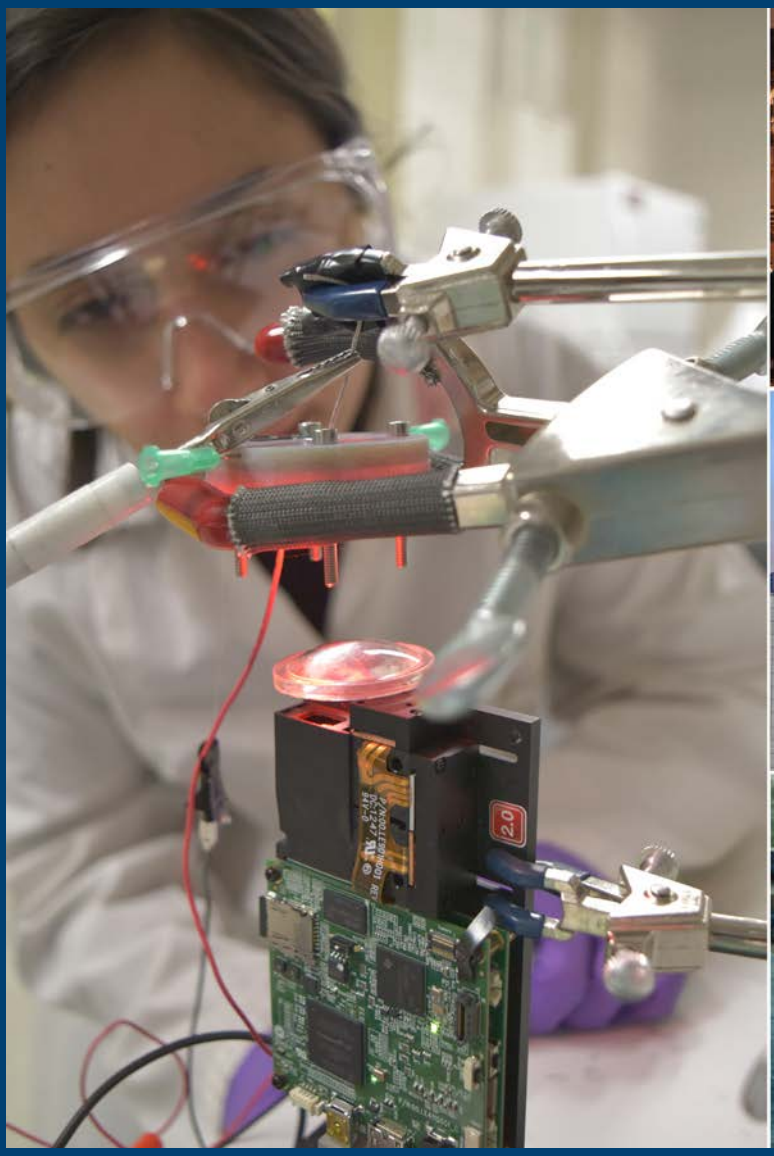
IC-IMPACTS

Networks of Centres of Excellence
Building Healthy Communities in Canada & India



2017–2018 ANNUAL REPORT

From left: Dr. Nemy Banthia, CEO & Scientific Director, IC-IMPACTS; The Honourable Kirsty Duncan, Minister of Science and Sport; Mr. Bill Barrable, CEO, Rick Hansen Institute; Dr. H.S. Chhabra, Chief of Spine Services & Medical Director, Indian Spinal Injuries Centre. Agreement signed in New Delhi, February 2018.

IC-IMPACTS has created a research partnership between Canada and India that has launched 39 projects, generated 17 technology deployments, and trained 792 HQPs, while researchers have produced 808 publications and 27 patents and invention disclosures. With our bilateral partners, IC-IMPACTS has improved the quality of research, found applications for research in a broader global context, and increased the trade pathways for Canadian companies.

—Dr. Nemy Banthia

CEO & Scientific Director, IC-IMPACTS

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YEAR IN REVIEW

MESSAGE FROM THE CHAIR

On behalf of the Board of Directors, I am delighted to report on IC-IMPACTS' achievements in bilateral collaborations between India and Canada in the 2017–18 fiscal year. Since its inception in 2013, IC-IMPACTS has been driven by finding solutions in areas that matter most to people in both nations.

In November 2017, the Government of Canada announced its commitment to extend IC-IMPACTS funding by $8.4 million over the 2018–21 mandate. This was immediately followed by an unprecedented announcement by the Government of India that it would support IC-IMPACTS with one hundred percent matching funds for the same period. Equal support by both governments is a testimony to the successes of IC-IMPACTS' bilateral research, knowledge mobilization, and economic development model.

After the public announcement of the funding extension, IC-IMPACTS reached agreement with key partners in India and Canada to launch major initiatives, including, importantly, the following two:

- IC-IMPACTS, the Department of Biotechnology, and the Department of Science and Technology (Government of India) signed a joint work plan and held a two-day workshop at the Indian Institute of Technology (BHU) in Varanasi to develop the scope of rejuvenating a stretch of the Ganga River in Varanasi, which is part of a $3 billion new investment by the Indian Government. The pilot project will establish cost-effective and space-efficient solutions that can be implemented on a larger scale. This collaboration will demonstrate research solutions to effectively clean water systems such as those in First Nations communities in Canada that experience boil water advisories.

- IC-IMPACTS signed an agreement with the Rick Hansen Institute and the Indian Spinal Injuries Centre to develop and bring to market unique technologies to improve the quality of life of people with spinal cord injuries and secondary complications and/or reduce the cost of care for government healthcare systems and insurers in both Canada and India.

As IC-IMPACTS grows and expands toward fulfilling its extended mandate, it will require new expertise and guidance to ensure the smooth management of the network. This led to several welcome additions to the IC-IMPACTS Head Office team this year: new COO Shapoor Marfatia, graduate of IIT Bombay and UBC, brings an entrepreneurial spirit and a wealth of experience in business development and operations in India and Canada; new Manager of Communication Morgan Chojnacki, graduate of Carleton and Concordia universities, brings expertise in web and print communications from UBC, non-profits, and the private sector.

The Board of Directors remains committed to ensuring that IC-IMPACTS has the governance capacity and management leadership both scientifically and administratively to lead the research and training objectives of the Centre.

In the 2018–19 fiscal year we aim to:

- Deepen our engagement with Canada's First Nations to solve challenges experienced in remote and underserved communities. With significant past successes in the domain of water (including lifting the boil water advisory in Lytton First Nation, BC), IC-IMPACTS is excited to embark on a major initiative with the Assembly of First Nations in the area of housing;

- Launch more initiatives focusing on commercializing research that solves real-world problems in Canadian and Indian communities that need them most;

- Develop a longer term vision and strategic plan for IC-IMPACTS beyond its current mandate.

I am grateful to our executive and office team, partners, researchers, students, and communities across Canada and India for their dedication and commitment to IC-IMPACTS.

Mr. Barj S. Dhahan
Chair of the Board of Directors, IC-IMPACTS

MESSAGE FROM THE CEO & SCIENTIFIC DIRECTOR

Born out of a bold vision of two governments—the Government of Canada and the Government of India—IC-IMPACTS had a very productive year in 2017–18. It established numerous new partnerships, provided innovative training to over 100 HQPs, deployed translational technologies into more than 12 new partner communities, and nurtured four new start-ups.

At the foundation of IC-IMPACTS' achievements are the over 808 highly cited journal papers that IC-IMPACTS researchers have published in the first five years of its existence and the 27 patents or technology disclosures that have resulted from these communications.

In spite of a busy year, IC-IMPACTS has never forgotten the real purpose behind its creation: ***To Work on Discoveries that Create and Cultivate Trade Pathways between Canada and India***. It has also not forgotten that the creation of advanced innovations is the critical building block of a robust and equitable global economy.

IC-IMPACTS enormously values diversity and we are proud of the fact that the female/male ratio in our graduate student population is significantly higher than the national average in both Canada and India.

We expect the coming year to be equally—if not more—exciting. We shall strive to reach out to universities that have so far not participated actively in the program. Equally important, IC-IMPACTS will work towards expanding the model of bilateral partnership to China. We will continue to strengthen relations with First Nations communities in the area of housing, water, and health and launch new technology demonstration projects. We will also strive to become a "Gateway to India" for Canadian NCEs, International NGOs, and Canadian companies.

No opportunity with the goal of world-class research, economic development, and community transformation is too small for IC-IMPACTS.

It is an honour to continue to serve as Chief Executive Officer and Scientific Director of IC-IMPACTS. I would like to thank the members of our Board, students, researchers, partners, and staff for their dedication and achievements.

Dr. Nemy Banthia
Chief Executive Officer & Scientific Director, IC-IMPACTS

IC-IMPACTS ACHIEVEMENTS, 2013–18

PROJECTS

39
INDO-CANADIAN PROJECTS

17
TECHNOLOGY DEPLOYMENTS

JOBS

792
INNOVATORS TRAINED

90%
STUDENTS EMPLOYED

PUBLICATIONS

808
SCIENTIFIC PUBLICATIONS

27
PATENTS & LICENSES

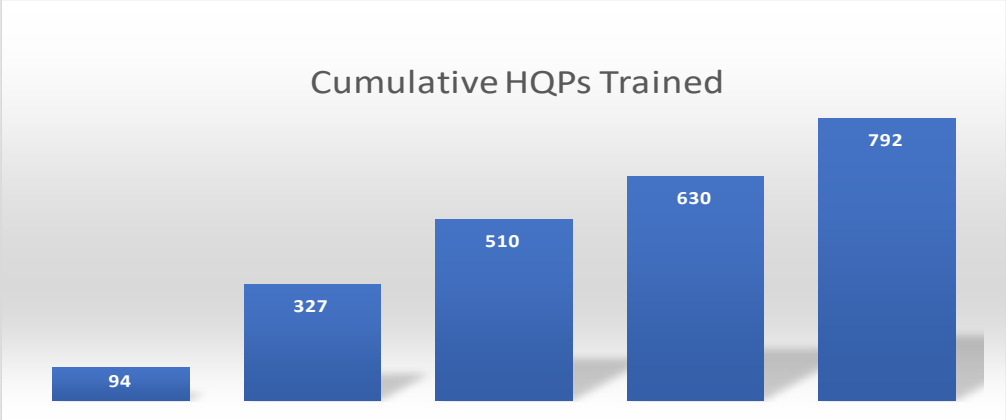
PARTNERSHIPS

278
MULTI-SECTOR PARTNERSHIPS

100%
NCE FUNDING LEVERAGED*

** 100% NCE research funds will be matched by an equal contribution from the Government of India during the funding extension period*

HIGHLY QUALIFIED PROFESSIONALS



With an initial goal to train 700 HQPs over five years, IC-IMPACTS is proud to report that over this period 792 HQPs have been trained through our research projects, more than 13% above the target.

START-UPS BY HQP

IC-IMPACTS facilitated four significant start-ups in this fiscal year, including the two featured below.

MITHRA SUSTAINABLE SOLUTIONS

Negar Roghanian, recent PhD graduate supervised by Dr. Nemy Banthia, created a start-up, Mithra Sustainable Solutions, based on her research project to develop new anti-corrosion materials that can be applied to pipes and other structures to extend their lifespan.

Dr. Roghanian applied for and secured a patent for her invention and launched the start-up in March 2018. It currently has three employees.

HRG INFRASTRUCTURE

Harsh Rathod, PhD candidate supervised by Dr. Rishi Gupta, created a start-up, HRG Infrastructure, while working with Dr. Gupta on a project on structural health monitoring (SHM) protocols for long-span railway bridges and heritage structures. The start-up's vision is to make civil infrastructure safer and serviceable and focuses on condition assessment and management of civil infrastructures.

HRG Infrastructure currently has five employees. Mr. Rathod is the recipient of the Mitacs Entrepreneurship Award for 2018.

SAFE & SUSTAINABLE INFRASTRUCTURE

PROJECTS

Characterization And Use Of Industrial Fly Ash
Canadian Lead: Dr. Daman Panesar, University of Toronto
Indian Lead: Dr. Bhupinder Singh, IIT Roorkee

Modelling And Assessment Of Deficient And Repaired Structures
Canadian Lead: Dr. Frank Vecchio, University of Toronto
Indian Lead: Dr. Umesh Sharma, IIT Roorkee

Full Field Non-Contact SHM Protocols For Long Span Railway Bridges And Heritage Structures
Canadian Lead: Dr. Rishi Gupta, University of Victoria
Indian Lead: Dr. Esakki Balasubramanian, Vel Tech

Evaluating The Integrity Of Railway Infrastructure In India And Canada With An Emphasis On Bridges And Tracks
Canadian Lead: Dr. Mustafa Gul, University of Alberta
Indian Lead: Dr. Pradipta Banerji, IIT Roorkee

Application Of Precast Products Made Using Bottom Ash And Fly Ash For Rural Pavements And Other Infrastructure In India
Canadian Lead: Dr. Rishi Gupta, University of Victoria
Indian Lead: Dr. Urmil Dave, IIT Nirma University

Solar Energy Powered Net-Zero Energy Smart Buildings
Canadian Lead: Dr. Bruno Lee, Concordia University
Indian Lead: Dr. Srinivas Reddy, IIT Madras

India Canada Initiative For Resilient Global Urban Shelter
Canadian Lead: Dr. Constantin Christopoulos, University of Toronto
Indian Lead: Dr. Ravi Sinha, IIT Bombay

Strengthening And Sustaining Civil Infrastructure In India And Canada
Canadian Lead: Dr. Nemy Banthia, The University of British Columbia
Indian Academic Institutions: IIT Hyderabad, IIT Delhi, IIT Mumbai,
National Institute of Engineering (Mysore), VNIT (Nagpur)

Structural Health Monitoring Of Tall Buildings Using Vibration-Based Techniques
Canadian Lead: Dr. Lucia Tirca, Concordia University
Indian Lead: Dr. Soraj Panigrahi, Central Building Research Institute (CSIR), Roorkee, India

Energy And Water Disaggregation For Non-Intrusive Load Monitoring In Buildings
Canadian Lead: Dr. Ivan Bajic, Simon Fraser University
Indian Lead: Dr. Angshul Majumdar, IIT Delhi

Smart Sensor Deployment In Buildings: Evacuation Planning And Energy Management
Canadian Lead: Dr. Mark Fox, University of Toronto
Indian Lead: Dr. Krithi Ramamritham, IIT Bombay

Urban Heat Island Effect And Building Energy Demand: Linkages Explained Using A Dense, Low-Cost Sensor Network
Canadian Lead: Dr. Raja Sengupta, McGill University
Indian Lead: Dr. Prasad Pathak, Shiv Nadar University

BUILDINGS STRENGTHENED AGAINST EARTHQUAKES THROUGH ADVANCED CONCRETE RESEARCH

CHALLENGE

The west coast of British Columbia lies near the edge of the North American and Juan de Fuca plates, making it the most earthquake-prone region of Canada. In the offshore region west of Vancouver Island, more than 100 earthquakes of magnitude 5 or greater have occurred during the past 70 years. Research shows that there is a 1 in 4 chance that Vancouver will have a major earthquake within the next 50 years.

Similarly, Roorkee, India, is an area with high seismic activity. The north-eastern region of the country as well as the entire Himalayan belt is susceptible to great earthquakes of magnitude 8 or higher. In addition, three-quarters of the buildings in India are built with unreinforced masonry walls that can easily collapse during low-magnitude seismic tremors. This poses a huge risk for rural communities, rapidly growing urban centres, and a serious threat to life in the event of an earthquake.

> *The cement industry produces close to 7% of global greenhouse gas emissions. Replacing 70% of cement with flyash reduces the amount of cement used.*
>
> **—Dr. Nemy Banthia**

RESPONSE: HIGH RESILIENCE CONCRETE

Dr. Nemy Banthia's team developed a high resilience eco-friendly concrete with a low carbon footprint. The resulting product, Eco-friendly Ductile Cementitious Composite (EDCC), was subjected to full scale tests on unreinforced masonry units. It withstood intensities as high as the magnitude 9.0–9.1 earthquake that struck Tohoku, Japan in 2011.

IC-IMPACTS provided the funding for the EDCC material to be applied to Annie B. Jamieson Elementary School in Vancouver and a retrofit was completed successfully in November 2017.

Dr. Banthia (left) with recent PhD graduate Dr. Salman Soleimani at the Annie B. Jamieson Elementary School during the retrofit, November 2017

FEATURED INNOVATIONS

Researchers are currently in talks with other communities for future demo projects, including a second school in Roorkee, India.

As a result of the successful retrofit, the EDCC material and seismic retrofitting technique have been added to the *Seismic Retrofit Guidelines*, 3rd Edition, published by Engineers and Geoscientists British Columbia. SRG-3 will be used by Engineers and Geoscientists BC members who are undertaking work on the seismic assessment and retrofit of BC schools.

RESPONSE: SEISMIC ISOLATION PLATFORMS

Dr. Constantin Christopoulos led a project to develop a cost-effective seismic isolation platform (SIP) that can be mass implemented for the most commonly designed buildings in urban settings in India.

An SIP consists of a low-cost, highly resilient layer that is built at the base of a building designed to absorb the seismic energy induced by earthquakes. This provides protection from earthquakes even if the buildings are designed and built with limited seismic resistance.

Dr. Christopoulos' team visited Indian construction sites and met researchers and structural engineers in Mumbai to assess construction practices and the availability and cost of materials. Benchmark buildings were then selected in partnership with IIT Bombay.

A twenty-story building in Mumbai and an eight-story building in Bangalore were used as pilot study buildings to investigate the potential advantages of an SIP concept. The seismic behaviour of a fixed-base and isolated structure was studied under the highest seismic hazard level in India. Currently, two seismic isolation platforms (SIPs) concepts are undergoing full-scale component-level tests at the Structural Testing Facility at the University of Toronto.

The project aligns with India's Smart Cities Mission, an urban renewal and retrofitting plan for 100 cities across India. Dr. Christopoulos' team is working with India to implement this technology and has plans to re-import the technology to Canada and scale up implementation.

Dr. Christopoulos' team visiting construction sites and meeting with structural engineers in Mumbai

INTEGRATED WATER MANAGEMENT

PROJECTS

An Innovative Sustainable Biotechnology Or Resource Recovery From Wastewater Streams Using Microwave Enhanced Advanced Oxidation With Algae
Canadian Lead: Dr. Victor Lo, The University of British Columbia
Indian Lead: Dr. Pradeep Kumar, IIT Roorkee

Biomonitoring Of Water Quality In Relation To Human Health Using Biosensors And Improvements Through Nanoparticle-Based Purification Systems
Canadian Lead: Dr. Damase P. Khasa, Université Laval
Indian Lead: Dr. Manzoor Shah, University of Kashmir

A Study Of Technology And Financial Appropriateness Of Water And Wastewater Infrastructure In Selected Cities Of India
Canadian Lead: Dr. Govind Gopakumar, Concordia University
Indian Lead: Dr. N.C. Narayanan, IIT Bombay

Development Of A Low-Cost Water Monitoring Kit For Multiplex Heavy Metal Detection Based On Aptamer Sensors
Canadian Lead: Dr. David Juncker, McGill University
Indian Lead: Dr. Rohit Srivastava, IIT Bombay

An Innovative Green Technology For Treating Municipal And Industrial Wastewater Entering Rivers And Streams
Canadian Lead: Dr. Shiv Prasher, McGill University
Indian Lead: Prof. Rameshwar Kanwar, Lovely Professional University

Development Of An ICT Platform For Water Quality Monitoring
Canadian Lead: Dr. Clarence de Silva, The University of British Columbia
Indian Lead: Dr. Sandhya Shrivastava, Bhavan's Research Centre, Mumbai University

Compact High-Rate Water Treatment Systems For Small Communities
Canadian Lead: Dr. Ramin Farnood, University of Toronto
Indian Lead: Dr. Vivek Kumar, IIT Roorkee

High Quality Potable Water For Small/Remote Communities In Canada And India
Canadian Lead: Dr. Pierre Bérubé, The University of British Columbia
Indian Lead: Dr. Anand Krishnamurthy, GE India

A Nanotechnology Enabled Device For The Detection Of Harmful Bacteria In Drinking Water
Canadian Lead: Dr. Michael Serpe, University of Alberta
Indian Lead: Dr. Soumyo Mukherji, IIT Bombay

Development Of Capacitive Deionization Technology For Point-Of-Use Water Purification
Canadian Lead: Dr. Madjid Mohseni, The University of British Columbia
Indian Lead: Dr. Sathish Kumar, Eureka Forbes Ltd.

FEATURED INNOVATIONS

NEW TECHNOLOGIES ACHIEVE SAFER WATER

CHALLENGE

Access to clean, safe water is a problem faced by communities across Canada and disproportionately affects First Nations communities. Ranging from boil water advisories to total bans for any kind of use, some First Nations reserves have struggled without safe water for decades.

India faces a problem of water contamination as well and experiences the highest incidence of diarrhea-related deaths in the world. Traditional and standard methods of identifying contaminants in water are slow, laborious, and can require specialized expertise. Therefore, rapid and portable diagnostic tests for the detection of E. coli are needed.

RESPONSE: PASSIVE MEMBRANE SYSTEM

Dr. Pierre Bérubé's team is focused on developing systems to ensure high-quality potable water for small/remote communities in Canada and India.

As part of the IC-IMPACTS project "High Quality Water for Rural/Remote Communities," a novel biological membrane filtration process was developed. The system was designed to operate passively (i.e., with limited to no need for electrical power and process chemicals) and proved effective in the treatment of drinking water. Because of its ability to produce high quality potable water and its simplicity, there is significant interest to demonstrate the technology at a pilot scale.

Currently, the technology is being demonstrated in West Vancouver, BC. A similar version has been deployed on Texada Island, BC, and in Tl'azt'en Nation, BC. A number of other communities have expressed interest in piloting the passive ultrafiltration membrane system.

The design of a pilot is being finalized for Hupacasath First Nation, BC, and will be installed over the next year. As well, the District of Central Kootenay, BC has expressed interest in piloting the system.

One of the aims of Dr. Bérubé's project is to identify what system is best suited to the population size. Preliminary results from the analysis confirm that passive membrane systems are the best option for smaller communities, hybrid systems for intermediate size communities, and conventional systems for larger communities.

> *The research focuses on an immediate and significant need both in Canada and India: the provision of high quality drinking water to residents of small and rural communities.... In Canada alone, over 6 million people live in small/rural communities.*
>
> **—Dr. Pierre Bérubé**

Pilot-scale passive membrane system ready for field deployment

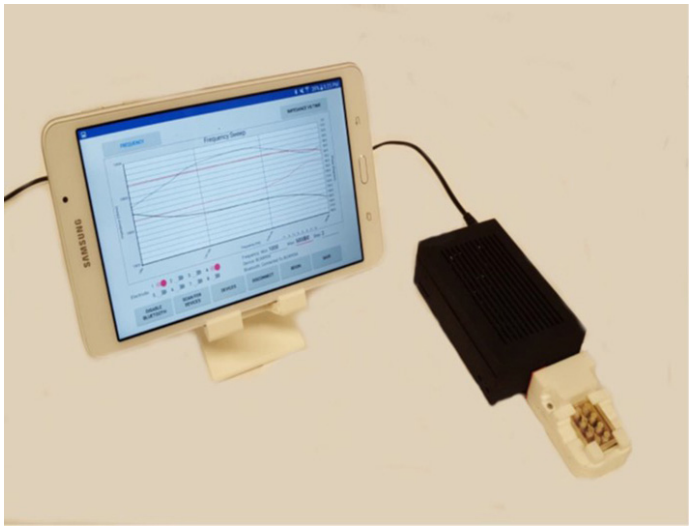
The development of cost models for passive membranes, conventional membranes, and a hybrid of passive and conventional membrane systems are ongoing.

RESPONSE: HANDHELD BIOSENSOR

Dr. Damase Khasa's team has made important progress in developing eco-friendly, smart, and cost-effective water monitoring devices and hydrophytoremediation technology.

Using a holistic approach comprising community engagement and biophysical components, Dr. Khasa's team aimed to develop technology to assess the water quality in targeted water bodies of Canada and India using impedance-based handheld biosensors. The team also developed a nanoparticle-based water treatment system to eliminate toxins and microorganisms in water.

An impedance-based biosensor that can detect changes in the surface modification of a microfabricated chip using impedance spectroscopy has been developed.



The handheld biosensor is versatile, portable, low-cost, and easy to use

The point-of-care device using interdigitated electrodes technology can detect E. coli concentration as low as 5 bacteria/mL in less than 20 minutes and is capable of transmitting the information through a Bluetooth module which connects to a smartphone application.

This device can be applied to detect E. coli in water bodies, drinkable water, and food.

PUBLIC HEALTH

PROJECTS

Next Generation Molecular Diagnostics For Emerging Viral Diseases
Canadian Lead: Dr. Francois Jean, The University of British Columbia
Indian Lead: Dr. Santanu Chattopadhyay, Nationwide the Family Doctors

Dialled In: Tapping Community Voice To Improve Child Immunization Services In India
Canadian Lead: Dr. Mira Johri, Université de Montréal
Indian Lead: Dr. Alok Kumar Mathur, Indian Institute of Health Management Research (IIHMR) University

Engaging Community Pharmacists In India To Enhance Early Detection Of Tuberculosis
Canadian Lead: Dr. Madhukar Pai, McGill University
Indian Lead: Dr. Nita Jha, World Health Partners

A High Quality Serotype Discriminating Dengue Virus Diagnostic Test Adapted For Field Investigation
Canadian Lead: Dr. Sachdev Sidhu, University of Toronto
Indian Lead: Dr. Amitabha Chaudhuri, SciGenom Labs

Identification Of High Affinity Ligands Against Dengue Virus NS1 For The Development Of An Affordable Point-Of-Care Diagnostic Kit
Canadian Lead: Dr. Tom Hobman, University of Alberta
Indian Lead: Dr. Easwaran Sreekumar, Rajiv Gandhi Centre for Biotechnology

A Portable Fever Kit For Dengue And Chikungunya
Canadian Lead: Dr. Stewart Aitchision, University of Toronto
Indian Lead: Dr. Manoj Varma, Indian Institute of Science

A Point-Of-Care Device For Malaria Diagnosis And Drug Resistance Genotyping
Canadian Lead: Dr. Stephanie Yanow, University of Alberta
Indian Lead: Dr. Aparup Das, National Institute of Malaria Research

Development Of A Hand Held Molecular Point-Of-Care Test Device For Infectious Diseases
Canadian Lead: Dr. James Mahony, McMaster University
Indian Lead: Professor Daman Saluja, University of Delhi

Development Of A Portable Device For Early Detection Of Eye Infection And Dry Eye Disease
Canadian Lead: Dr. James Feng, The University of British Columbia
Indian Lead: Dr. Ashutosh Richhariya, L.V. Prasad Eye Institute

Surface Modulation Of CUS Quantam Dots Using Biginelli Compounds For Construction Of A Portable Fluorescence Sensor For Bacteria
Canadian Lead: Dr. Jan J. Dubowski, Université de Sherbrooke
Indian Lead: Dr. Narinder Singh, Indian Institute of Technology Ropar

FEATURED INNOVATIONS

IMPROVING IMMUNIZATION COVERAGE

CHALLENGE

Vaccination is one of the most effective and cost-saving ways to improve child health and survival by preventing the occurrence of critical infectious diseases. Remote communities in India and Canada have consistently low rates of child vaccination, putting those populations at risk of serious illness. In rural Uttar Pradesh, India, for example, only 45% of children are fully vaccinated.

RESPONSE: MOBILE PHONE TECHNOLOGY

Dr. Mira Johri's project aimed to develop and evaluate a scalable community engagement intervention facilitated by mobile phone technology to increase immunization coverage among underserved populations in India.

Beginning in Hardoi District in Uttar Pradesh, researchers established a toll-free number for immunization. The service aims to improve both child health and service delivery.

Named "Tika Vaani" ("Vaccine Voice"), the pilot study ran from February 2018 to July 2018.

Results from April 2018 show that approximately 60 distinct villages had been reached by the intervention and 192 face-to-face meetings had been organized in these villages; 4,008 adults and 1,999 children (under age 15) participated in outreach activities, attending live demonstrations of the technology and service; 2,991 adult family members of a child less than 2 years of age had been trained to use the service; 1,647 distinct callers listened to 14,275 content elements; and 126 callers contacted the newly established helpline.

Improving immunization coverage through community engagement in India

The combination of public outreach and technology make this a scalable initiative, applicable to communities in Canada as well as India.

> *4,008 adults (1,329 male, 2,679 female) and 1,999 children (under age 15) have participated in outreach activities, attending live demonstrations of the technology and service.*
>
> **—Dr. Mira Johri**

EARLY DETECTION OF TUBERCULOSIS

CHALLENGE

India bears the world's highest burden of tuberculosis (TB), and accounts for a third of the "missing 3 million cases" that remain undiagnosed. Diagnostic delays, averaging two months, contribute to high morbidity and mortality and increased community transmission.

In Canada, Indigenous communities are disproportionately affected by TB infection. The TB rate among Indigenous people was almost six times greater than the overall Canadian rate in 2008 and in Nunavut, it was more than 38 times the national rate (184.4 cases per 100,000 population).

RESPONSE: TRAINING PHARMACISTS

Pharmacies are the first point of contact for many undiagnosed patients, and serve as optimum entry-points to screening services. This year McGill University, Canada and World Health Partners (WHP), India partnered to pilot an intervention that engages community-based pharmacists and utilizes e-health technology to achieve early TB case detection in India.

Researchers successfully recruited 105 pharmacists into the study, educated and trained them on TB symptoms and case detection, and incentivized them to refer patients to the appropriate medical care with a modest incentive scheme ($2 per CXR referral, $1 per doctor referral, and $4 per TB case notification).

After 18 months of intervention, 73% of participating pharmacists triaged TB symptomatic patients in the community and made 841 doctor referrals either directly (85% completed) or as a result of a CXR referral (99% completed). Of 809 patients completing the doctor referral, 332 (41%) were assigned a microbiological test by the referred doctor. A total of 255 TB cases were notified due to the initial referral of a study pharmacist, and 251 (98%) patients initiated TB treatment under the care of a doctor.

Researchers are also using SMS text messages to engage and educate pharmacy providers, and a state-of-the-art ICT platform to facilitate e-referrals that expedite patients' access to TB screening and diagnostic services.

This intervention may be applied to help detect and manage a range of other illnesses in India and Canada.

IC-IMPACTS ACHIEVEMENTS, 2017–18

This year, IC-IMPACTS research projects added:

- 224 publications, including 8 contributions specific to First Nations
- 7 patents
- 4 start-ups
- 7 new partners
- 162 HQP-years and 910 short-term training participants
- $3.72 million of non-NCE funds, which is greater than the $2.83 milllion leveraged from non-NCE sources in 2016–17

HQP: LEADERS OF TOMORROW

WORKSHOPS

During 2017–18, IC-IMPACTS funded and guided six HQP-led workshops across Canada, with participation from Canadian and Indian students. These HQP-led workshops provided leadership opportunities for HQP and enabled them to expand their HQP networks.

Workshops focused on a range of topics from smart sensors that monitor infrastructure, water, and public health to water challenges in rural and Indigenous communities.

FELLOWSHIP PROGRAM

IC-IMPACTS partnered with Engage North at the University of Alberta to run the Community Engagement Fellowship Program with the Yellowknives Dene First Nation in the N'Dilo and Dettah communities in the Northwest Territories.

Participants in the Engage North Fellowship

The four-month-long fellowships tackled key challenges facing community health and sustainability and provided opportunities for students to develop their research and leadership skills.

Through support from IC-IMPACTS, my leadership skills have been enhanced. It was possible to organize an event that had more than 50 participants.... I have been able to integrate into a strong network with other IC-IMPACTS members across Canada and India.

—Christopher Nzediegwu, PhD Candidate, McGill University

SUMMER INSTITUTE

IC-IMPACTS held its annual Summer Institute with community partners ?aq'am of the Ktunaxa First Nation as well as the Ktunaxa Nation Council. HQP from Canada and India participated in a week-long program with the following theme: Sustainable Communities in Low-Resource Settings.

Participants explored, with community members and researchers, the unique challenges faced by Indigenous communities in Canada, specifically within the context of a First Nation community in British Columbia, and the interconnectivity of those issues to rural communities in India.

TRAINING OPPORTUNITIES IN THE FIELD

IC-IMPACTS researchers and partners in Canada and India provided additional training opportunities for students. For instance:

- Dr. Victor Lo from the University of British Columbia provided training for students who were interested in developing new technologies for the municipal wastewater treatment and envionmental engineering field.

> *By putting together students from Canada and India, students learn to engage in multi-stakeholder projects and cater to differences in perspectives, cultures, and ideas.*
>
> **—Dr. Madjid Mohseni**

- Dr. Rajesh Seth from the University of Windsor worked with CSIR-NEERI in India on a demonstration project that required multidisciplinary and multi-sectoral interaction and building collaborative relationships with the two Canadian HQPs who were primarily tasked with ensuring proper deployment and commissioning of the aeration system.

Participants in Dr. Seth's demonstration project in India

- Dr. Shiv Prasher from McGill University co-organized with Lovely Professional University a two-day international conference on Innovative Strategies for Sustainable Water Management in November 2017.

Participants in the conference on Innovative Strategies for Sustainable Water Management

NEW AGREEMENTS WITH KEY PARTNERS

This fiscal year marked the renewal and expansion of relationships with the Department of Science and Technology (DST) and the Department of Biotechnology (DBT) in India as well as new Canadian partners, such as the Rick Hansen Institute, the Assembly of First Nations, and faculties in other institutions.

IC-IMPACTS reached agreement with key partners in India and Canada to launch major initiatives, including:

- **DBT, DST, AND INDIAN INSTITUTE OF TECHNOLOGY (BHU) VARANASI**

  IC-IMPACTS, DBT, and DST signed a joint work plan and held a two-day workshop at IIT (BHU) Varanasi to develop the scope of rejuvenating a stretch of the Ganga River in Varanasi, which is part of a $3 billion new investment by the Indian Government.

  The pilot will establish cost-effective and space-efficient solutions that can be implemented on a larger scale. This collaboration will demonstrate research solutions to effectively clean water systems such as those in First Nations communities that experience boil water advisories.

Location of Varanasi and Ganga River in India

Dr. Nemy Banthia (middle) signing work plan with the Department of Science and Technology (DST), and the Department of Biotechnology (DBT), Government of India, New Delhi, February 2018

> *A key success of IC-IMPACTS has been the development of relationships with First Nations communities in Canada and the development of appropriate water treatment technologies for these and other small/rural communities in Canada and India.*
>
> **—Dr. Pierre Bérubé**

- **RICK HANSEN INSTITUTE (RHI) AND INDIAN SPINAL INJURIES CENTRE (ISIC)**

  IC-IMPACTS signed an agreement with RHI and ISIC to develop and bring to market unique technologies to improve the quality of life of people with spinal cord injuries and/or reduce the cost of care for government healthcare systems and insurers in both Canada and India.

The Honourable Kirsty Duncan at the Indian Spinal Injuries Centre in New Delhi, February 2018

The Honourable Kirsty Duncan greeting Dr. H.S. Chhabra, Chief of Spine Services & Medical Director, Indian Spinal Injuries Centre, New Delhi, February 2018

- **TATA CONSULTANCY SERVICES (TCS)**

  IC-IMPACTS signed an agreement with TCS—a global IT leader (with revenue over $18 billion)—to jointly fund the mobility of Canadian graduate students to conduct research at TCS innovation centres in India.

- **SENSEINDIA LTD (PART OF STARMASS GROUP)**

  IC-IMPACTS and SenseIndia—a global provider of turnkey solutions for infrastructure—will collaborate to monitor the health of bridges and public infrastructure using high-tech sensors.

- **STARMASS AND NATIONAL ACADEMY OF CONSTRUCTION (NAC, GOVERNMENT OF TELANGANA)**

  IC-IMPACTS, Starmass, and NAC will collaborate in the area of skills development with a particular focus on the large Indian workforce in the sector of hard infrastructure such as bridges, roads, dams, and tunnels.

From left: Danush Doongaji, SenseIndia; Uzayr Siddiqui, Starmass Environment Technologies; Dr. Nemy Banthia, IC-IMPACTS; UBC President Dr. Santa Ono, at the Taj Tower Business Center, New Delhi, February 2018

LOOKING AHEAD

In November 2017, the Government of Canada announced its commitment to extend IC-IMPACTS funding by $8.4 million for the 2018–21 mandate in New Delhi, India. At the same time, the Government of India announced equal matching funding through the Department of Science and Technology (DST) and the Department of Biotechnology (DBT).

Canada's Minister of Innovation, Science and Economic Development, The Honourable Navdeep Bains, announces funding extension for IC-IMPACTS, November 2017, New Delhi

NCE Chair Dr. B. Mario Pinto (left) with Secretary to the Government of India, Department of Science and Technology. Seated behind the podium, Professor Ashutosh Sharma (right) with dignitaries

This shift from unilateral funding by Canada to equal and bilateral funding by both countries leverages Canadian investments in IC-IMPACTS by 100%.

With this public announcement, IC-IMPACTS is embarking on the following top initiatives for the coming year and beyond:

1. **Deepen our engagement with Canada's First Nations**: With significant past successes in the domain of water (including lifting the boil water advisory in Lytton First Nation, BC), IC-IMPACTS is excited to embark on a major initiative with the Assembly of First Nations in the area of housing.

   With a Focus Group on Housing in Ottawa in July 2018, IC-IMPACTS plans to launch a Call for Proposals on "Smart Housing for First Nations Communities" that may lead to a model house or a retrofit of a public facility in an underserved/remote community in Canada.

2. **Network expansion**: IC-IMPACTS is working to ensure that the benefits and features of its partnerships are accessible to other universities outside of its founding universities. IC-IMPACTS is inviting leading universities to utilize this effective bilateral model to collaborate in the areas of knowledge mobilization and joint research opportunities in Canada and India.

IC-IMPACTS has been a highly successful program in finding solutions for water, health, and infrastructure challenges faced by communities!

—Professor Ashutosh Sharma
Secretary to the Government of India, Department of Science and Technology

3. **IC-IMPACTS as a Gateway to India**: Plans are already underway to position IC-IMPACTS as a Gateway to India for other NCEs and Centres. Discussions are taking place with two other NCEs to explore avenues to launch common calls for proposals, collaborate on HQP and innovative training programs, develop knowledge mobilization and dissemination tools, and bring technologies developed by other NCEs to India through Canadian industrial partners.

IC-IMPACTS makes a site visit at the steps of the Ganga River in Varanasi to scope out a work plan with DBT and DST for the Ganga Rejuvenation initiative, February 2018

4. **Partnering with NGOs**: IC-IMPACTS will continue to work with the Rick Hansen Institute and explore similar avenues of collaboration with the Agha Khan Foundation, Bill and Melinda Gates Foundation, and other organizations, to improve the lives of people through a judicious use of technology.

5. **Expanding IC-IMPACTS to China**: IC-IMPACTS' model of strategic collaboration and the goal of creating economic prosperity through bilateral research has garnered significant interest in China. Dialogue is currently underway with the Chinese Academy of Sciences and the Academy of Engineering, and a meeting is planned in Beijing this summer to explore common areas of interest as well as develop appropriate terms of reference.

7 PRINCIPLES OF IC-IMPACTS INTERNATIONAL RESEARCH PARTNERSHIPS

1. Building strong relationship and trust over the long term
2. Matching funds from India and Canada
3. Co-development and joint leadership
4. Engagement with First Nations communities
5. Student/HQP mobilization
6. Participation of women in science and technology initiatives
7. Mutual economic development

After five years of operation, IC-IMPACTS is firing on all cylinders. The unprecedented engagement by all stakeholders in Canada and India—governments, industry, academia, and local communities—is a testament to how bilateral R&D initiatives should be formulated. The network has a very bright future as it continues to build from success to success.

—Dr. Arvind Gupta
Board Member, IC-IMPACTS, Professor, Computer Science, UBC

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Dr. Stewart Aitchison, Theme Lead, Public Health: Disease Prevention and Treatment, Associate Professor, Department of Chemistry, University of Toronto

Dr. Michael Serpe, Theme Lead, Integrated Water Management (on leave), Associate Professor, Department of Chemistry, University of Toronto

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Central Electronic Engineering Research Institute
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IIT Bombay
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National Health System Resource Center
National Instruments Corporation
National Mission for Clean Ganga (NMCG)
NHSRC Ministry of Health and Family
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GLOBAL GOVERNMENT PARTNERS

Water Magic

PARTNERSHIPS

CANADIAN COMMUNITY PARTNERS

?aq'am First Nation Community
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INDEPENDENT AUDITOR'S REPORT

To the Directors of IC-IMPACTS Centres of Excellence

We have audited the accompanying financial statements of IC-IMPACTS Centres of Excellence (the "Network"), which comprise the statements of financial position as at March 31, 2018 and the statements of operations and changes in net assets and cash flows for the year then ended, and a summary of significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statements
Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility
Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion
In our opinion, the financial statements present fairly, in all material respects, the financial position of the Network as at March 31, 2018 and the results of its operations and its cash flows for the year then ended, in accordance with Canadian accounting standards for not-for-profit organizations.

Hay + Watson

Chartered Professional Accountants
Vancouver, British Columbia
May 25, 2018

IC-IMPACTS Centres of Excellence

Statements of Financial Position
As at March 31, 2018 and 2017

		2018		2017
Assets				
Current				
Cash	**$**	**14,355**	$	-
Restricted cash – Uncommitted (Note 4)		**1,337,542**		4,292,190
Restricted cash – Held at other institutions (Note 4)		**83,700**		240,238
Accounts receivable		**1,931**		18,833
Contributions receivable (Note 4)		**225,000**		-
Unspent research grants receivable (Note 5)		**80,000**		92,235
Unspent research grants (Note 5)		**2,101,042**		2,324,466
Prepaid expenses		**16,487**		31,399
		3,860,057		6,999,361
Liabilities				
Current				
Accounts payable and accrued liabilities		**28,336**		28,735
Deferred contributions (Note 7)		**3,817,366**		6,970,626
		3,845,702		6,999,361
Net assets	**$**	**14,355**	$	-

IC-IMPACTS Centres of Excellence

Statements of Operations and Changes in Net Assets
Years ended March 31, 2018 and 2017

		2018		2017
Receipts				
Contribution from Networks of Centres of Excellence	**$**	**3,407,432**	$	2,986,635
Contributions from co-hosting universities		**744,555**		744,447
Contributions from other partners		**14,515**		-
Total Receipts		**4,166,502**		3,731,082
Disbursements				
Research and training programs				
Highly qualified personnel support		**644,436**		513,005
Research networking		**85,412**		61,814
Research grants (Note 5)		**2,661,608**		2,309,242
Technology transfer		**129,375**		135,509
		3,520,831		3,019,570
Administrative operations				
Communications and promotion		**15,446**		10,600
Operating costs		**114,541**		176,923
Professional and consulting fees		**49,687**		30,169
Staff salaries		**451,642**		493,820
		631,316		711,512
Total Disbursements		**4,152,147**		3,731,082
Excess of receipts over disbursements		**14,355**		-
Net assets, beginning of year		**-**		-
Net assets, end of year	**$**	**14,355**	$	-

IC-IMPACTS Centres of Excellence

Statements of Cash Flows
Years ended March 31, 2018 and 2017

	2018	2017
Cash provided by (used in)		
Operating activities		
Cash received from Networks of Centres of Excellence	**$ -**	$ 2,830,050
Cash received from Canadian universities	**774,500**	659,500
Cash received from other contributions	**14,515**	-
Cash returned from unspent research grants	**25,800**	22,488
Cash disbursed for research grants	**(2,452,180)**	(2,844,170)
Cash disbursed for operations and networking	**(1,459,466)**	(1,424,272)
Decrease in cash	**(3,096,831)**	(756,404)
Cash, beginning of year	**4,532,428**	5,288,832
Cash, end of year	**$ 1,435,597**	$ 4,532,428
Cash composed of		
Cash	**$ 14,355**	$ -
Restricted cash – Uncommitted	**1,337,542**	4,292,190
Restricted cash – Held at other institutions	**83,700**	240,238
	$ 1,435,597	$ 4,532,428

For the latest news and information, please visit:

WWW.IC-IMPACTS.COM

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