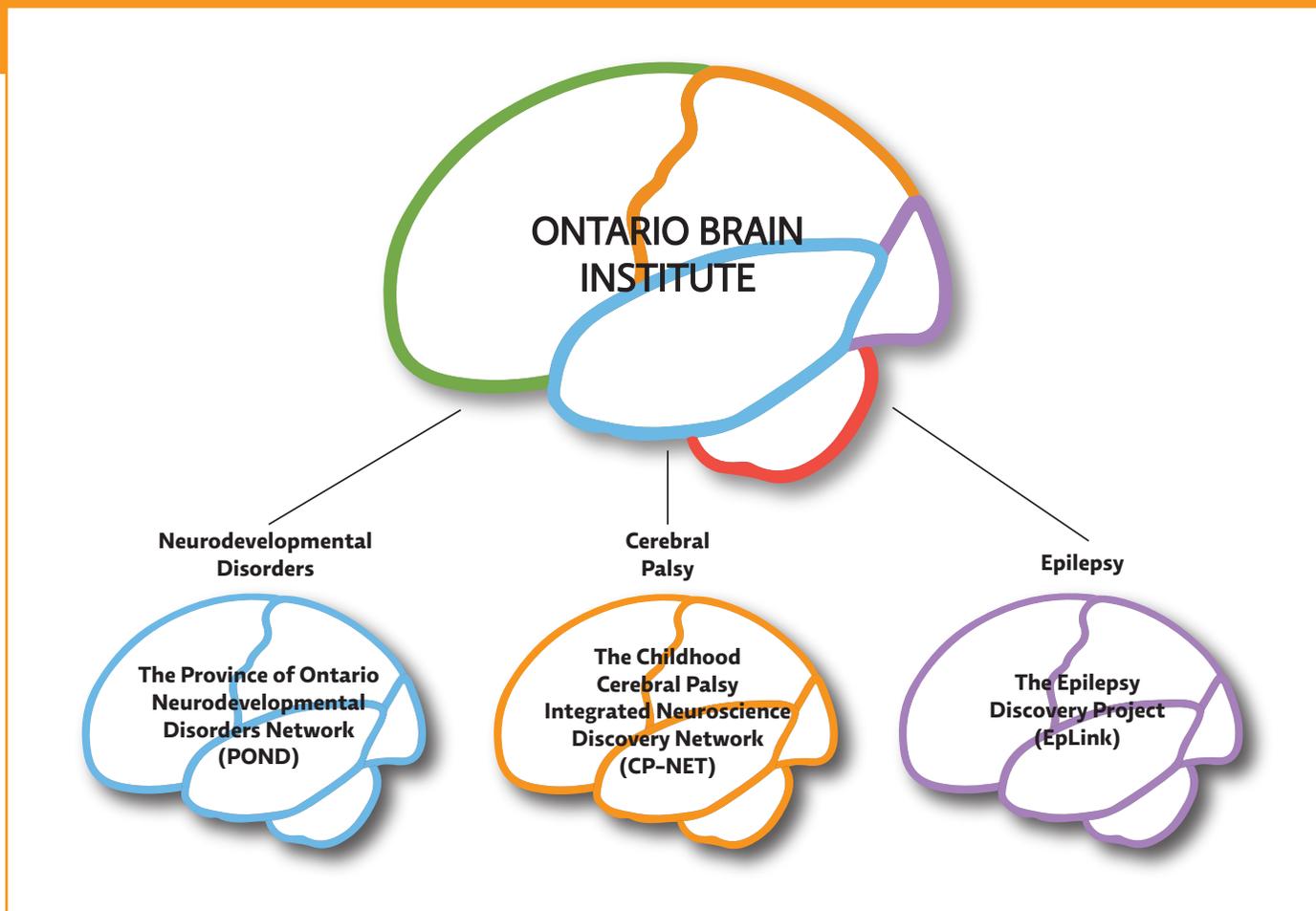
Identifying priority research themes

Maximizing the real impact of Ontario's neuroscience research and clinical strength would be achieved through investment in high-quality research programs, emphasizing: scientific excellence, translation, pan-Ontario collaboration, partnerships, and early patient and economic impact. In April of 2011, OBI received 33 letters of intent covering a wide range of brain disorders. OBI called for proposals based around new ideas, and most importantly, new ways of working together.

Many of the letters, however, came from researchers in similar fields and this spoke to competition instead of partnership. In line with OBI's vision of integration and collaboration, and after external review, the proposals that passed the threshold were consolidated into a total of seven.

Researchers who focused on depression were asked if they could work together on a province-wide program, breaking down silos between groups and institutions. However, the opportunity to forge connections in other areas, and even between disorders, was not as obvious. For instance, individual letters of intent had been submitted proposing programs on a wide range of neurodegenerative disorders including: Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis (or Lou Gehrig's disease), frontotemporal lobar dementia, and vascular cognitive impairment. Similarly, various letters of intent were submitted with respect to distinct neurodevelopmental disorders such as autism and attention deficit hyperactivity disorder. Though these groups seemed disparate initially, through discussion the rationale for collaboration grew stronger resulting in integrated proposals that broke down the silos not only between institutions and disciplines but also disorders. This type of cross-disorder, multi-disciplinary collaboration was an important first step in OBI's role as catalyst, integrator, and innovator.

Each of the seven groups went on to hold workshops that



brought together the newly formed consortia of researchers, clinicians, companies, patients and their representatives. During these workshops, participants advocated from their own perspectives. Discussion was facilitated around the state of the art in science, the practical requirements of hospitals and clinics, the needs and desires of patients, and the opportunities for business. These discussions helped align people's views and inform each group's final application to OBI.

With a total investment of \$15M over three years from the Province of Ontario, and the requirement to match an additional third of this, not all seven programs could be funded. Given its proof-of-principle mandate and a relatively short time frame to demonstrate impact, the review process favoured programs that were most ready to benefit from OBI's approach, meaning that integration of excellent research within the clinical framework, and avenues for commercialization, knowledge translation, and ultimately, early patient impact had to be clearly in place.

Each of the seven research program proposals were carefully reviewed by both the SAC and IAC. The SAC considered the importance of the topic, the strength of the researchers, and the breadth of the disciplines and institutes, while the IAC evaluated the commercialization potential of the proposed research programs. The guidance of these two councils was then used to inform the Board of Directors, which was responsible for passing the final decision on funding of the research programs.

In March of 2012, OBI announced funding for three of the seven programs: cerebral palsy, epilepsy, and neurodevelopmental disorders. Developing truly integrated research programs around these three areas would become OBI's first priority over its initial years. To do this, OBI set up a new system to enable collaboration, accelerate discovery, and provide real impact for people living with brain disorders. In the hope and expectation of renewal and extended funding, OBI also maintained development in the other four programs (i.e., addiction, depression, neurodegenerative diseases, and traumatic brain injury).

Our funding model

The OBI is not a typical funding agency. It provides sustained, research program-based funding providing that the programs maintain scientific excellence and reach the agreed upon milestones. In this way, stable and enduring collaborations are forged. The funding to any one researcher may not be large, but the funds are flexible and they fill in the gaps in the system to enhance collaboration and the translation of research. Another unique aspect of OBI's funding model is that it does not take ownership of any intellectual property created by its research programs. Instead, it encourages them to develop it in Ontario by enabling valuable partnerships.

Vision and mission

The Ontario Brain Institute aims to improve the lives of people living with brain disorders by working to support a single vision: Ontario as a world leader in brain research, commercialization, and care.

The OBI's first strategic implementation plan

Within a month of starting, Dr. Donald Stuss established a strategic implementation plan that outlined the method for setting up a system of research, innovation, and translation. The strategy focused on three priorities:

1. Creating a patient-centred research system to drive discovery;
2. Engaging industry to drive economic results; and
3. Driving borderless knowledge exchange between researchers, patient communities, policy makers, and industry.

Priorities for impact

Priority 1

Patient-centred research system to drive discovery

- Develop a detailed characterization of patients with brain disorders and factors that influence patient outcomes
- Drive translational research that generates a richer mechanistic understanding of brain disorders, driving discovery in prevention, detection, and treatment
- Guide innovation by clinical relevance at the earliest stages of discovery, accelerating the technology development pathway and improving the likelihood of clinical validation and future commercial viability

Priority 2

Engaging industry to drive economic results

- Encourage cross-sector dialogue and industry participation in research
- Help Ontario researchers recognize the commercial potential of their work early in the discovery process and capitalize on opportunities for the creation of additional economic value
- Support product development by mitigating investment risk

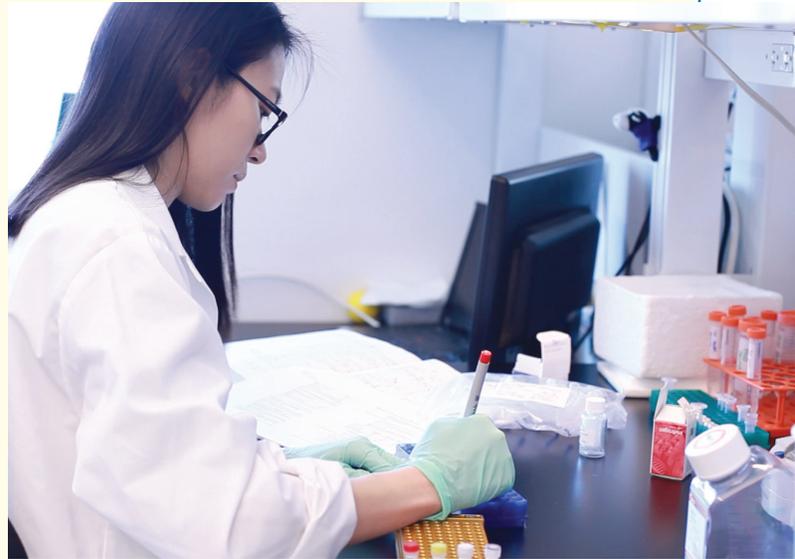
Priority 3

Driving borderless knowledge exchange between all stakeholders

- Provide formal and regular opportunities for dialogue among scientists, clinicians, trainees and industry
- Streamline real-time sharing of information and ideas
- Provide opportunities for patients and policymakers to help shape, contextualize, and harness the science

1 Integrated discovery: research

"Integrated discovery" describes an approach to research that spans many research and clinical disciplines and involves collecting different types of data, ranging from genetic and molecular to imaging and behavioural. By establishing a common approach to how data are collected, standardized assessments will allow data to be shared from across the province, maximizing clinical impact. With in-depth information on individuals with a specific disorder, researchers will be able to take a new look at root causes among diverse disorders. Because the approach is part of a province-wide system where clinical and research data are gathered and kept in a comparable format, it also provides the opportunity to apply findings in one disorder to others. As such, the approach is hypothesis-driven, yet allows exploratory, curiosity-driven research both currently and in the future. Through the use of a state-of-the-art informatics platform, researchers are able to pursue questions across different disorders, facilitating the discovery of common mechanisms to enable the fullest understanding of the disorder, and the brain at large.



The Centre for Applied Genomics, The Hospital for Sick Children, Toronto, Ontario



The Centre for Applied Genomics, The Hospital for Sick Children, Toronto, Ontario

Integrated discovery at a glance

- Three funded pan-Ontario research programs developed on the basis of scientific excellence and consultation from both the Science Advisory Council and the Industry Advisory Council. The programs involve:
 - 80+ researchers
 - 35+ institutions
 - 35+ companies
 - 20+ patient advocacy groups

"It is clear that the OBI has galvanized the scientific research communities among different thematic areas and neuroscientists in Ontario. This is seen, in particular, in the funded Integrated Discovery programs, where groups of researchers and clinician-scientists have come together, on a scale and scope not previously realized. This organizational effort in connectivity alone has led to new connections among the community that is producing novel high quality research groups with the potential for high impact research teams in the future." External review, 2012

Why study neurodevelopmental disorders?

Introducing POND

More than 300,000 children and youth in Ontario are affected by neurodevelopmental disorders like ASD (autism spectrum disorder), ADHD (attention deficit hyperactivity disorder), obsessive compulsive disorder (OCD), and intellectual disability (ID).³ These are disorders that begin in childhood and continue through adulthood, affecting an individual's ability to think, learn, interact socially, and even play.⁴



Dr. Evdokia Anagnostou, Lead Researcher, POND, Holland Bloorview Kids Rehabilitation Hospital, Toronto, Ontario

Neurodevelopmental disorders are not clear-cut, easy-to-segregate, “clear water between them” conditions. There is often considerable variability in how these disorders are expressed and sometimes individuals can have more than one neurodevelopmental disorder. For example, about 30 percent of individuals with autism also have symptoms of ADHD.⁵ For this reason, **The Province of Ontario Neurodevelopmental Disorders (POND) Network** has brought together a diverse group of researchers to investigate the common underlying causes to neurodevelopmental disorders. Instead of asking “what makes this disorder unique”, they are asking “how are these disorders similar and what does that teach us?”

The POND **patient registry** is a comprehensive database containing all neurodevelopmental patient information—including up-to-date personal and medical histories and projections—important for monitoring patient progress by providing complete profiles of each individual's therapeutic track record. The patient registry will draw from patient assessments conducted by a panel of experts on a variety of aspects of brain health, or “**multidisciplinary evaluation**”. Multidisciplinary evaluation yields a sensitive portrait of a patient's needs on an individual basis, and is therefore crucial in optimizing patient therapy. POND will directly inform **models of neurodevelopmental disorders** used to guide Ontario-based research, such as investigations to distinguish between the inherited (**genetic**) and environmental (**epigenetic**) factors that contribute to pediatric neurological development. Through the POND **clinical trials network**, researchers across Ontario will be engaged in partnership toward a common goal of improving the lives of patients with neurodevelopmental disorders.

³ http://www.autismsocietycanada.ca/DocsAndMedia/ASC_Internal/info_ASCwhatisautisminfosheet_27_June_07_e.pdf

⁴ Mood Disorders Society of Canada. *Quick Facts: Mental Illness and Addiction in Canada*. 2007

⁵ Stahlberg, O., Soderstrom, H., Rastam, M., & Gillberg, C. (2004) *Bipolar disorder, schizophrenia, and other psychotic disorders in adults with childhood onset AD/HD and/or autism spectrum disorders*. *Journal of Neural Transmission*, 111, 891-902

POND highlights

Overview

- Creating the first Canadian clinical trials network specializing in childhood neurodevelopmental disorders, in order to accelerate the development of new, more effective medications
- Targeting drugs for specific symptoms or brain changes since not all children have a specific disorder for the same reason
- Developing a large clinical database of children with these disorders to advance scientific understanding
- Examining possible environmental risk factors and environmental–genetic interactions that affect the expression of neurodevelopmental disorders
- Developing models to better understand disease mechanisms and quicken the pace of testing new treatments

Lead institutions

- Holland Bloorview Kids Rehabilitation Hospital
- The Hospital for Sick Children

Participating institutions

- Children’s Hospital of Western Ontario
- Lawson Health Research Institute
- McMaster Children’s Hospital
- McMaster University
- Oakville Trafalgar Hospital
- Toronto ADHD Clinic
- Toronto East General Hospital
- St. Joseph’s Hospital
- University of Ottawa
- University of Toronto
- Western University

Executive committee

- Dr. Evdokia Anagnostou, Holland Bloorview Kids Rehabilitation Hospital
- Dr. Paul Arnold, The Hospital for Sick Children
- Dr. Jason Lerch, The Hospital for Sick Children
- Dr. Rob Nicolson, Western University
- Dr. Russell Schachar, The Hospital for Sick Children
- Dr. Stephen Scherer, The Hospital for Sick Children
- Dr. Peter Szatmari, The Hospital for Sick Children, formerly McMaster University

Researchers involved

27

Industry partners

17

Patient advocacy groups

- Autism Speaks Canada
- Autism Ontario
- Canadian Autism Intervention Research Network
- Community Living Ontario
- Ontario OCD Network
- TotallyADD.com

Why study epilepsy? Introducing EpLink



Dr. Jorge Burneo, Co-Lead, EpLink, London Health Sciences Centre University Hospital, Western University, London, Ontario

Epilepsy is one of the most common neurological conditions worldwide. In Ontario, it affects approximately one percent of the population.⁶ The disorder causes seizures of varying kinds and intensity, limiting an individual's ability to lead an independent, fulfilling life.

The Epilepsy Discovery Project (EpLink) has been designed to improve the care of epilepsy from secondary prevention through to diagnoses and treatment. One of the EpLink program's goals is to achieve **seizure control for epilepsy patients** whose seizures are currently uncontrolled. The research fostered by EpLink aims to improve care for epilepsy in the ways of diagnosis, drugs, diets, surgery, brain stimulation, and research into gene therapies. One research priority involves looking into the causes of epilepsy—including inherited (**genetic**) and environmental (**epigenetic**) factors—and early detection of epilepsy. This includes individual patient **brain state** profiles made possible by state-of-the-art **brain imaging** techniques. Following from improved diagnostic methods, other research aims to develop minimally invasive **drug- and lifestyle-based therapies**, including the promising approach of electrical **brain stimulation**. Likewise, research is being conducted to improve the techniques, efficacy, and outcomes for **surgery**. Overall, the goal of research is to improve **patient treatment**, with sensitivity to **quality of everyday life**, as well as improving **the public perception** of epilepsy.

⁶ Canadian Institute for Health Information. *The Burden of Neurological Diseases, Disorders and Injuries in Canada*. 2007

EpLink highlights

Overview

- Investigation of dietary treatment of seizures
- Development of potential new drugs to the point where they are ready for review by major pharmaceutical companies
- Brain-state classification and stimulation, and the development of new approaches to modulating brain states by deep brain stimulation
- Use of imaging to predict onset of epilepsy after traumatic brain injury
- Use of imaging to improve outcomes after surgery

Lead institutions

- University of Toronto
- Western University

Participating institutions

- Children's Hospital of Eastern Ontario
- Hamilton Health Sciences Centre
- London Health Sciences Centre
- McMaster University
- North York General Hospital
- The Hospital for Sick Children
- University Health Network
- University of Ottawa

Executive committee

- Dr. Jorge G. Burneo,
London Health Sciences Centre
- Dr. W. McIntyre Burnham,
University of Toronto

Researchers involved

26

Industry partners

8

Patient advocacy groups

- The Canadian Epilepsy Alliance
- Epilepsy Canada
- Epilepsy and Seizure Disorder Resource Centre of South Eastern Ontario
- Epilepsy Ontario
- Epilepsy Toronto
- SUDEP Aware
- The Epilepsy Support Centre London

Why study cerebral palsy? Introducing CP-NET



Dr. Darcy Fehlings, Lead Researcher, CP-NET, Holland Bloorview Kids Rehabilitation Hospital, Toronto, Ontario

Cerebral palsy (CP) is the most common physical disability in children. CP is a condition that affects movement—caused by injury to a part of the brain during or just after birth. More than 20,000 people in Ontario are affected by CP.⁷

The Childhood Cerebral Palsy Integrated Neuroscience Discovery Network (CP-NET) has been designed to improve the lives of people living with CP. CP-NET aims to identify inheritable and environmental **risk factors** associated with the development of CP. To this end, new research focuses on modelling CP in animals, so as to better understand what is causing the disorder in humans. New **brain imaging techniques** afford a better understanding of what in the brain can cause CP and how to best conduct rehabilitation. People living with CP usually find it difficult to interact with their environment; research to improve **rehabilitation**, including augmented **communication technology** such as interactive communication devices, can greatly enhance the **quality of everyday life**. **Psychosocial evaluation** initiatives prioritize how the individual patient and their family fit into the “bigger picture” of CP in Ontario, so that patient care can be made as effective and comprehensive as possible.

⁷ http://www.ofcp.ca/living_cp.php

CP-Net highlights

Research platforms

- Clinical Risk Factor database of information from approximately 350 children with hemiplegic CP from across Ontario—including neonatal, obstetrical, and health records of participants
- Genetic analysis of both children and parents to better understand the causes of CP, and generate potential insights into future prevention strategies
- Investigate effects of rehabilitation treatments through the use of functional MRI and mouse models
- Investigate state-of-the-art technologies to help improve treatment, including video games to make rehabilitation therapy more enjoyable and effective

Lead institution

- Holland Bloorview Kids Rehabilitation Hospital

Participating institutions

- ErinoakKids Centre for Treatment and Development
- Grandview Children's Centre
- Health Sciences North, Sudbury
- Hotel Dieu Hospital
- Lawson Health Research Institute
- Laurentian University
- McMaster Children's Hospital
- McMaster University
- Ottawa Children's Treatment Centre
- Queen's University
- Thames Valley Children's Centre
- The Hospital for Sick Children
- University Health Network
- University of Ottawa
- University of Toronto
- Western University

CP-NET executive committee

- Dr. Gabrielle deVeber,
The Hospital for Sick Children
- Dr. Darcy Fehlings,
Holland Bloorview Kids Rehabilitation Hospital
- Dr. Michael Fehlings,
Toronto Western Hospital
- Dr. Ravi Menon,
Western University
- Dr. Peter Rosenbaum,
McMaster University
- Dr. Stephen Scherer,
The Hospital for Sick Children

Researchers involved

27

Industry partners

12

Patient advocacy groups

- CanChild Centre for Childhood Disability Research
- Heart and Stroke Foundation of Ontario
- Ontario Association of Children's Rehabilitation Services
- Ontario Federation for Cerebral Palsy
- Parents for Children with Hemiplegic Cerebral Palsy

SUCCESS STORIES

Patient advocacy initiatives driving research

Mary Secco, Director of Strategic Initiatives of the Epilepsy Support Centre in London, spoke about her camp for children with epilepsy during an EpLink workshop. Since many children affected by epilepsy are often discouraged from attending camps, Mary created a setting where camp staff are trained in first response to seizures, allowing children to participate in a wide range of activities. While Mary strongly believed that participation in the camp was beneficial, she had no solid evidence to prove it until one of the researchers involved in EpLink realized the value of turning this initiative into actual research. Through collaborations between patient advocates and researchers, Mary's camp has provided a platform for an interventional study to test whether participation in the camp has a positive impact on quality of life. Results of this study will help inform the development of similar programs that aim to enhance the lives of people living with epilepsy.

Embedding commercialization into research

Ketogen Inc. is a small Ontario-based pharmaceutical company working to develop new types of drugs for the treatment of epilepsy. Through its partnership with OBI's EpLink program, the company has gained access to top researchers, clinicians, and product development capabilities. The drug candidate that Ketogen is developing aims to serve as a replacement for the ketogenic diet, which is used clinically as a treatment for drug-resistant epilepsy. Although the ketogenic diet can be effective, it takes a huge amount of effort to prepare and is known to create other health problems, like abnormal fat profiles in the blood. As Dr. John S. Andrews, CEO of Ketogen explains, "being a basic researcher, you're often several steps removed from the patients. When you're talking to some of these other groups you get to understand what the impact of this disease is, why your product is necessary, why people don't take the diet. So it helps us understand what we actually need to do to help the patient".

2 Brain-CODE

The opportunity to create a virtual centre for data management quickly became apparent after the creation of the Integrated Discovery programs. So, OBI developed Brain-CODE (Centre for Ontario Data Exploration)—a database that manages the collection, storage and eventual analysis of data streaming in from the research programs. Brain-CODE will allow researchers to share their discoveries and start asking novel, never-before-possible questions. It will enable researchers to begin looking across disorders and brain conditions to better understand common underlying causes.

A cornerstone of effective collaboration among researchers involves the sharing of data. In order for researchers to be able to share and analyse their data properly they must be comparing apples to apples—the data must be standardized. The standardization of data collection on a province-wide scale, across several research platforms—and including multiple data types—is what makes Brain-CODE unique in the world. It goes beyond pushing the

“Innovation is about new equipment and new technology. But it is also about asking questions of data in a different way, which is very exciting.”

Kathleen Wynne
Premier of Ontario

boundaries for new kinds of scientific enquiry—it will allow for more targeted clinical trials that test new treatments for brain disorders.

Brain-CODE was developed for OBI by “InDoc”—a consortium of not-for-profit organizations that bring expertise in molecular data collection, imaging, military-grade security, storage, computing, and informatics. The proposal was to build Brain-CODE on previous investments from the Ontario government.

The data in Brain-CODE are housed at Ontario’s High Performance Computing Virtual Laboratory at Queen’s University, which is the only facility of its kind in Canada that supports regulatory-compliant processes.

Brain-CODE is designed to allow secure linkages to other databases, allowing for a richer level of analysis. The development of Brain-CODE is also guided by an International Advisory Committee, which provides direction on international best practices.

Brain-CODE at a glance

Security

- Secure, encrypted, and compliant with regulatory requirements
- Granted OBI with “Privacy by Design Ambassador” status by the Information and Privacy Commissioner of Ontario

Infrastructure

- Extensible informatics platform that manages the acquisition and storage of multidimensional data collected from patients with a variety of brain disorders

Standardization

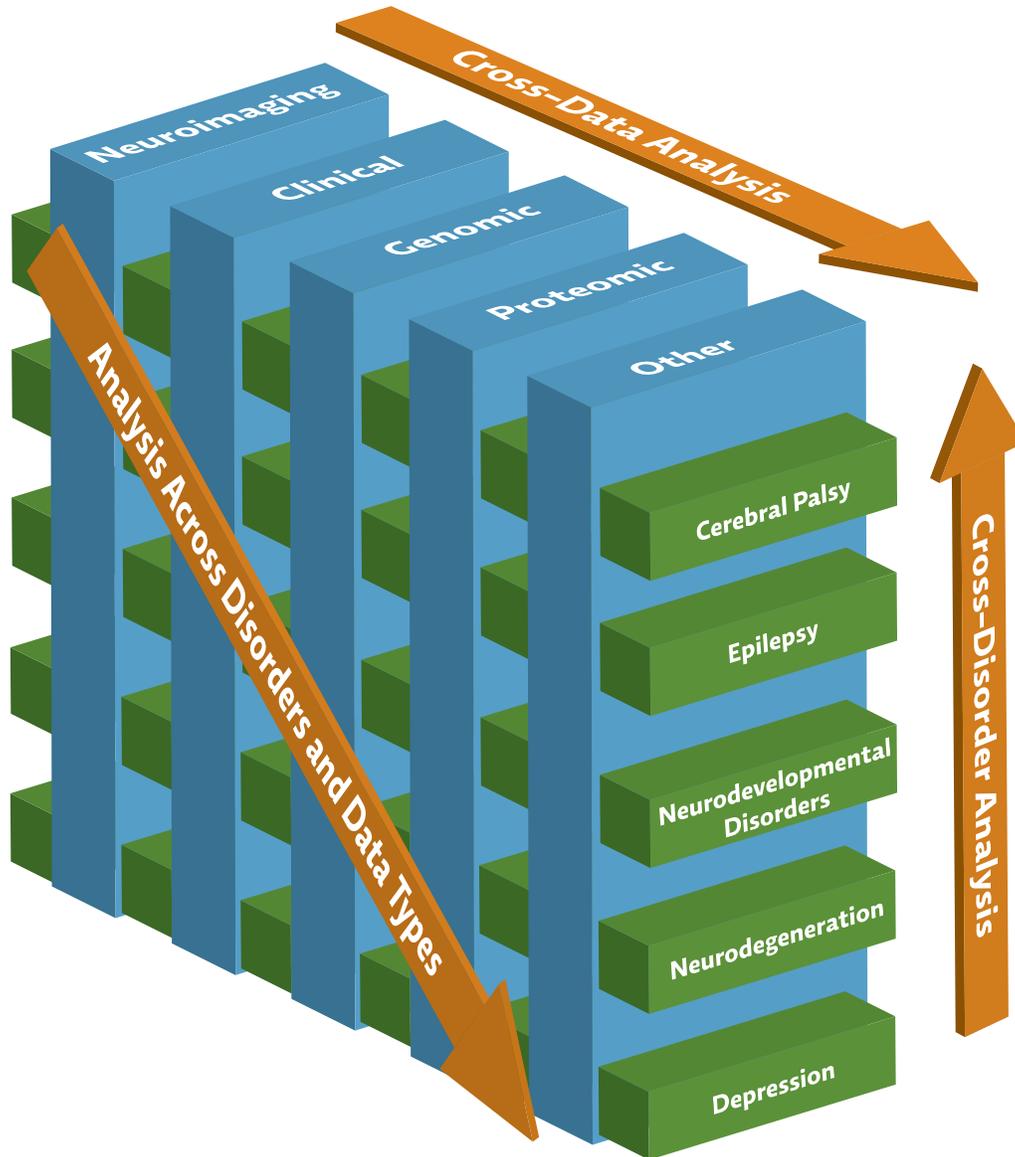
- Common Data Elements allow for comparison across disorders and databases

Research & health impact

- Brain-CODE will allow for a new level of patient-centred research questions to be asked. This will be enhanced by its ability to link with other databases

Expertise

- International Advisory Committee
- InDOC, a consortium of Ontario not-for-profits building Brain-CODE



“The centralizing data-collection and distribution system called “Brain-CODE” is, to date, the most prominent example of new initiatives forming from the provision of integrative forums to researchers and clinicians... it has the potential to be a model for other provinces, if not even on a national scale, for data collection systems with enormous translational potential.”

External review, 2012

“Brain-CODE itself has the future potential to revolutionize Ontario’s capacity to conduct clinical trials, especially for industry, and will actually attract investment.”

External review, 2012

SUCCESS STORIES

The value of the integrated discovery approach

Complex genetic factors

have been shown to play an important role in neurodevelopmental disorders. There is strong evidence from twin and family studies that highlights the important role that complex genetic factors play in neurodevelopmental disorders. Exciting findings from recent genome scanning experiments suggest that there is significant overlap in both genes and behaviours featured across neurodevelopmental disorders. Dr. Stephen Scherer, Director of The Centre for Applied Genomics at The Hospital for Sick Children and the leader of the genomics platform for the OBI research program focused on neurodevelopmental disorders (POND) was awarded with a \$10M federal grant for a large-scale applied research project named “Autism Spectrum Disorders: Genome to Outcomes”. Dr. Scherer explains that, “access to the POND patient registry was a big asset in the application for this grant. The comprehensive database provides complete profiles of each individual’s therapeutic track record, and evaluation of these records from a diverse group of experts creates a sensitive portrait of a patient’s needs on an individual and provincial basis which is crucial in optimizing patient therapy. Furthermore, an analytics tool like Brain-CODE will allow researchers to harness a personalized approach to the treatment of neurodevelopmental disorders as well enable discovery across disorders”.

Privacy by Design

Privacy does matter,

which is why OBI has taken a proactive approach to prevent security and privacy breaches and protect sensitive data. Dr. Ann Cavoukian, Ontario’s Information and Privacy Commissioner, and her staff, began working with OBI in 2012 to ensure that Brain-CODE safeguards the privacy of the individuals whose data are housed in Brain-CODE. Privacy is embedded within the design of Brain-CODE through the following: patients must provide informed consent—consent forms outline how the data will be used; all personal identifier data are encrypted at the time of capture and encryption is validated before data are transmitted; only a minimal amount of personal health information is gathered and stored in Brain-CODE; and prior to the release of any data, a Privacy Risk Assessment Tool is used to assess the risk of any data being re-identified. In October of 2012, OBI was granted “Privacy by Design Ambassador” status by the Information and Privacy Commissioner of Ontario for the development of Brain-CODE.

3 Commercialization



GaitTronics Inc. is an innovative rehabilitation robotics company headquartered in Ottawa, Ontario. CTO and Co-Founder, Dr. Aliasgar Morbi and CEO and Co-Founder, Richard Beranek pose with the GaitEnable.

Commercialization is a critical step in translating research ideas into better patient care. For OBI, partnerships are at the root of this translation. Through the development of collaborative partnerships between private sector and not-for-profit institutions, OBI focuses on accelerating the commercialization of brain-related tools. The objective of these efforts is to create an Ontario neuroscience cluster.

A cluster, within a commercialization perspective, is used to identify a geographic concentration of companies, suppliers, and service providers of a related industry all within a 'commutable distance'. Clusters allow companies to maximize their efficiency by providing for greater sharing of local infrastructure, better matching of skills between employees and employers, and the diffusion of knowledge among workers.

In 2011, a study was commissioned to identify Ontario's potential for a neuroscience cluster. Results were highly favourable—it highlighted two opportunities that needed to be seized, including improving ways to access capital and investing in the development of future leaders.

A key step in developing the cluster was setting up the Ontario Brain Innovation Council (OBIC) to help Ontario become a leader in translating brain research into accessible health benefits and economic prosperity.

The OBIC supports OBI's cluster programs by helping to create new relationships between existing players, recruit and develop new talent, advise on the efficient use of resources, share best practices, and to identify new market opportunities for organizations to work together.

OBIC's commercialization initiatives at a glance

- Development of the Industry Advisory Council
- Establishing the Ontario Brain Innovation Council
- Cross-sector dialogue and industry participation in research, including representatives from both pharmaceutical and medical device companies
- Leveraging of industry resources to drive discovery
- Working with Ontario Network of Entrepreneurs and other participating institutions' tech-transfer agents in support of the development of strategies to pool technologies, distribute risk, and accelerate commercialization
- Partnership with the Federal Economic Development Agency for Southern Ontario (FedDev Ontario)
- Training programs for highly-skilled graduate students



Award by FedDev Ontario to OBI for the creation of a neuroscience cluster in Ontario. Toronto Rehabilitation Institute, University Health Network, Toronto, Ontario. From left: Dr. Bob Bell, CEO of University Health Network; Dr. Donald Stuss, President and Scientific Director, Ontario Brain Institute; Mr. Joseph Rotman, Chair of the Board, Ontario Brain Institute; The Honourable Gary Goodyear, Minister of State (Federal Economic Development Agency for Southern Ontario); Dr. Geoff Fernie, Vice President of Research, Toronto Rehabilitation Institute, University Health Network

A focus on neurotechnology

Access to capital was identified as one of the essential components necessary to promote Ontario's strength as a neuroscience cluster. To address this, OBI has formed partnerships to help support young Ontario companies specializing in neurotechnology.

One example of this is OBI's partnership with Canada's Federal Economic Development Agency for Southern Ontario (FedDev Ontario). Together they have fostered a cluster-based initiative called "NeuroTech Ontario" that matches \$11 million from FedDev Ontario with more than \$11 million in private-sector investment to support 14 different neurotechnology projects aimed at developing new devices and treatments for brain disorders.

Cultivating the right talent

Ongoing development of leadership in the neuroscience commercialization sector was also identified as an important factor needed to drive a robust neuroscience cluster in Ontario. To promote this, OBI has developed the Experiential Education Initiative, aimed at fostering the growth of the human capital needed to sustain the neuroscience cluster.

Training opportunities: the Experiential Education Initiative

In Ontario, there is a growing pool of highly qualified neuroscientists. These are the people whose skills are needed to sustain a neuroscience cluster in Ontario. But their potential will be largely untapped without the right catalyst. This is why there is a genuine need for training programs that can harness the talents of these highly qualified people.

The programs that form part of OBI's Experiential Education Initiative are focused on helping neuroscientists bridge the gap between academia and other external fields where their knowledge can be applied practically. The initiative currently includes the OBI Entrepreneurs Program, in partnership with the Ontario Centres of Excellence, and the OBI Graduate Opportunity Internship Program. Plans to add a Graduate Opportunity Management Fellowship Program are underway. Specifically, these initiatives aim to:

- Help develop leaders in Ontario's knowledge-based economy
- Create expertise in the management of neuroscience research, knowledge translation, and commercialization of neuroscience
- Increase employment options for neuroscientists—qualifying them for high-quality jobs that contribute to a knowledge-based economy

OBI Entrepreneurs Program

The aim of this program is to drive the emergence of entrepreneurial spirit in the Ontario neuroscience cluster, increasing both the number of entrepreneurial scientists and ultimately, the number of neuroscience-related companies.

In partnership with the Ontario Centres of Excellence, the program provides \$50,000 to help post-graduate students in neuroscience or related fields to focus full-time, over a one year period, on commercialization activities related to a neuroscience-based opportunity.

Graduate Opportunity (GO) Internships

The Graduate Opportunity Internship Program was developed to offer opportunities away from the bench to graduate neuroscientists. OBI aims to place 10 interns annually, with the help of leveraging partnerships such as FedDev Ontario's Graduate Enterprise Internship Program. These placements may be with small-to-medium size enterprise, large multi-nationals or commercialization organizations across the province. OBI partners provide co-funding and subsidies for company contributions to place highly trained graduate students in new and exciting career opportunities.

SUCCESS STORIES

Entrepreneurs and researchers involved in mutually beneficial relationships

Dr. Aliasgar Morbi is a PhD graduate from Mechanical Engineering program at Carleton University. After participating in the OBI's Experiential Education Initiative as an entrepreneur, he created the company GaitTronics and is developing a robot that assists in patient mobilization. When the functional prototype had been created, and the next step required research partnerships to test and validate the effectiveness of the device, Dr. Morbi reached out to OBI to discuss meeting, and pitching to one of the Integrated Discovery programs focused on children with rehabilitation needs. The Integrated Discovery program focused on cerebral palsy (CP-NET) is now in the process of developing a strategic plan to purchase, and test the equipment in a clinical trial utilizing several of its research sites across the province. By working together, these two programs will accelerate the commercialization of a device that will impact patient and caregiver wellbeing.

"Through the OBI's efforts, there has been more progress toward commercialization in the past six months than I have seen in the past 30 years of my career."

Dr. W. McIntyre Burnham Co-lead of EpLink

Research spin-off provides new role for OBI intern

Dr. Peter Carlen, a researcher in the EpLink program, is developing a wireless monitoring system to detect impending seizures and alert the patient. To commercialize the device Dr. Carlen created the spin-off company, Avertus. In the early days of Avertus, OBI provided support in the creation of business plans and exploration of funding opportunities. This development work was completed primarily by OBI Intern Dr. Ron Gonzales, a Ph.D. graduate who was completing an MBA. Upon completion of his MBA studies, Dr. Gonzales was recruited to Avertus for the role of VP, Commercialization. Furthermore, the OBI Industry Relations team is assisting Avertus in sourcing follow-on funding. By assisting with access to capital, managerial talent, and translational research that can be commercialized, OBI is helping Avertus bring a seizure detection device for epilepsy to market.

"The OBI's success at fostering communication and building teams has generated excitement and attracted the attention of industry partners not directly involved in the Integrated Discovery programs. The joint government investment for the development of the neurodevice cluster in Ontario exemplifies the OBI's ability to attract investment dollars in Ontario directed specifically to brain research."

External review, 2012

4 Knowledge translation and communications

Getting people to work together is important to maximize the opportunity for discovery and innovation. It's also critical that those discoveries and innovations are quickly made accessible to those who need them.

OBI decided to combine the activities of communications and knowledge translation into an Outreach

program focused on facilitating the movement of research into action through telling stories, creating community, connecting research to care, and evaluating the impact of OBI's work. Combined, these activities would also demonstrate the collective impact of Ontario's neuroscience efforts.



Outreach at a glance

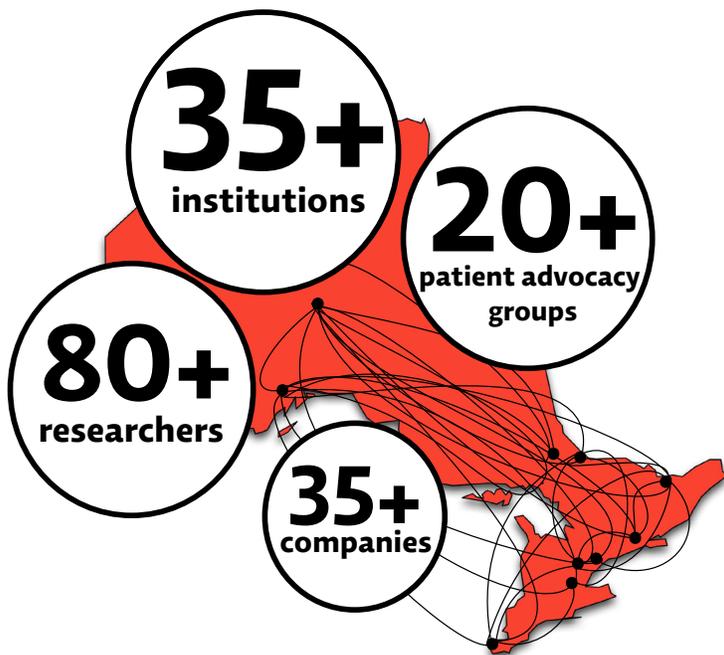
- Developed a website and established a presence on social media
- Hosted webinars, developed clear language summaries for research programs, and produced a biannual newsletter
- Over 60 earned media features, including print, radio, and TV
- Hosted public events designed to spread awareness and knowledge about brain disorders including a public lecture held in partnership with the Canadian Institute for Advanced Research (CIFAR)
- Established Patient Advisory Committees for each of the research programs
- Hosted a knowledge translation training session for OBI-funded researchers
- Developed a community engagement strategy to involve patients in the OBI's activities
- Developed a process for synthesizing, disseminating and implementing knowledge; an OBI report synthesized data from nearly 50 studies and found that routine physical activity is an effective lifestyle intervention to reduce the risk (by 40%) and reduce symptoms of Alzheimer's disease. This knowledge is now being implemented in a wide range of community-based physical activity initiatives

Telling our story

OBI began with a vision and a story to tell. Over the last few years, OBI built an active, engaged audience and spread interest in brain research by using a variety of media tools. OBI has used story-telling to raise awareness, change culture, and demonstrate the impact and growing connectivity of Ontario's neuroscience community. These efforts have increased the online presence of OBI and enhanced the recognition of OBI and partner activities.

Creating community

Collaborations and partnerships exist at the heart of every OBI activity. But these connections could never occur without creating opportunities for different groups to meet, share knowledge and discover new ways of working together. By creating an environment that facilitates effective interaction between different groups, OBI is helping to ensure that ideas, innovations, and communication flow seamlessly—both within and between groups, and ultimately to those living with brain disorders.



OBI's neuroscience community

As part of OBI's continuous effort to make research more accessible, a public lecture was held to share the information that stemmed out of a workshop—a collaboration between OBI and the Canadian Institute for Advanced Research (CIFAR) that assembled an international group of researchers to discuss current perspectives and future directions in autism research. A public talk—entitled 'Cracking the Autism Enigma'—given by CIFAR and OBI researcher, Dr. Stephen Scherer, and sponsored by Autism Speaks Canada, drew a crowd of over 300 people on a cold February evening.

In an effort to continue connecting families, researchers, clinicians, and support service providers, OBI and the SickKids Centre for Brain and Behaviour worked together to host an Education Day for families and individuals with epilepsy. The event provided an opportunity to disseminate recent advances in epilepsy research and to connect families to support services.

Continuing on its mission to connect Ontario's strengths in neuroscience, OBI began a series of province-wide "Talk and Listen" tours. In each city visited (Sudbury, Ottawa, and Thunder Bay), OBI hosted events to help connect the existing neuroscience groups within the city and also discuss how to integrate these individuals and groups within the greater Ontario neuroscience community. These tours are now part of OBI's regular Outreach activity.

Connecting research to care

While the research programs were being established, OBI began an initiative around the use of physical activity for treatment and prevention of Alzheimer's disease, allowing OBI to test and evaluate the effectiveness of its approach to knowledge translation. This process of synthesizing, disseminating and implementing knowledge is now well-articulated and ready to be applied to research programs so that research evidence can be moved into practice, improving care for individuals living with brain disorders.

Evaluating impact

Evaluation is necessary to demonstrate the impact of OBI's activity and the investment of the Ontario government. There is a plan in place to weave evaluation into every OBI initiative and measure the collective impact of this system towards the goal of improving brain health.

SUCCESS STORIES

Patient Advisory Committees

The OBI established Patient Advisory Committees for each of its three research programs. Each of these Committees includes Integrated Discovery program representatives, patients, caregivers, and patient advocates. The purpose of these Committees is to establish a forum for knowledge exchange between the research programs and the community. As one member stated, “it’s the link between bench, backyard, and back”. These Committees help OBI share clear language summaries of research program findings, recruit patients for clinical trials, and facilitate discussion around key issues for patients and their families—to name a few.

“The Alzheimer Society of Ontario commends the new Premier for supporting brain research in Ontario through the Ontario Brain Institute. Not only will it help us understand more about the brain but it is also an investment in keeping Ontario a world leader in this important field. We also look forward to working with the new government on the implementation of the Seniors Strategy.”

David Harvey Chief Public Policy and Program Initiatives Officer, Alzheimer Society of Ontario

Turning knowledge into action

A report by OBI analyzed over 50 years of research and found that being physically active is an effective way to reduce the risk of Alzheimer’s disease, and also improve everyday life of those living with Alzheimer’s disease. Specifically, the report confirmed that in older adults without Alzheimer’s disease, those who were very physically active were almost 40% less likely to develop Alzheimer’s disease as those who were inactive. Working in partnership with the Alzheimer Society of Ontario, ParticipACTION, and the Science Media Centre of Canada, OBI released the report in March 2013 to kick off Brain Awareness Week. To date, the report has generated over 150 stories from various news outlets, blogs and social media across Canada and around the world. The widespread attention and success of the report provides an environment for OBI and other organizations to begin exploring ways to use this evidence toward the prevention and management of Alzheimer’s disease.

“The OBI’s focus on connecting brain research to individuals impacted by brain conditions, as well as their role in moving knowledge into practice is what makes OBI a natural partner for Neurological Health Charities Canada (NHCC). We are thrilled with today’s announcement of continued funding for OBI, and NHCC looks forward to continued collaboration with them in the future.”

Joyce Gordon Chair, Neurological Health Charities Canada

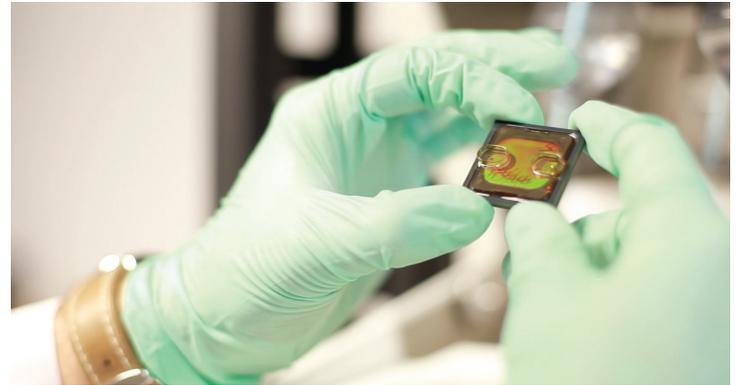
“The Ontario Brain Institute is marshalling these discoveries and the remarkable breadth of research talent across our province to spur discovery in the application of new treatments... the OBI has played a crucial role in supporting research in universities across Ontario and the affiliated research hospitals.”

Dr. Catharine Whiteside
Dean of Medicine, University of Toronto

By bringing together diverse perspectives and facilitating ways for them to work together, OBI intended to improve the system of brain research in Ontario. Over its first three years, OBI has supported initiatives within Ontario’s neuroscience community, enabling clinicians, academic researchers, patient advocacy groups, and industry partners to work together. The resulting Integrated Discovery programs are focused squarely on patient impact.

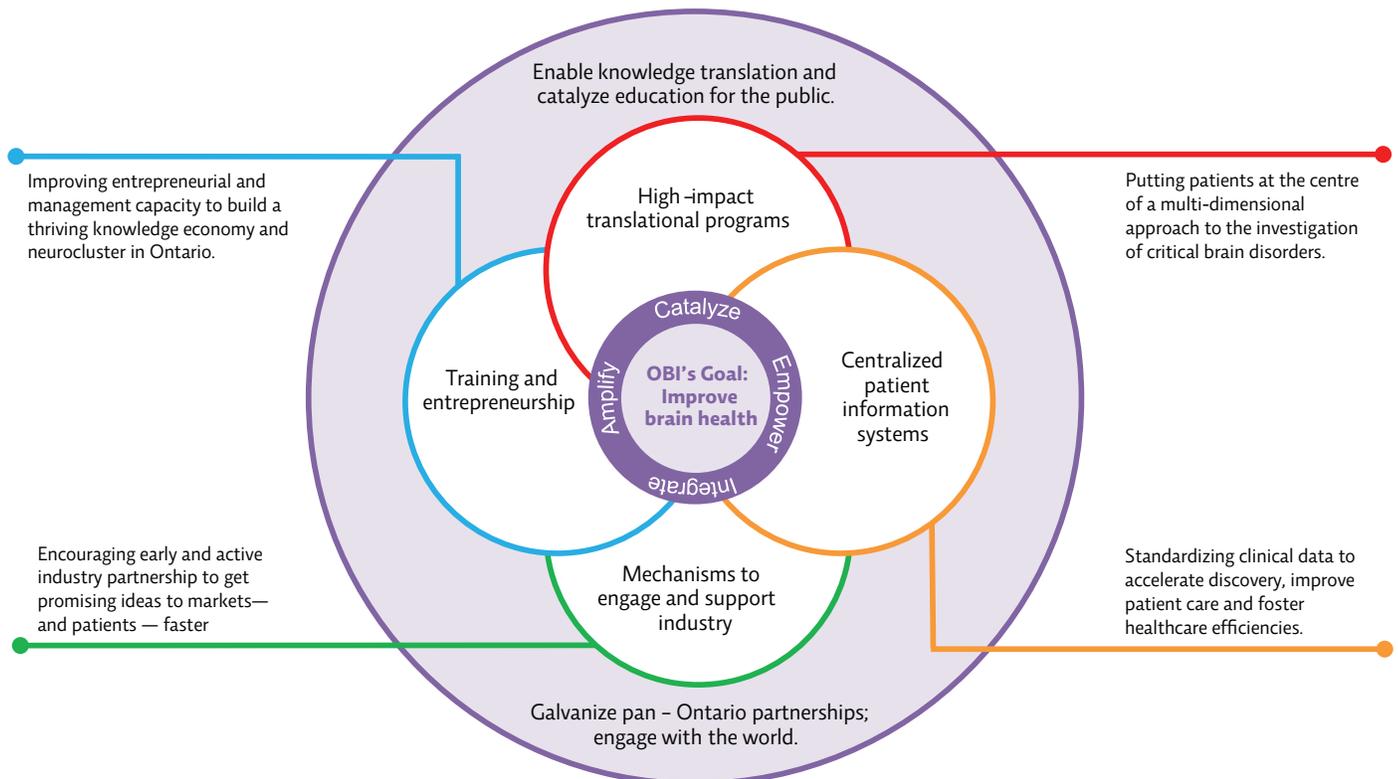
By engaging industry partners from the very beginning of a research project, commercialization of the research outcomes becomes a priority as opposed to an afterthought. By engaging

clinicians and patient advocacy groups, patient needs are placed at the centre of cutting-edge research. By providing hands-on business and managerial training to highly-skilled researchers, there is support for the human capital that’s needed to move good ideas to the market place with speed. Each component of the system plays a specific and crucial role, but that does not mean interactions are linear—knowledge flows in many directions through this virtuous cycle of activity.



The Centre for Applied Genomics at The Hospital for Sick Children allows researchers to perform cutting-edge genetics research.

The Ontario Brain Institute innovation system

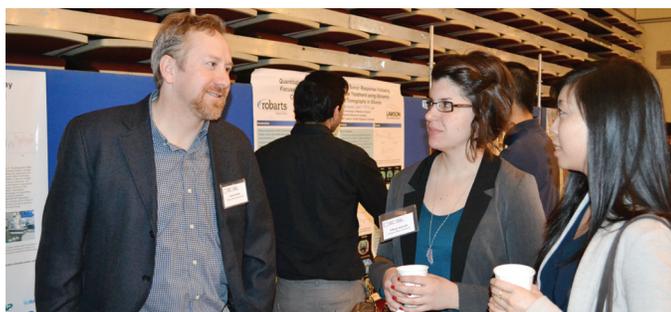


In November of 2012, OBI underwent an external review by a panel of experts in neuroscience, policy, commercialization, and patient care. The review presented strong arguments in favour of sustaining the OBI: “The people of Ontario are fortunate to have an outstanding human resource and physical infrastructure, which is at the foundation of Ontario brain science and knowledge translation. The carefully and strategically planned harnessing of this knowledge to action foundation serves to benefit the community’s health and welfare. It is the opinion of this Review Panel that the success of OBI will enhance this huge asset for generations to come.”



Dr. W. McIntyre Burnham, of the University of Toronto, has been one of Ontario’s leading experts in epilepsy for over 40 years.

In March of 2013, the Ontario government announced the renewal of OBI funding at \$100 million over five years. This funding would continue to provide support for OBI’s existing research programs on cerebral palsy, neurodevelopmental disorders, and epilepsy as well as allow the organization to expand its research into the areas of depression and neurodegeneration, disorders affecting hundreds of thousands of Ontarians.⁸ With the addition of the two new programs, OBI now connects over 35 participating research institutions, 200 researchers, 45 companies, 25 patient advocacy groups, and a projected 5,000 patients.



An OBI entrepreneur shares his experiences with OBI interns.



Dr. Elaine Biddiss and Dr. Ajmal Kahn focus on bridging research to care by creating innovative assistive devices for people with CP.

“The OBI does not focus on capacity building. We build on excellence that already exists. The province of Ontario is a hotbed of brain research excellence, cutting-edge medical facilities and highly skilled neuroscientists. One million Ontarians suffer from brain disorders, including mental health disorders, but this province has the infrastructure to change that. The OBI supports a new way of doing research—research that acts as a key driver of patient care, as a pivotal founder of new jobs. By embedding commercialization into research, and basic research into care, the OBI is changing the system.”

Dr. Donald Stuss President and Scientific Director, Ontario Brain Institute

⁸ Health Canada. *A Report on Mental Illness in Canada*. 2002

“OBI’s unique approach has provided the world-class research capability in Ontario a sharper focus and is leveraging the strength and potential of the collective capability. This... should be seen as a model for how governments, academia and industry can work effectively together to achieve a common goal. I have no doubt that the Ontario neuroscience research community is considerably stronger, and has a brighter future because of OBI.”

Paul N. Lucas Former President and CEO, GlaxoSmithKline Inc.

Nearing the end of 2012, OBI’s first phase was beginning to wind down and it would soon be time for the Ontario government to consider the renewal of funding for the OBI. Dr. Calvin Stiller, co-founder of the MaRS centre and lifelong innovator, saw the potential in OBI’s innovation system to drive an initiative that was much larger than what had been originally set out in OBI’s strategic implementation plan.

The 30 year vision

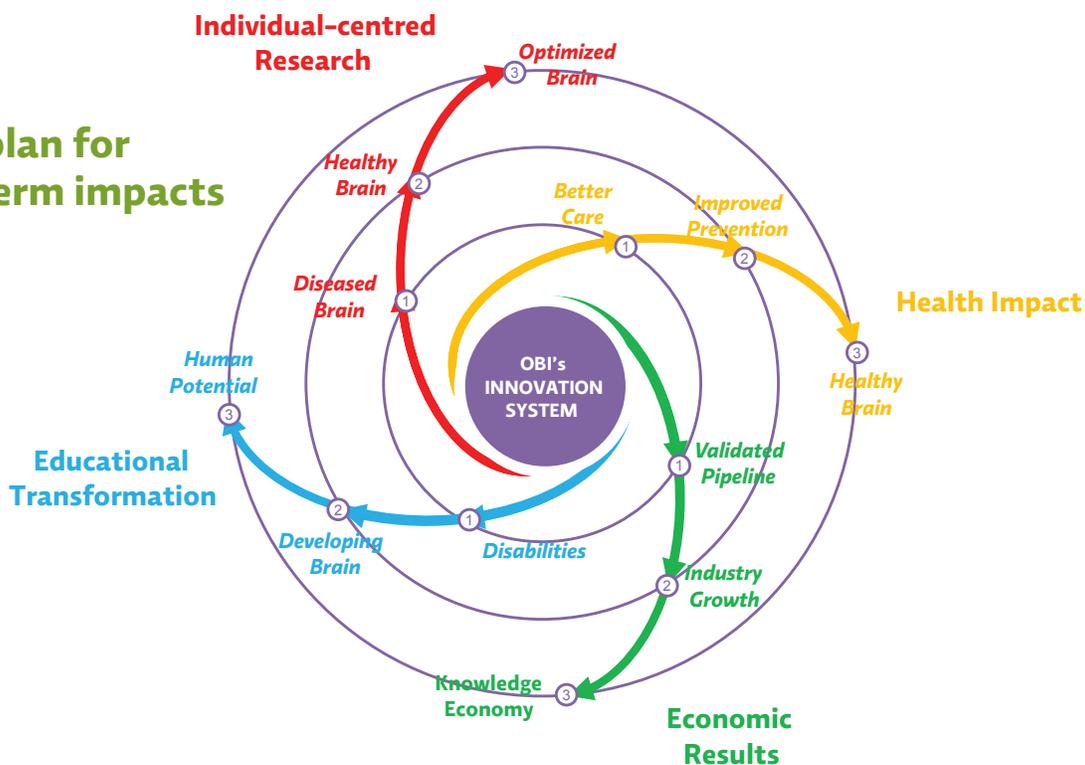
After assessing OBI’s early impacts and evaluating the strength of its innovation system, OBI sought to chart Ontario’s full potential to become a leader in the world of brain health before approaching the Ontario government with a proposal for further investment.

Brain disorders represent a critical component of OBI’s Phase 1, but brain health is not simply about the treatment and prevention of disease. It’s also about supporting and maintaining normal development and optimizing how we use

our brains early in life as well as enhancing the performance and well-being of our brains as we age. This critical point is what drove OBI to envision three distinct phases of development over the next several years: **disorders of brain function (current phase); understanding healthy brain function; and optimizing brain performance.**

Recognizing that different brain disorders emerge at distinct stages of human development, OBI considered it necessary to adopt a “lifespan approach” to the study of the brain, in which research on all stages of brain development—from infants and children to younger and older adults—is fostered within collaborative teams. This approach would provide a platform for understanding when problems occur during normal brain development and how disorders start and progress. With a greater understanding about the variability in healthy brain function and the thresholds of dysfunction, new knowledge would be available to inform the development of education initiatives and practices aimed at optimizing brain functioning in the future.

OBI’s plan for long-term impacts





OBI funding renewal announcement, The Hospital for Sick Children, Toronto, Ontario. From left: The Honourable Reza Moridi, Minister of Research and Innovation; The Honourable Kathleen Wynne, Premier of Ontario; The Honourable Deb Matthews, Minister of Health and Long-Term Care

“Research and innovation are vital in creating a better province for everyone. By investing in leading edge research, we’re helping to improve outcomes for patients and export Ontario expertise, and that helps create jobs.”

Kathleen Wynne Premier of Ontario

“The Ontario Brain Institute’s collaborative, patient-focused approach to addressing brain disease and disorders is what makes it truly unique. Conditions like Alzheimer’s, stroke, depression and traumatic brain injury affect hundreds of thousands of Ontarians, so the institute’s work touches lives—family, friends, our own—and helps to bring better outcomes for patients.”

Deb Matthews Minister of Health and Long-Term Care

“The Ontario Brain Institute is harnessing Ontario’s world-leading research expertise to make new discoveries that will improve the lives of millions of people. Today’s announcement allows us to continue building on the OBI’s achievements and bring good jobs, investment, and the best minds to the province.”

Reza Moridi Minister of Research and Innovation

“The formation of the Ontario Brain Institute is one of the most important initiatives I have undertaken. I am pleased to participate in and support the Ontario government’s vision to accelerate commercialization and improve patient care through a strong research community. From my perspective, we are just beginning to demonstrate the impact that the Ontario Brain Institute will have on research and innovation across Ontario. Going forward, we will continue to build on past investments and our many research strengths with the hopes of positioning Ontario amongst the world leaders in the global transformation occurring around brain research and neuroscience.”

Joseph Rotman Chair, Ontario Brain Institute

Acknowledgements

We would like to thank the enumerable people who contributed to the establishment and success of the Ontario Brain Institute.

Ontario Brain Institute Board of Directors



Joseph L. Rotman, O.C., LL.D.

Mr. Rotman is Chair of the Board at the OBI. He is also Chairman of Roy-L Capital Corporation. He has been involved in establishing a number of private and public companies in many different industries. Mr. Rotman has applied his business experience to advancing Canadian life sciences research, the development of Canada's innovation and commercialization capacity, and related public policy at the federal and provincial levels. He led the creation of the Rotman Research Institute at Baycrest Centre for Geriatric Care affiliated with the University of Toronto, and served two three-year terms on the Governing Council of the Canadian Institutes of Health Research (CIHR) from June 2000 to June 2006. He has served as a Director on numerous corporate boards including the Bank of Montreal, Barrick Gold Corporation, Canada Northwest Energy Ltd., Masonite International, and TrizecHahn Corp. As well, he served as Chair of the Board as Founder of Tarragon Oil and Gas, Geocrude Energy, and PanCana Resources, amongst others. As the Founder, he remains a Director of Clairvest Group Inc., which provides merchant banking for emerging companies and is listed on the Toronto Stock Exchange. Mr. Rotman was awarded an honorary LLD from the University of Toronto in 1994. In 1995, he was made an Officer of the Order of Canada, and in August 2008 Mr. Rotman was appointed Chair of the Canada Council for the Arts.



Donald T. Stuss, Ph.D., C. Psych., ABPP-CN, O.Ont., FRSC, FCAHS

Dr. Stuss is the President and Scientific Director of the OBI. His research focuses on understanding and treating the cognitive functions and personality changes associated with the frontal lobes as they occur after stroke, normal aging, and in those with traumatic brain injury or dementia. He is a University of Toronto Professor of Medicine (Neurology and Rehabilitation Science) and Psychology; an adjunct Senior Scientist at Baycrest's Rotman Research Institute and Founding Director of the Rotman Research Institute, from 1989 to 2008; Reva James Leeds Chair in Neuroscience and Research Leadership 2001-2009; Vice-President Research, at Baycrest, 1991-2004, 2006-2009; Vice-President Academic Education at Baycrest 2006-2008; and interim Director and CEO of the Heart and Stroke Foundation Centre for Stroke Recovery 2008-2009. Dr. Stuss has one co-authored book, and four co-edited books; over 200 publications and 49 chapters; and presented over 250 invited scientific lectures and workshops.



Susan Fitzpatrick, Ph.D.

Susan Fitzpatrick is Vice President of the James S. McDonnell Foundation, one of a limited number of international grant makers supporting university-based research in the biological and behavioural sciences through foundation-initiated programs via competitive, peer-review proposal processes. Susan received her PhD in Biochemistry and Neurology from Cornell University Medical College (1984). After five years pursuing in vivo NMR spectroscopic studies of brain metabolism in the Department of Molecular Biochemistry and Biophysics at Yale University, her career shifted to non-profit administration. Susan was the Associate Executive Director of the Miami Project to Cure Paralysis (1989-1992), a comprehensive basic science and applied science research center focused on restoring neurological function to persons with spinal cord injury. Her responsibilities included all public outreach and educational efforts and she served as the scientific liaison to the development, fundraising, and public relations staff. As Executive Director of the Brain Trauma Foundation (1992-1993), she guided the Foundation through a re-organization to become a leader in advancing the acute care of patients with traumatic brain injury. Joining the James S. McDonnell Foundation in 1993 as the Foundation's first Program Officer, she was later promoted to Program Director in 1997 and to Vice President in 2000. Susan is an adjunct associate professor of Neurobiology and Anatomy at Washington University School of Medicine (St. Louis), teaching neuroscience. As well, she lectures and writes on issues concerning the role of private philanthropy in the support of scientific research and on issues related to the public understanding of science.



Valerie Pringle, C.M.

Ms. Pringle is the Co-Chair of the Trans Canada Trail Foundation and a Board Member of the Centre for Addiction and Mental Health Foundation, the Stephen Lewis Foundation and the Canadian Broadcast Heritage Museum. She is the spokesperson for the Canadian Foundation for AIDS Research (CANFAR), and a member of the Ryerson University Campaign Cabinet. She is member of the Order of Canada.



Marcus E. Raichle, M.D.

Dr. Raichle, a neurologist, is a Professor of Radiology, Neurology, Neurobiology and Biomedical Engineering at Washington University in St. Louis. He is a member of the National Academy of Sciences, The Institute of Medicine and the American Academy of Arts and Sciences and a Fellow of the American Association for the Advancement of Science. He and his colleagues have made outstanding contributions to the study of human brain function through the development and use of positron emission tomography and functional magnetic resonance imaging. Their landmark study (*Nature*, 1988) described the first integrated strategy for the design, execution and interpretation of functional brain images. Another seminal study led to the discovery that blood flow and glucose utilization change more than oxygen consumption in the active brain (*Science*, 1988) causing tissue oxygen to vary with brain activity. This discovery provided the physiological basis for subsequent development fMRI and caused researchers to reconsider the dogma that brain uses oxidative phosphorylation exclusively to fuel its functional activities. Finally seeking to explain task-induced activity decreases in functional brain images they employed an innovative strategy to define a physiological baseline (*PNAS*, 2001; *Nature Reviews Neuroscience*, 2001). This has led to the concept of a default mode of brain function and invigorated studies of intrinsic functional activity, an issue largely dormant for more than a century. An important facet of this work was the discovery of a unique fronto-parietal network in the brain that has come to be known as the default mode network (DMN). This network is now the focus of work on brain function in health and disease worldwide. Dr. Raichle and his group has consistently led in defining the frontiers of cognitive neuroscience through the development and use of functional brain imaging techniques.



Meredith Sauderson

Meredith Sauderson is an active volunteer based in Toronto. She is a graduate of University College, University of Toronto, where she was a recipient of the Students' Administrative Council Honour Award. After a year at OCE, she taught for two years at Northern Secondary School before retiring to raise a family of three children with her husband Bill. She is founding member and former Chair of the Toronto Friends of the Visual Arts, former Chair of the University of Toronto Art Centre, and she spent thirty years volunteering at the Art Gallery of Ontario as an education docent, and as a travel coordinator. During this time, she spent four years as a member of the Ontario Liquor License Board and ten years on the National Board of Parkinson Society Canada culminating in a two-year term as Chair. This latter role provided her with an insight into health care for neurological diseases. In 1988, the Saudersons' youngest daughter was struck by a car and underwent intensive brain surgery. This led to the founding of The Sauderson Chair in Acquired Brain Injury at the Toronto Rehabilitation Institute. Meredith is a recipient of both the Queen's Gold and Jubilee medals and the University of Toronto's Arbor Award.



Todd Vienneau

Todd Vienneau is a proven pharmaceutical industry leader with 20 years of experience across multiple disciplines. He currently holds the position Director, Business Development responsible for New Growth Opportunities at GlaxoSmithKline Canada. He joined GlaxoSmithKline (then GlaxoWellcome) in 1999 and has held multiple senior management positions across many functions including Medical Affairs, Regulatory Affairs and Pharmaceutical Development. In 2006, Todd received GSK's Spirit Award for Leadership. Prior to joining GlaxoSmithKline, Todd was with Proctor & Gamble in both their Canadian and Global operations working in OTC Health Care Product Development and Pharmaceutical New Product Development teams. During his career Todd has been involved in the development and commercialization of many products across multiple disease areas. His broad functional and therapeutic area experience provides a solid foundation for leading efforts across a wide spectrum of disciplines. Todd holds an Honours Bachelor of Science degree in Biochemistry from the University of Waterloo, has excellent people management and communication skills along with a commercial-oriented strategic focus.

Founders

Lawrence and Frances Bloomberg
Mount Sinai Hospital

Sydney and Florence Cooper
Baycrest

Gerald and Geraldine Heffernan
University of Toronto

William and Susanne Holland
Holland Bloorview

Richard M. Ivey
Western University

Robert and Linda Krembil
University Health Network

Arthur and Sonia Labatt
The Hospital for Sick Children

Joseph and Sandra Rotman
Ontario Brain Institute

Lawrence and Judith Tanenbaum
Brain Canada

GlaxoSmithKline Inc.

IBM Canada Ltd.

Medtronic of Canada Ltd.

Nestlé Health Science, Canada

Pfizer Canada Ltd.

Valeant Canada LP

Science Advisory Council

Dr. Marcus Raichle (Chair)
Washington University in St. Louis
<http://www.nil.wustl.edu/labs/raichle/>

Dr. Joseph T. Coyle
Harvard University
<http://connects.catalyst.harvard.edu/Profiles/display/Person/52960>

Dr. Fred H. Gage
Salk Institute for Biological Studies
<http://www.salk.edu/faculty/gage.html>

Dr. John Hardy
University College London
<https://iris.ucl.ac.uk/research/personal?upi=JHARD28>

Dr. Daniel S. Marcus
Washington University in St. Louis
http://incf.org/community/people/dmarcus/person_view

Dr. Joseph B. Martin
Harvard University
<http://neuro.med.harvard.edu/people/faculty/joseph-martin>

Dr. Richard Murphy
Richard Murphy & Associates, Inc.
<http://rmurphyassoc.com/history.html>

Dr. William J. Powers
University of North Carolina
http://findadoc.unchealthcare.org/directory/profile.asp?dbase=main&setsize=5&pict_id=0004097

Dr. Trevor Robins
Cambridge University
<http://www.neuroscience.cam.ac.uk/directory/profile.php?Trevor>

Dr. Olaf Sporns
Indiana University
<http://psych.indiana.edu/faculty/osporns.php>

Dr. Brian A. Wandell
Stanford University
<https://www.stanford.edu/group/vista/cgi-bin/wandell/>

Industry Advisory Council

Todd Vienneau (Chair)
Director, Business, GlaxoSmithKline Inc.
<http://www.gsk.ca/english/index.html>

Anne Vivian-Scott
President, CEO, BKIN Technologies
<http://www.bkintechnologies.com/>

Dr. Doron Sagman
VP, R&D, Eli Lilly
<http://www.lilly.ca/>

Genevieve Lavertu
Director, Legal, Scientific Affairs & Business Development
and

Greg Molnar
Director, Neuromodulation Research, Medtronic
<http://www.medtronic.ca/>

Dr. John Andrews
President and Chief Scientific Officer, Neuraxon
<http://www.neuraxon.com/>

John Soloninka
President, CEO, Health Technologies Exchange
<https://www.htx.ca/default.aspx>

Julie Yankovich
Director, Business Operations, Valeant Pharmaceuticals North America
<http://www.valeant.com/>

Dr. Mark Lundie
Director, R&D, Pfizer Canada Inc.
<http://www.pfizer.ca/en/home/?>

Pat Horgan
VP, Manufacturing and Development, Smarter Planet
and

Don Aldridge
General Manager, Research and Life Sciences, IBM Canada Inc.
<http://www.ibm.com/ca/en/>

Cynthia Stewart
Manager, Academic Partnerships, GE Health Care
<http://www3.gehealthcare.com/en>

External Review Committee

Dr. Samuel Weiss (Chair)
Director, Hotchkiss Brain Institute,
University of Calgary

Dr. Howard Chertkow
Director, Bloomfield Centre for Studies in Aging
McGill University

Dr. Dan Marcus
(SAC Representative), Assistant Professor
Washington University

Dr. Mark Lundie
(IAC Representative), Director, Research and Development
Pfizer Canada

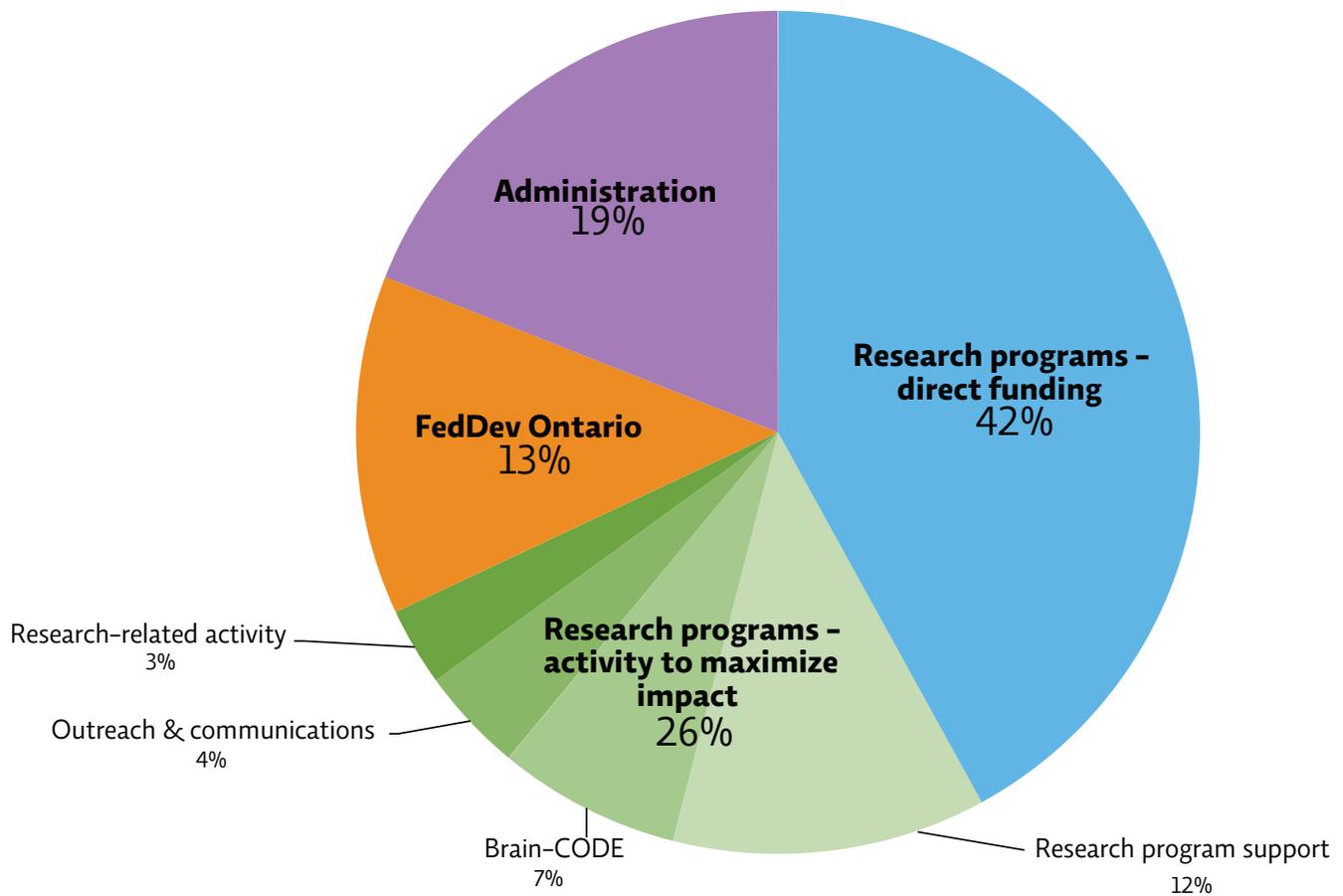
Ms. Vanessa Foran
Director, Policy, Partnerships and Government Relations
Neurological Health Charities Canada

Dr. Neil Buckholtz
Director, Division of Neuroscience
National Institute on Aging, USA

International Science Advisory Council

Dr. Huda Akil	Quarton Distinguished University Professor of Neuroscience and Psychiatry at the University of Michigan and the co-Director of its Molecular & Behavioral Neuroscience Institute http://www.mbni.med.umich.edu/mbni/faculty/akil/akil.html
Dr. Sarah Caddick	Principal Advisor on Neuroscience to Lord Sainsbury of Turville http://www.gatsby.org.uk/
Dr. H. Christian Fibiger	Chief Scientific Officer of Biovail Laboratories International SRL
Dr. Russell Foster	Professor of Circadian Neuroscience and Head of the Nuffield Laboratory of Ophthalmology at the University of Oxford http://www.ndcn.ox.ac.uk/departments/NLO/team/principal-investigators/russell-foster
Dr. Michael E. Greenberg	Professor of Neurobiology, Chair of Department of Neurobiology at Harvard Medical School http://neuro.med.harvard.edu/people/faculty/michael-greenberg
Dr. John A. Hardy	Professor of Neuroscience, Institute of Neurology at University College London http://www.ucl.ac.uk/rlweston-inst/people/john
Dr. Michael Hausser	Professor of Neuroscience at University College London and a Senior Research Fellow of the Wellcome Trust http://www.ucl.ac.uk/WIBR/research/neuro/mh/
Dr. Michael Howlett	President and CEO of the Mental Health Commission of Canada http://www.mentalhealthcommission.ca/
Dr. Ulman Lindenberger	Director of the Center for Lifespan Psychology at the Max Planck Institute for Human Development, Berlin https://www.mpib-berlin.mpg.de/en/staff/ulman-lindenberger
Dr. Richard Mayeux	Gertrude H. Sergievsky Professor of Neurology, Psychiatry and Epidemiology at Columbia University in New York City http://asp.cumc.columbia.edu/facdb/profile_list.asp?uni=rpm2&DepAffil=Psychiatry
Dr. Remi Quirion	McGill University Full Professor, Psychiatry (affiliation Neurology, Pharmacology and Therapeutics) and Scientific Director at the Douglas Mental Health University Institute http://www.douglas.qc.ca/researcher/remi-quirion?locale=en
Dr. Martin Raff	Fellow of the Royal Society, the British Academy of Medical Sciences, and the Academia Europaea http://www.ucl.ac.uk/lmcb/research-group/martin-raff
Dr. Marcus E. Raichle	Professor of Radiology, Neurology, Neurobiology and Biomedical Engineering at Washington University in St. Louis http://www.nil.wustl.edu/labs/raichle/
Dr. Terrence J. Sejnowski	Computational Neurobiology Laboratory, Salk Institute for Biological Studies http://www.salk.edu/faculty/sejnowski.html
Dr. Bryce Weir	Goldblatt Professor Emeritus of Surgery and Neurology http://neurosurgery.org/society/bio.aspx?MemberID=3722
Dr. Samuel Weiss	Professor and Alberta Heritage Foundation for Medical Research (AHFMR) Scientist in the Departments of Cell Biology & Anatomy and Pharmacology & Therapeutics at the University of Calgary, Faculty of Medicine http://www.cell.ucalgary.ca/s_weiss.html

OBI's investment by the numbers



The total funding of \$20.25 M comes from multiple sources.

A large portion of administration expenditure pertains to start-up costs.





**ONTARIO INSTITUTE
BRAIN ONTARIEN
INSTITUTE DU CERVEAU**

438 University Avenue, Suite 1618
Toronto, Ontario M5G 2K8

Tel: 647-847-9000
Fax: 1-866-570-5818
www.braininstitute.ca