



CIHR IRSC

CIHR Institute of Neurosciences, Mental Health and Addiction

Internal Assessment for 2011 International Review



Canadian Institutes
of Health Research

Instituts de recherche
en santé du Canada

Canada

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Mandate and Context

Mandate and mission

The CIHR Institute of Neurosciences, Mental Health and Addiction (INMHA) draws on a strong and distinguished tradition in Canada of advancing basic and clinical brain research in the service of neurological, psychiatric and addiction medicine. The legacies of Penfield, Lehmann and Hebb serve as beacons throughout the world in their respective fields of neurology, psychiatry and cognitive/behavioural sciences and in Canada they left an indelible mark on each of these disciplines. Accordingly, a principal challenge faced by INMHA is to serve as a champion for the strong cohort of basic and clinical neuroscientists devoted to decoding brain and spinal cord function and to ensure the sharing of this knowledge across a broad range of disciplines through innovative and effective strategic initiatives.

In keeping with this legacy, the mandate of INMHA is to support research that enhances knowledge of the brain, mental health, neurological health, vision, hearing and cognitive functioning. Our goal is to reduce the burden of brain illness through prevention strategies, screening, diagnosis, treatment, support systems and palliation. We will improve the understanding of human thought, emotion, behaviour, sensation (sight, hearing, touch, taste, smell) perception, learning and memory. INMHA's vision is that innovative research will provide new knowledge of the biological and socio-cultural processes underlying neurological, mental and addictive disorders.

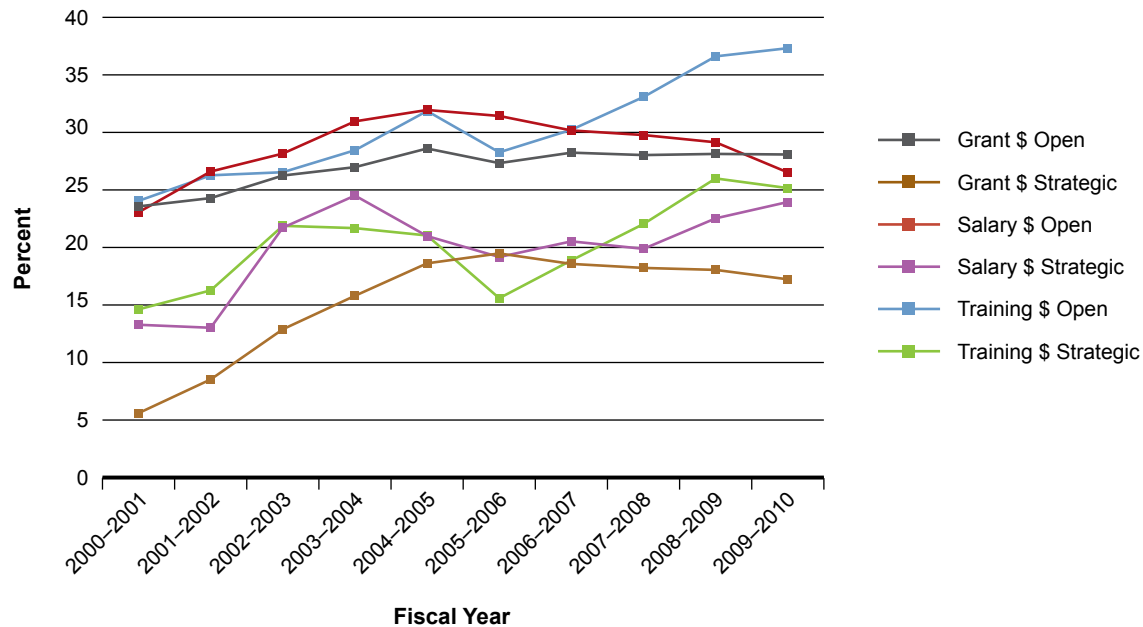
As such, INMHA's mission is to foster excellence in innovative, ethically responsible research in Canada that aims to increase our knowledge of the functioning and disorders of the brain and the mind, the spinal cord, the sensory and motor systems, as well as mental health, mental illness and all forms of addiction. INMHA supports initiatives that mobilize and link scientists in innovative, collaborative programs across these research domains. The Institute facilitates the translation of this new knowledge into a better quality of life for all Canadians by supporting interdisciplinary teams committed to linking new discoveries in basic and clinical neuroscience to improved outcomes, health promotion and health care services.¹

Context

In developed countries, brain-related illnesses constitute a high burden of illness, ranking second for mortality and first for disability.² This is reflected in total funding for grants related to INMHA's mandate, which account for 28.1% of the CIHR envelope for open programs (\$131.5 million for 1,185 grants) and 17.2% of strategic programs in 2009–2010 (\$41.2 million for 488 grants) (Figure 1). Because these numbers are based on an assessment of relevance to the INMHA mandate, a grant can be assigned to more than one institute.

The strength and maturity of INMHA’s community is evident in the Open Operating Grant Program, where researchers have indicated INMHA as their primary institute for 16.2% of grant applications, and where 17.7% of the funded applications have INMHA identified as their primary institute (for the 10 competitions between Spring 2005 and Fall 2009). It is important to note that these data are based on researcher self-selection and have not been validated by CIHR.

Figure 1: Percentage of total CIHR expenditures related to INMHA mandate areas over the past decade



Note: The above graph presents the percentage of total CIHR expenditures related to INMHA’s mandate in the validated keyword search dataset. A single grant, salary or award may be assigned to more than one institute.

As a point of comparison, INMHA’s mandate encompasses six of the National Institutes of Health in the USA: the National Eye Institute, the National Institute on Alcohol Abuse and Alcoholism, the National Institute on Deafness and Other Communication Disorders, the National Institute on Drug Abuse, the National Institute of Mental Health and the National Institute of Neurological Disorders and Stroke.

Dr. Rémi Quirion served as inaugural Scientific Director of INMHA from 2001–2009 and was the architect of INMHA’s strategic program. Dr. Anthony Phillips, former chair of INMHA’s Institute Advisory Board (IAB), succeeded him as Scientific Director in 2009.³

Response to the 2006 International Review

In the five years since the first International Review in 2006, INMHA has built upon existing strengths as well as improving its range of activities, in line with the following recommendations of the international report.⁴

Increase funding to meet needs of a large, diverse and productive research community

The annual budget of INMHA reached \$7 million in 2005 and has increased by 21.4% to its current \$8.5 million in 2010. As we will show throughout this report, INMHA has leveraged significantly its modest funding through a variety of national and international partnerships to maximize the number and range of strategic initiatives available to its broad research community.

Improve alignment and integration with partnerships (government, industry and end-user groups)

The success of INMHA has relied greatly upon the development of meaningful partnerships within CIHR and with other government departments. Three particularly fruitful partnerships have involved relationships between the Regenerative Medicine and Nanomedicine Initiative (RMNI) with the Natural Sciences and Engineering Research Council of Canada,⁵ team and catalyst grants in collaboration with the National Anti-Drug Strategy with Health Canada,⁶ and the National Population Health Study on Neurological Conditions with the Public Health Agency of Canada, which received a targeted \$15 million award from the federal government in support of its objectives.⁷

INMHA also played a constructive role in the establishment of the Mental Health Commission of Canada⁸ (MHCC), with the scientific director and members of the IAB as active members of its key committees. The MHCC's most recent success came in the form of a \$110 million grant to study mental health and homelessness.

Outreach and interaction with international community

In a theme that will be developed further, INMHA has played a major role in fostering strong international partnerships between CIHR and its counterparts in the USA, Finland, Germany, China and Japan.

Expansion and integration between CIHR themes

Individual researchers and teams under the INMHA mandate have been supported by grants, awards and training programs through the Institute's strategic grant budget and other CIHR programs. This has led directly to the creation of large multidisciplinary research networks, such as NeuroDevNet, funded by the Networks of Centres of Excellence. The support of basic biomedical research, initially by the Medical Research Council of Canada and later by CIHR, has also led to the emergence of biotech companies, as exemplified by NeuroMed Pharmaceuticals, now CombinatoRx.

INMHA's guiding principle has been to foster innovation through interdisciplinary research, promoting the integration of the four themes of CIHR, ethics and the areas of INMHA's mandate. At the same time, INMHA has maintained existing strengths in basic and clinical neurosciences while developing a strong commitment to translational research.

Institute Priorities

INMHA's activities over the last 10 years have been closely aligned with the priorities described in the two strategic plans of the Institute, published in 2001 and 2006.

INMHA's first strategic plan (2001–2005)⁹ was formulated during its inaugural year as the product of consultations with scientists at more than 30 universities and research centres across the country. Consultations were also conducted with non-governmental organizations (NGOs) and funding bodies across Canada and abroad. The final set of strategic directions was determined by INMHA's Institute Advisory Board (IAB).

The second and current strategic plan (2007–2011)¹⁰ incorporated the recommendations of the first International Review Panel,⁴ information provided by the stakeholder survey from the first International Review and perspectives gathered at numerous meetings with researchers, NGOs, leaders of industry and decision makers at all levels. This plan also included input from stakeholders in response to two national reports: *Out of the Shadows at Last: Transforming Mental Health, Mental Illness and Addiction Services in Canada* (report from the Standing Senate Committee on Social Affairs, Science and Technology),¹¹ and the *Unique Challenges in Sensory and Communication Disorders* (an INMHA special survey for stakeholder input).¹²

The consultations revealed a clear message: less than four years was too short a time in which the first series of strategic initiatives could achieve the desired impact on the health of Canadians. Accordingly, INMHA retained the four major strategic priorities from its first strategic plan and re-emphasized the importance of strategic training and partnerships. Specifically, INMHA has focused on the following objectives:

1. To foster and develop excellence in trans-disciplinary research in neurosciences, sensory systems, mental health and addiction. INMHA remains committed to encouraging and supporting exciting and novel research areas as they emerge from the highlighted four major strategic initiatives:
 - Regenerative medicine – brain and spinal cord repair, vision and hearing loss
 - First episode events in neurological and mental illnesses and in addiction
 - Co-occurrence of brain disorders with other health problems
 - Substance abuse, with a focus on nicotine addiction and tobacco abuse

2. To promote effective knowledge translation of innovative research findings and improve best practices
3. To promote INMHA's presence internationally and increase the impact of Canadian scientists on the international stage

Key Initiatives

An exhaustive list of INMHA's many initiatives is not provided here; instead, we have highlighted specific initiatives aligned with our three Institute priorities as listed in the previous section. These initiatives have helped transform our strategic plan into vibrant and innovative research programs. Information on the outputs and outcomes of these initiatives is listed in the following section.

As already noted, INMHA developed its funding initiatives in a consultative process that started with our Institute Advisory Board (IAB) developing a framework and that continued through a workshop with stakeholders. Researchers, funding partners and decision makers from government were invited to share their views on strengths and gaps in Canadian research in INMHA's mandate areas and to identify, explore and set research priorities. INMHA staff then developed the text of the funding opportunity through further consultation with partners and IAB members.

Initiative 1: Foster and develop excellence in trans-disciplinary research

Regenerative Medicine and Nanomedicine Initiative

Funded and co-led initially by INMHA and the Institute of Genetics, the Regenerative Medicine and Nanomedicine Initiative (RMNI) is a highly successful cross-CIHR funding program created in 2003. The program supports the development of new and emerging areas of integrative research in regenerative medicine and nanomedicine that span the mandate of CIHR including related social, ethical, environmental, economic and legal issues.⁵ The focus of RMNI strategic programs is on addressing the larger scientific questions or finding solutions for major health research challenges, rather than focusing on specific tools or technologies. The RMNI program is particularly responsive to the demands of various research communities to support interdisciplinary approaches for integrating new technologies and, as a result, improve health benefits (this is further illustrated in this report's Outputs and Outcomes section). Funds from CIHR and its partners total \$84 million. Through its leadership of this program, INMHA has been extremely successful in leveraging its resources for the benefit of researchers within its mandate areas.

Early Life Events and First Episode of Brain Disorders Initiative

An emerging consensus in the area of mental health suggests that many conditions have their roots in early brain development and may be most amenable to treatment at initial presentation. The Institute, along with the Institutes of Human Development, Child and Youth Health and Aboriginal Peoples' Health launched the Early Life Events and First Episode of Brain Disorders Initiative for a better understanding of the etiology of brain disorders and the development of more appropriate diagnoses, individualized therapies, improved quality of care, better health services and population health strategies.^{13,14} Research projects from this initiative have been seminal in the creation of NeuroDevNet, a recently established Network of Centres of Excellence (further discussed in following sections).

Co-morbidity of Brain Disorders and Other Health Problems

Traditional approaches focusing on a single health issue overlook the growing body of evidence showing that many brain-related disorders including mental illness, addiction, neurological conditions and nerve and sensory disorders commonly occur with other medical or psychiatric conditions. Co-occurring disorders have an impact on symptoms and treatment response, leading to a more difficult course of illness over time, with more impairment and greater social disability. INMHA and its partners launched Co-morbidity of Brain Disorders and Other Health Problems to foster multidisciplinary collaborations among researchers, organizations and consumers. The involvement of non-research organizations in this program is essential for improving the lives of those affected by co-morbidities that include mental illness and addiction.^{15,16}

Substance abuse

The study of alcohol and illicit drug use, abuse, and addictions, and cross-addictions with tobacco and gambling addiction requires independent and integrated research attention in Canada. INMHA has led many funding collaborations on this topic, among them a multi-partnered initiative, the Canadian Tobacco Control Research Initiative,¹⁷ from 2002 to 2009.

In response to the 2003 Forum on Alcohol and Illicit Drugs Research in Canada,¹⁸ INMHA launched another multi-partnered initiative: Research in Addictions: Innovative Approaches in Health Research.¹⁹ This initiative was designed to challenge researchers working across the full spectrum of health research to undertake work that would contribute to our understanding of alcohol and illicit drug use, abuse and addiction, and cross-addictions with gambling and tobacco use. Research funded through this initiative has informed the intervention strategies of addiction professionals and policy makers, as the next section shows.

Pain research

Although INMHA had not targeted pain research as a strategic priority, funding for this strong area of our mandate threads through a number of initiatives of the Institute, with a particular focus in salary and training. We have thus chosen to highlight this area of research in our report.

Initiative 2: Promote effective knowledge translation of innovative research findings and improve best practices

INMHA has contributed to this mandate through funding opportunities that involve the participation of workplaces, governments and NGOs. The Institute has also provided funding for knowledge translation activities in its Meetings, Planning and Dissemination Grant Program, as well as funding NGOs to develop public awareness for conditions under INMHA's mandate.

Mental health in the workplace

In developed countries, economies are increasingly knowledge-based, making a workforce with good mental health an economy's most valuable resource. Untreated mental health and addictive disorders result in lost productivity. In response to an appeal from leaders within the business community, INMHA in partnership with the Institutes of Population and Public Health and Gender and Health developed the Mental Health in the Workplace: Delivering Evidence for Action initiative. The community responded by developing action-oriented research projects that included research teams made up of workplace stakeholders from all disciplines relevant to the research.²⁰

Knowledge translation in mental health and addiction

The Interim Report of the Standing Senate Committee on Social Affairs, Science and Technology²¹ identified a pressing need for better translation of knowledge in mental health and addiction to the health care and support community. In response, INMHA launched the funding opportunity Meeting the National Challenge: Putting Mental Health and Addiction Knowledge into Practice to assess current knowledge foundations in mental health and addiction. Steps were taken to identify knowledge gaps and priorities. This initiative funds intervention research to improve the transfer and uptake of knowledge among a broad range of stakeholders.²²

Neuroethics

Consistent with developing trends in brain science, INMHA has championed the integration and identification of ethical issues relating to brain sciences and brain disorders. Building on previous funding of two large-scale networks in the area of neuroethics, INMHA also funded the INMHA Chair in Neuroethics, further establishing Canada as an international leader in this field.²³

Initiative 3: Promote INMHA's presence and increase the impact of Canadian scientists on the international stage

In keeping with a growing realization that international collaboration is a key element for success in all sectors of science, INMHA has forged many successful international partnerships. Although INMHA's financial support for Canadian researchers on international collaborative teams is relatively modest, the investment has significantly leveraged international research funds. These international initiatives (with selected examples presented below) have given Canadian health researchers increased visibility on large-scale international activities and allowed the scientists to participate in many international funding initiatives, peer reviews and steering committees.

Canada–United States collaborations

As the United States is our closest neighbour and largest trading partner, partnerships, especially with the National Institutes of Health (NIH), were given highest priority. INMHA participated in several cross-cutting programs such as the Shared Neurobiology of Fragile X Syndrome and Autism, a public-private partnership that included three NIH institutes and NGOs.²⁴ INMHA also partnered with the National Science Foundation and NIH on the Collaborative Research in Computational Neurosciences initiative. This program supported innovative, interdisciplinary and collaborative research aimed at understanding nervous system function, the mechanisms underlying nervous system disorders and computational strategies used by the nervous system.²⁵

Canada–China collaboration

A bilateral program with Japan formed a template for the China-Canada Joint Health Research Initiative (CCJHRI) with China's National Natural Sciences Foundation. INMHA has been the strategic lead on the CCJHRI since its inception and has worked closely with other CIHR Institutes to develop the program and deliver annual bi-lateral meetings and scientific workshops.²⁶

Canada–Europe collaborations

In parallel with developing partnerships and innovative research programs in the USA and Asia, INMHA has also been active in Europe. The Academy of Finland supports research on substance use, abuse and addictions, making it a natural partner for INMHA on many initiatives. Consonant with a focus on the field of neuroethics in Canada, INMHA played a leading role in developing the Finland–Germany–Canada Joint Initiative in Neuroethics,²⁷ which built upon existing partnerships and shared priorities of the partners.

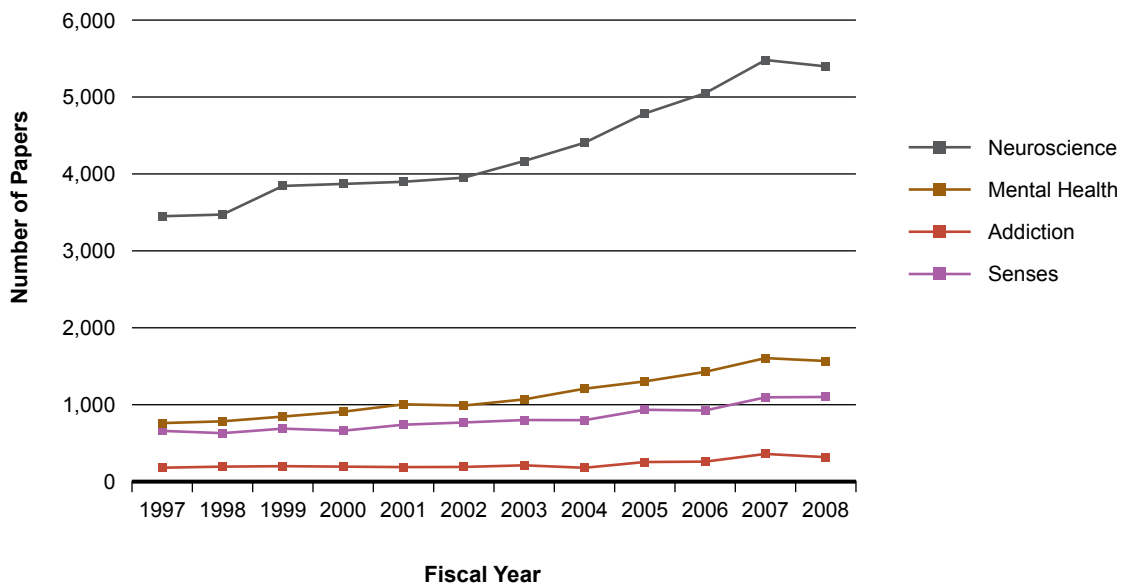
Outputs and Outcomes

Advancing knowledge

Funding for grants in all INMHA mandate areas follows closely the increase in CIHR’s overall budget. While significant Canadian charity-based funding is available to researchers in some large CIHR Institutes, such opportunities are more limited in areas of brain health. However, government agencies and small charity-based organizations do provide targeted funding in certain areas.

The capacity and strength of the Canadian neuroscience research community is reflected in publication statistics. Bibliometric analysis for years 2003–2008 shows Canada ranks fifth among the 20 most productive countries for publication output and fourth for the average relative citations (ARC) in the area of neurosciences.²⁸ The number of publications increased at an accelerating rate after 2002 in the area of neurosciences, with the number of publications increasing by 14% between 1997 and 2002 and then by 30% between 2003 and 2008; and mental health, with the number of publications increasing by 26% between 1997 and 2002 and then by 47% between 2003 and 2008. This trend is also seen for the areas of addiction and senses, but to a lesser extent (Figure 2). The trend in publication corresponds to the increase of CIHR’s overall budget, including dedicated funding to INMHA after a period of budget stagnation for the Medical Research Council at the end of the 1990s.

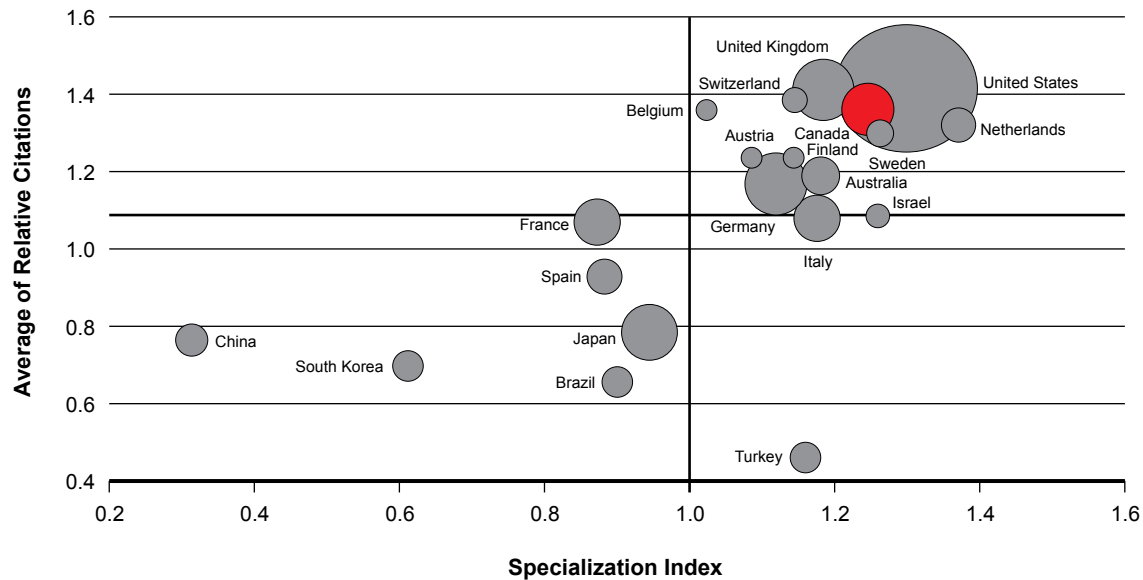
Figure 2: Number of Canadian papers in INMHA mandate domains, 1997–2008



Note: The drop in the number of publications seen in the last year reflects an incomplete dataset at the time of analysis and should not be interpreted as a decrease in publication number.

Figure 3 shows Canada to be highly competitive with the United States and the United Kingdom for publication impact (represented by ARC) and specialization indices. The literature in the area was identified through a combined set of journal titles and Medical Subject Headings (MeSH) searches. The top 20 countries were ranked based on number of publications for the entire time period. ARC data are incomplete for 2008 and thus may underestimate the actual value.

Figure 3: Scatterplots of the average of relative citations and specialization index of the top 20 most productive countries in the domain of neuroscience, 2003–2008



Source: Observatoire des Sciences et des Technologies, CBD (current as of July 2009), Web of Science and Medline databases

Examples of large-scale funding initiatives in which INMHA played a leadership or supportive role are provided below. These examples are meant to illustrate the sorts of outcomes INMHA has achieved through targeted strategic activities (e.g., regenerative medicine and nanomedicine) and open funding programs (e.g., NeuroDevNet).

Regenerative Medicine and Nanomedicine Initiative

Regenerative Medicine and Nanomedicine Initiative (RMNI) research funding focuses on multidisciplinary team-based approaches and innovative high-risk/high-reward projects that have the potential to make a significant health impact. As of December 2010, RMNI has secured \$82.3 million in funding from CIHR, its institutes and external partners for grants and awards.

Due to extensive partnering in RMNI, individual partners including INMHA are able to leverage their funds significantly toward directly relevant research projects. INMHA has committed 11.2% of total funds to RMNI, whereas 46.8% of funding for all grants funded is deemed relevant to INMHA. This represents more than a 3:1 leverage ratio for the funding of multidisciplinary research related to the mandate of INMHA.

A list of projects can be found on the RMNI website;⁵ among them three team grants related to vision research. Of particular note is the project led by ophthalmologist Dr. Isabelle Brunette at the Maisonneuve-Rosemont Hospital of the Université de Montréal. The project is part of a multidisciplinary program that includes physicists at the Institut national de la recherche scientifique and tissue engineers at the Laboratoire d'organogenèse expérimentale.

Corneal transplantation – Improving health care through multidisciplinary work

Leveraging their RMNI Team grant with a prestigious Canada Foundation for Innovation (CFI) International Opportunities award, Dr. Brunette's team has adapted a powerful femtosecond laser system directly into a biomedical environment for corneal transplantation. Using this laser, the team can now selectively remove the donor corneal layers needed to replace the diseased layers of a patient's cornea with a high precision match.

Using tissue engineering technology, the team has succeeded in reconstructing new corneas from a patient's own endothelial cells and transplanting them back into a living eye. The team is currently in discussion with Health Canada on the approval process for a novel tissue-engineered corneal substitute that they are developing. An innovative feature is that the team incorporates social science researchers to measure the socioeconomic benefits of this new procedure on the Canadian health care system.

The tissue engineering and FSL (femtosecond laser)-assisted approaches are expected to improve significantly the outcome of corneal transplantation for endothelial dysfunction, a painful and blinding condition responsible for 42% of the 57,736 corneal grafts performed each year in Canada and the U.S. The approaches also hold the promise of decreasing waiting times for corneal transplantation.

Another example of outstanding research funded by RMNI is a project led by Dr. Serge Rossignol. His team of researchers from the basic and clinical sciences at the Université de Montréal, McGill University and Université Laval are investigating whether sensory enhancements such as muscle reinforcement, tactile stimulation or visual virtual reality motivate people to work harder on treadmills.

Spinal cord injury – Relearning to walk

Training on a treadmill can help people with spinal lesions regain some of their ability to walk but little is known about the underlying mechanisms at play. The spinal cord has circuits that can generate basic functions such as locomotion even after an accident or degenerative disease creates a lesion. Key to unlocking these mechanisms – and adapting them to clinical benefit – it is a multidisciplinary approach that unites clinical and rehabilitation specialists with the latest biomedical research.

Dr. Rossignol and his team aim to provide evidence that will help develop guidelines on how to provide training that achieves the best results. The team is also using electrophysiology and magnetic resonance imaging (MRI) to measure changes in the nervous system before and after training to better understand the mechanisms involved in the regeneration of locomotion.

The implications are far-reaching. “We’re not talking about miracles here,” says Dr. Rossignol. “But if you can improve someone’s ability to walk from 0.2 metres per second to 0.5, it can mean the difference between being able to cross a street or not.”

NeuroDevNet

INMHA's commitment to fund multidisciplinary research and innovative research in several areas including Fetal Alcohol Spectrum Disorders (FASD) and Neuroethics laid the foundation for the NeuroDevNet, a Network of Centres of Excellence (NCE) hosted by the University of British Columbia. Led by Dr. Dan Goldowitz, a recruit to Canada through the Canada Research Chairs (CRC) program, NeuroDevNet combines basic research in brain development with clinical research from in utero development to early childhood.²⁹ This NCE includes research on cerebral palsy, autism and fetal alcohol spectrum disorder with Neuroethics, knowledge translation and bioinformatics (including imaging) cores.

Research into fetal alcohol spectrum disorders

Dr. James Reynolds, a researcher in prenatal alcohol exposure and Dr. Doug Munoz, an expert studying the saccadic eye movement system initiated a new project in 2004 to investigate the use of eye movement behaviours as a novel, objective tool for assessing brain function in children with FASD. This led to the formation of a multidisciplinary team assembled and funded through the Life Events and First Episodes of Brain Disorders Initiative. The team's goal is to combine basic biomedical and clinical studies to better understand the underlying mechanisms of alcohol-induced developmental brain injury and the functional deficits that occur in children with FASD.

NeuroDevNet subsequently engaged multiple investigators and built on the success of this INMHA Team grant. Dr. Reynolds has been appointed project leader for the FASD component of the NCE and several new projects and collaborations have emerged from the studies funded by the initial grant.

Neuroethics

For neuroscience research to be applied for maximum health benefit it is critical to understand the interaction of research with ethics and society. However, neither what constitutes ethical values nor how to implement them in neuroscience is as obvious as it may seem. Acknowledging the complexity of the issues, INMHA has invested more than \$3.2 million in Neuroethics, a new discipline fully dedicated to bridging biomedical ethics and the basic and clinical neurosciences. These funds supported the establishment of large networks and of the National Core for Neuroethics, a national research resource at the University of British Columbia.

The new NeuroDevNet NeuroethicsCore is co-led by Dr. Judy Illes, INMHA Chair in Neuroethics and Dr. Eric Racine.

Capacity building

Both large-scale programs described above exhibit a strong emphasis on the multidisciplinary training of the next generation of research scientists. In addition, INMHA continues to invest heavily in dedicated training through CIHR's Strategic Training Initiative in Health Research program. This program was created to increase Canada's international competitiveness by recruiting and training new, bright and creative research talent.³⁰ Since 2002, 18 training programs have been or continue to be supported by INMHA with topics across the range of our mandate and the four CIHR themes. Of note, three training grants include a significant component of pain research. This builds on a strong expertise in this area of research in Canada.

New frontiers in neuroscience with material sciences and photonics

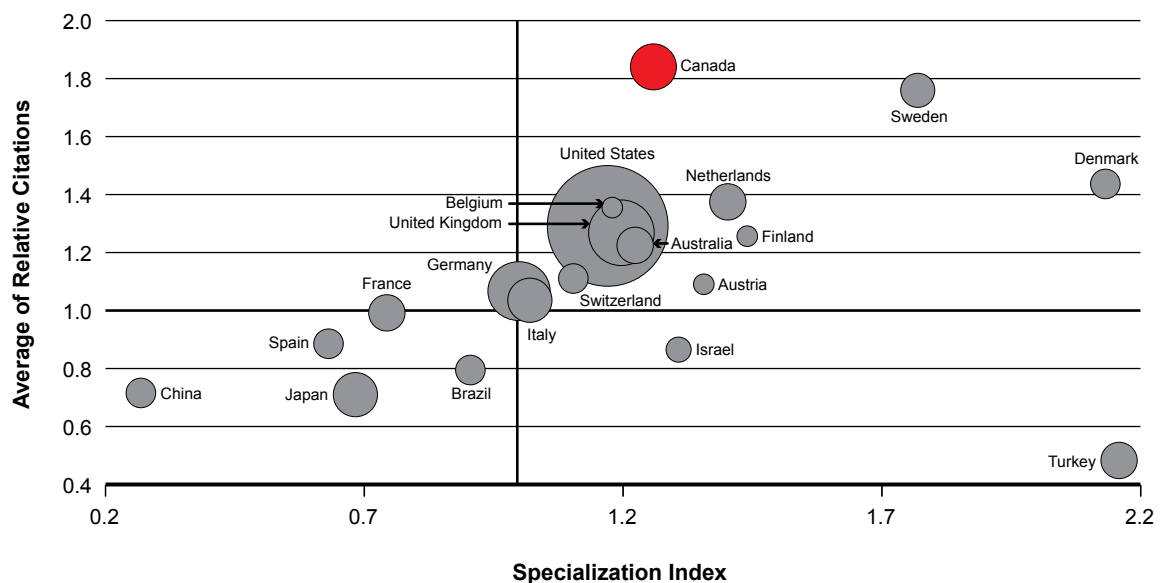
This training program, located at the Université Laval in Québec City, is situated at the interface between neurosciences, photonics, nanotechnology and computational sciences. It is intended to create a generation of health scientists with a truly trans-disciplinary attitude and an ability to apply and develop novel approaches derived from the fields of physics, chemistry and computational sciences for the study of neural mechanisms. Disorders examined include epilepsy, Parkinson's and Huntington's diseases, Alzheimer's disease, schizophrenia, depression and anxiety disorders, multiple sclerosis, neuropathies and chronic pain. A relatively modest investment of roughly \$3 million by INMHA catalyzed subsequent funding from a variety of sources, including the CFI, in excess of \$35 million.

Strategic support by INMHA for building capacity in the area of pain has been strong in keeping with a commitment to foster research excellence. Collaboration with the EJLB (Edith Jacobson Low-Beer) Foundation and the Royal Society of Canada established the EJLB-CIHR Michael Smith Chair in Neurosciences and Mental Health, with two chairs already awarded.³¹ This program initially supported the recruitment of Dr. Min Zhou, an expert on synaptic plasticity and pain perception, from Washington University to the University of Toronto. The incumbent is Dr. Georg Northoff at the University of Ottawa Institute of Mental Health Research. Dr. Northoff is an expert on diagnostic and therapeutic tools that will help better assess neuroscience-related illnesses.

Similarly, a partnership with the Institute of Musculoskeletal Health and Arthritis, the Canadian Pain Society and AstraZeneca Canada led to the Biology of Pain Young Investigator program to support clinically relevant research that enhances the understanding of pain pathophysiology and underlying mechanisms.³²

A recent INMHA bibliometric analysis showed that pain research in Canada was an established field in 1997–2002 with Canadian researchers leading the world for average of relative citations (ARC).²⁸ Canada has further enhanced its relative scientific impact (Figure 4) in the second period of our bibliometric analysis (2003–2008) and again leads the world for ARC. Taking into account the delay in publications resulting from grant funding, the first period (1997–2002) would correspond to publications related to pre-CIHR funding, whereas the second period (2003–2008) would mostly correspond to publications related to CIHR funding.

Figure 4: Scatterplots of the average of relative citations and specialization index of the top 20 most productive countries in the domain of pain for 2003–2008



Source: Observatoire des Sciences et des Technologies, CBD (current as of July 2009), Web of Science and Medline databases

Informing decision making

Mental health in the workplace

In Canada’s knowledge-based economy, a mentally healthy workforce is a key factor in innovation and productivity. However, recent statistics show serious problems in workforce mental health that need to be addressed. Mental illness accounts for about 30% of short- and long-term disability claims and about 70% of the total cost in Canada.³³ In 2004, INMHA, the Institute of Population and Public Health and the Institute of Gender and Health undertook an initiative to build capacity and fund research on workplace mental health. To date, CIHR has overseen four national symposia. These symposia have brought together business leaders, not-for-profit organizations and researchers to identify mental health research topics reflecting business and research perspectives. In addition, publicity in the area of workplace mental health has been enhanced.

CIHR has launched two calls for research proposals for teams of researchers working with business organizations to test workplace interventions with the goal of improving workforce mental health. The private sector was involved in all aspects of this initiative. The resulting culture of joint research collaboration will increase the business sector's knowledge and commitment to research in this area and will ensure that research results are translated into practice.

Manufacturing poor mental health?

A major CIHR initiative to investigate the impact of the workplace on mental health found that workers employed in manufacturing were most likely to report psychological problems. CIHR-funded scientist, Dr. Alain Marchand, of the Université de Montréal, used Statistics Canada survey data representing more than 77,000 workers in 139 occupations and 95 industries. Among those more likely to report mental health challenges were machine operators in the fabric, fur and leather products industries, labourers, food, beverage and tobacco wholesale distributors, electrical equipment and component manufacturers and auto mechanics.

Mental Health Commission of Canada

In 2006, the Senate Committee on Social Affairs, Science and Technology released the report *Out of the Shadows at Last: Transforming Mental Health, Mental Illness and Addiction Services in Canada*.¹¹ This widely-hailed document led to the creation of the Mental Health Commission of Canada (MHCC) in 2007. The MHCC comprises eight action groups.⁸ Dr. Anthony Phillips, INMHA's Scientific Director, Dr. Rémi Quirion, INMHA's former Scientific Director, and Dr. Benedikt Fischer, member of the Institute's Advisory Board, sit on the scientific committee of the MHCC.

Research on addiction

INMHA has been a major contributor to the evaluation of the first medically supervised injection site in North America, Insite, which has operated in Vancouver's Downtown Eastside since September 2003. The research team, led by Dr. Thomas Kerr from the University of British Columbia, has conducted research according to internationally recognized standards of ethics and methodology. This evaluation research has resulted in the publication of more than 30 articles in international peer-reviewed scientific and medical journals, with a high publication and recognition impact.³⁴

Insite evaluation

The findings of an evaluation of the safe injection site were published in a public report in 2009. The report's conclusions, individually published in scientific journals, were that the operation of Insite:

- *reduced the kinds of drug-using behaviours that increase the risk of HIV transmission and overdose death*
- *led to increased use of addiction treatment services among the people who inject at Insite*
- *reduced the amount of public injecting*
- *did not lead to an increase in injection drug use*
- *did not lead to an increase in drug-related crime*

Knowledge translation

INMHA has engaged with a large number of partners in expanding and promoting areas of common interest. Examples are included below.

The Barbara Turnbull Award for Spinal Cord Research

Established in 2001 and continuing to this day, this annual prize recognizes and supports the top-ranked spinal cord researcher identified through CIHR's Open Operating Grant Program. Named in honour of Ms. Barbara Turnbull, a well-known Toronto journalist who became quadriplegic at the age of 18, the award helps to increase public awareness of neurological conditions. The award is a partnership between the Barbara Turnbull Foundation, The Neuroscience Canada Foundation and INMHA.³⁵

Research community activities

INMHA has engaged directly with researchers by sponsoring and organizing many workshops, activities held in conjunction with IAB meetings and by its presence at major scientific meetings. INMHA, in partnership with the Institute of Human Development, Child and Youth Health has been an exhibitor and a sponsor of Canadian social activities at the annual Society for Neuroscience meeting since 2003.

INMHA played an active role in re-invigorating the Canadian Association for Neuroscience (CAN), first by sponsoring its membership in the International Brain Research Organization (IBRO) and subsequently, by providing strong support for re-establishing the CAN annual meeting. Now entering its fourth year, the CAN meeting attracts more than 1,000 participants. The Institute is also a major exhibitor at these meetings.

As part of its commitment to sharing Canadian expertise in the neurosciences, INMHA has co-funded several IBRO International Neuroscience Schools in South Africa, Argentina, Chile, Mexico, Morocco and the Democratic Republic of Congo. Since 2007, INMHA has co-sponsored IBRO schools in Canada in conjunction with the annual meetings of CAN.³⁶

Partnerships

The NGO Outreach Initiative is launched annually by INMHA in collaboration with other institutes and aims to develop communications-related partnerships with Canadian non-governmental, non-profit and community-based organizations. It offers awards of up to \$10,000 for innovative promotional ideas that help bridge the communications gap between science and the general public.³⁷

Café Scientifiques

From October 2006 to the end of June 2010, CIHR has hosted 247 Café Scientifiques. These extremely well-attended events bring together researchers and members of the public to discuss a given health topic in a pub, café or restaurant. These public outreach events demonstrate CIHR's efforts to implement knowledge translation. The Institute has organized a number of recent Café Scientifiques, such as *Drugs: the good, the bad and the useful*, hosted by McGill University in February 2008, and *I'm Just a Bit Stressed, That's All... : Drawing the Link between Stress and Mental Illness*, presented in March 2010 in partnership with the Mental Health Commission of Canada in Calgary, Alberta.

Economic impact

Part of the impact of INMHA and CIHR's funding efforts is evident in the organizations' support of trainees, who help ensure Canada's standing as a knowledge-based economy. Funding for trainees under INMHA's mandate accounts for 37% of funding available for capacity building through open competitions (\$19.9 million for 760 awards) and accounted for 25% of strategic competitions in 2009–2010 (\$4.4 million for 171 awards) (Figure 1).

With respect to the translation of basic and clinical research into products or improved services, one consequence of INMHA's focus on promoting emerging multidisciplinary research is that many key findings have yet to reach their full economic impact. The most significant outcomes are expected to be in the prevention, early intervention and early treatment of conditions and diseases. INMHA will ensure a systematic assessment of these impacts through a more integrated evaluation process for its funding initiatives.

In spite of the relatively short timeline, the research community supported by INMHA has been very active in utilizing research findings to develop products that improve health and health services.

Neural stem cells

Dr. Sam Weiss, Director of the Hotchkiss Brain Institute at the University of Calgary, is an international leader in the field of neural stem cells. With funding from CIHR and other sources, his laboratory was the first to discover central nervous system (CNS) stem cells within the adult brain. Remarkably, these stem cells (referred to as neurospheres) can be induced to divide and produce the three major cell types of the CNS. While investigating the mechanisms by which this occurs, Dr. Weiss's group made a significant translational discovery: two currently approved and clinically well-defined drugs can be used to direct the production of new neurons following traumatic brain injury or stroke.

The intellectual property from this discovery formed the basis of Stem Cell Therapeutics (SCT), a publicly traded biotechnology company focused on the commercialization of drug-based approaches to treat CNS diseases. Encouraging clinical results from SCT's Phase 2A safety trial in stroke showed clinically relevant recovery in 12 out of 12 patients who received the treatment. A larger Phase 2B trial is currently underway.

For his seminal discovery of adult neural stem cells and their importance in nerve cell regeneration, Dr. Weiss received the 2008 Canada Gairdner International Award.

Transformative effects of the Institute

This section outlines a number of areas in which the Institute has had a transformative effect – of note, the role of INMHA in developing research in neuroethics and in co-leading RMNI. INMHA has also played a leading role in promoting international partnerships, including a strong partnership with China.

International partnerships

In 2005, CIHR and the National Natural Science Foundation of China (NSFC) launched the China–Canada Joint Health Research Initiative (CCJHRI), initially supported by six CIHR Institutes and currently by 10 of CIHR's 13 institutes. Since CCJHRI's inception, INMHA has functioned as the strategic lead and has worked closely with other CIHR institutes to develop the program and deliver annual bilateral meetings and scientific workshops. To date the initiative has funded 89 teams within a joint China–Canada funding envelope of approximately \$20 million, with comparable support from NSFC. This is a unique and remarkable achievement within CIHR.

A formal evaluation of the first set of funded teams, conducted by INMHA, demonstrated that the program is well respected within the research community and has had the greatest impact on capacity building, particularly in the attainment of higher research degrees and intellectual capacity development.³⁸ The CCJHRI has also allowed researchers to leverage CCJHRI funds in order to secure other research funding.

As publicly stated in the 2009 bilateral conference in Beijing, the CCJHRI is considered a flagship international program by the presidents of both CIHR and NSFC. A new five-year agreement signed in September 2010 incorporates an expanded funding program for joint health research teams with a \$10 million budget from CIHR and a new \$4 million large joint strategic initiative focused on Alzheimer's disease. Comparable funding is made available to Chinese participants from NSFC.

INMHA has consistently achieved the integration of research themes and established strong partnerships at the national and international levels. It is now positioned to support the translation of research findings under its mandate.

Going Forward

As this report illustrates, INMHA has closely followed the blueprint laid out in its first and second strategic plans. It has identified and supported areas of Canadian research strength and areas where further support and development are needed. Through strategic partnerships with other CIHR institutes and key national and international organizations, INMHA has leveraged its resources for greater effectiveness.

With INMHA's second strategic plan ending in 2011, the Institute is well positioned to integrate the recommendations of the current International Review into its third strategic plan. The strategic planning process will continue to involve consultation with the research community and with decision makers in the area of health and NGOs. While INMHA has kept a consistent vision for the first 10 years, now is the time to reflect on past activities and successes and, more importantly, to identify exciting new opportunities. The goal of this process is to ensure further innovation in the basic and clinical neurosciences and the translation of this knowledge for the improved health of Canadians.

INMHA will also focus on emerging health issues, particularly in the areas of mental health and addiction, and will seek to integrate key developments with the Strategy for Patient-oriented Research (SPOR) to ensure alignment with the CIHR Roadmap. Throughout this exercise, INMHA will strive to remain a leader in integrated, multidisciplinary research and to maintain a strong presence in the international area.

Lessons learned

In preparing this report, INMHA has critically examined its slate of initiatives and the decision-making processes behind them. As a fledgling organization, INMHA initially had little experience with the concept of strategic funding. But throughout the first decade of its existence, it nevertheless played a major role in realizing the unique vision of the CIHR model of virtual institutes. It sought to identify and champion large-scale, cross-cutting opportunities such as the RMNI program. A strong network of partnerships has been developed at all levels, which created new linkages between organizations, research fields and individual researchers.

INMHA is gratified by its support for emerging fields of research such as Neuroethics as well as existing strong fields of research in areas ranging from pain to movement disorders and dementia. The Institute's support has ensured that Canadian researchers could initiate studies in the respective fields of brain research, mental illness and addiction and thereby achieve and sustain an international reputation of excellence. As already discussed, many of the key initiatives led by INMHA, such as RMNI and the newly developed international partnerships between China and Canada, are amongst the most successful of the pan-CIHR initiatives.

Of course, certain of INMHA's initiatives were less successful, due in part to INMHA's efforts to meet the high expectations of its vast and varied research community. Certain international ventures were not as fruitful as first envisioned. While the China–Canada collaboration flourished, the Japan–Canada collaboration failed to fulfill its potential; INMHA also learned that promoting the funding of emerging research fields is a painstaking task that requires patience and long-term support, and that some areas are not best served within CIHR's funding structure.

Importantly, INMHA has matured through these experiences and is now striving for a more streamlined approach to strategic planning. Emphasis will be placed on fewer initiatives, but each initiative will be larger in scope and have a wider breadth of activities. The Institute will also ensure that adequate plans are in place for oversight and evaluation of its strategic initiatives. It will re-examine its international activities and their rationale; ideally they will be integrated into our strategic initiatives and not serve as stand-alone activities.

New developments in sciences, research and knowledge

In the 10 years since the transition from the Medical Research Council to CIHR, it has become clear that CIHR-funded research must contribute appropriately to knowledge that will lead to improved health for Canadians. A multi-themed approach, as originally envisaged for CIHR, will continue to serve as a guiding principle as we move towards this goal. In addition, a focus on knowledge translation and the incorporation of ethics in all aspects of research is essential. The general public's increasing access to the Internet behooves us to think carefully about how to explain complex issues to non-researchers. Publications that earlier would have been accessible only to the research community are now easily accessible by the public.

Increased public awareness must be ensured if CIHR is to enjoy greater support from the federal and provincial governments and the general population. In this regard, close collaboration and increased communication with the voluntary health sector are essential if our organization is to reflect the needs and expectations of our communities, thereby ensuring that INMHA in particular, and CIHR in general, are viewed as accountable to Canadians.

Emerging issues

At one time, mental illness was assumed to be in the exclusive domain of psychiatry and psychology. However, as the remarkable discoveries from basic and clinical neuroscience informed our understanding of the critical importance of brain function in key aspects of mental and physical health, it became increasingly apparent that distinctions between psychiatric and neurological conditions had become blurred. Clearly, new concepts were needed that would emphasize the multi-faceted nature of brain-related ill health. Since its inception, INMHA has championed an integrated approach to understanding the nature of brain health.

The growing realization that the genetic code is not immutable and that DNA and chromatin modifications can greatly influence gene expression in a transient or permanent manner – as described by the emerging field of epigenetics – has profound implications for research on addiction and mental health. It has already had implications for cancer research. Environmental experiences, starting in utero and continuing throughout the lifespan, lead to physiological changes that will modify the behaviour of an individual and perhaps even of their descendants. Therefore, INMHA, in collaboration with the Institute of Genetics and the Institute of Cancer Research, is developing a strategic initiative in the broad area of epigenetics and is committed to joining the International Human Epigenetic Consortium to ensure a uniquely Canadian voice in the forum.

Research on addiction has expanded beyond drugs, alcohol and tobacco; some of the same processes that lead to substance abuse may apply to new types of dependencies (e.g. online gambling, social networking, shopping) and may account for aspects of obesity. Clearly, new approaches are needed if we are to deal more effectively with the critically important health issues related to addiction. INMHA is exploring the development of a new clinical intervention network (CIN) modeled on the very successful National Institute on Drug Abuse Clinical Trials Network (CTN) and linked to the SPOR initiative within the CIHR strategic plan. Ideally, formal partnerships between CIN and CTN will foster collaboration between Canadian and US researchers. Collaborations will help ensure optimal development of effective new strategies for understanding and treating a broad range of health issues related to addiction.

Health priorities

INMHA strives to reduce the burden of diseases related to its mandate by supporting multidisciplinary research in prevention and early intervention including barriers to health services. In this regard, INMHA is a key player in a \$15 million initiative co-led by the health portfolio of the federal government (including the Public Health Agency of Canada, Health Canada and CIHR) and the Neurological Health Charities of Canada for the National Populations Health Study on Neurological Conditions. Once completed, this four-year study will provide an extensive analysis of the burden of disease and gaps in research and health services that will help to inform INMHA's future strategic directions.

Alignment with CIHR Roadmap

The Institute's strategic initiatives are already aligned with CIHR's Roadmap in many important respects. In the area of major health challenges, two of CIHR's priorities, "to reduce health inequities of Aboriginal peoples and other vulnerable populations", and "to promote health and reduce the burden of chronic disease and mental illness" have a particular resonance with the mandate of INMHA. We plan to increase our commitment to patient-oriented research and improve the health care system through investments in treatment-oriented research, notably in the area of addictions. Participation in SPOR will be one of the principal avenues by which INMHA ensures ongoing translational activity.

Leadership

INMHA will continue to be a catalyst of change, by promoting the integration of research within its mandate and by forming meaningful international partnerships. Over the past 10 years, INMHA's strategic support has ensured that Canada's leading position in many specific areas, such as pain, dementia research, brain imaging and neurodevelopment have been maintained, while at the same time extending areas of specialization within INMHA's broad mandate. INMHA will continue to foster new approaches to important health questions in these fields. The Institute continues to support the creation of new interdisciplinary fields, such as Neuroethics, where Canada is recognized worldwide for its leadership. INMHA is well-positioned to continue to leverage other leadership opportunities in the areas of its mandate, to link its researchers with other international groups and funding programs, and thereby optimize interdisciplinary approaches to addressing many of the most complex issues in science.

List of Acronyms and Abbreviations

CIHR Institutes	
IAPH	Institute of Aboriginal Peoples' Health
IA	Institute of Aging
ICR	Institute of Cancer Research
ICRH	Institute of Circulatory and Respiratory Health
IGH	Institute of Gender and Health
IG	Institute of Genetics
IHSPR	Institute of Health Services and Policy Research
IHDCYH	Institute of Human Development, Child and Youth Health
III	Institute of Infection and Immunity
IMHA	Institute of Musculoskeletal Health and Arthritis
INMHA	Institute of Neurosciences, Mental Health and Addiction
INMD	Institute of Nutrition, Metabolism and Diabetes
IPPH	Institute of Population and Public Health
INMHA specific	
ARC	average of relative citations
CAN	Canadian Association for Neuroscience
CCJHRI	China–Canada Joint Health Research Initiative
CFI	Canada Foundation for Innovation
CIN	clinical intervention network
CNS	central nervous system
CRC	Canada Research Chair
CTN	Clinical Trials Network
EJLB	Edith Jacobson Low-Beer
FASD	Fetal Alcohol Spectrum Disorders
IAB	Institute Advisory Board
IBRO	International Brain Research Organization
INRS	Institut national de la recherche scientifique
MeSH	U.S. National Library of Medicine Medical Subject Headings
MHCC	Mental Health Commission of Canada
MRI	magnetic resonance imaging
NCE	Networks of Centres of Excellence
NGO	non-governmental organization
NIH	National Institutes of Health
NSFC	National Natural Sciences Foundation of China
RMNI	Regenerative Medicine and Nanomedicine Initiative
SCT	Stem Cell Therapeutics
SPOR	Strategy for Patient-Oriented Research

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