




Innovating for Access and Equity

A Global Journey of Impact
and Driving Quality Healthcare

Frugal Biomedical Innovations Program



"Access to health care shouldn't be bound by geography or borders. It should reach every corner, every community, every life. There is a critical need for sustainable biomedical solutions in Canada and abroad, rooted in a true understanding of the community and the people who will use them. Our program's innovations can improve health outcomes and equity around the world. We invite champions to come alongside and support this program."

Margaret Mutumba, MPH, PhD,
Program Director,
Frugal Biomedical Innovations Program



The Frugal Biomedical Innovations Program

Advancing Healthcare Access, Empowering Communities

In an era when access to quality healthcare remains unequal and where vital medical resources are often out of reach for millions, the Frugal Biomedical Innovations Program (FBIP) at Western stands as a beacon of hope and sustainable innovation.

From design to deployment, the Frugal Biomedical Innovations Program works with partners, researchers, clinicians, and end users in remote and low-resource communities in Northern Canada and Africa. Working together, collaborators in the program develop high-performance, low-cost medical devices, driving flexible and inclusive access to health care while meeting the unique needs of the communities where devices are most needed.

Established in January 2022, the Frugal Biomedical Innovations Program is the first program of its type in Canada, led by Western's School of Biomedical Engineering in collaboration with the Faculty of Engineering, the Schulich School of Medicine & Dentistry, Western's MedTech incubator BioNext, and the Africa Institute (an interdisciplinary entity within Western created to advance scholarships, partnerships, and collaborations with Africans).

The multi-disciplinary initiative works from concept to commercialization of medical technologies that minimize costs, reduce reliance on specialized personnel, and function effectively in unreliable infrastructure. Prototypes of devices are co-designed and co-developed, field tested and refined in collaboration with local partners and healthcare providers. The program aims to uphold quality and performance standards, while ensuring that critical medical technologies are accessible to all who need them. Additionally, the program provides resources to help researchers understand healthcare needs in relevant contexts, develop partnerships with multinational medical device companies, and cultivate linkages with teams in remote and low-resource settings

to scale innovations. When devices are ready for production, the FBIP promotes sourcing local materials and keeping the manufacturing and production of the devices within the partnering communities to ensure sustainability and translation into employment opportunities and economic empowerment for the local region.

Situated within Western University, the FBIP also provides unique and powerful educational opportunities for undergraduate and graduate students, and trainees from partner institutions. The program enriches experiential learning through practical training in frugal medical device design by prototyping and deployment in partner communities (consistent with international quality management and regulatory standards of medical devices), providing a valuable competitive advantage for career advancement in the medical device industry.

In today's world, half the global population lacks access to essential healthcare resources, reducing life expectancies in remote and low-resource contexts. Through our partnerships, the Frugal Biomedical Innovations Program will tackle these challenges head-on, growing the program to meet the needs of communities around the globe.

"Our students and faculty in the program are working shoulder-to-shoulder on diverse 'frugal' innovations, cultivating more creative problem solvers, and ultimately resulting in better, more sustainable innovations."

James Lacefield, Professor and Director,
School of Biomedical Engineering, Western

What is 'Frugal Engineering'?

The term "frugal engineering" is specific to the field and refers to the practice of designing and developing high-quality products or solutions with limited resources. It emphasizes simplicity, affordability, and adaptability, often using locally available materials and technologies to address pressing challenges in resource-constrained environments. This approach often involves reimagining traditional design principles and repurposing existing technologies to create innovative solutions.

"Frugal" does not mean sub-standard - it means creating solutions that respect the strengths and limitations of the people and the places they're serving – including being relatively inexpensive to build, use and fix.

A Global Need Sustainably Designed Medical Technology

Access to quality healthcare is a fundamental human right, yet for millions around the world living in remote and low-resource contexts, this right remains elusive. Limited infrastructure, scarce resources, and geographic isolation create barriers that impede timely and adequate healthcare delivery. In the face of these challenges, the development and deployment of innovative and sustainably made medical technologies emerge as beacon of hope, promising to bridge the gap and revolutionize healthcare access for those in need, both here in Canada in our remote and Northern communities, as well as resource constrained communities around the world.

Why is this mission critical? The answer lies in the profound impact it can have on countless lives worldwide. The vast majority of medical devices in low-income countries were donated from high-income countries, and 70 to 90% of those devices are not operational¹, or were developed with little or no consultation with the communities themselves. So, they sit on a shelf, unable to meet the community's needs.

Developing low-cost, easily accessible medical devices is not merely a matter of convenience; it is a matter of life and death. In regions where access to healthcare is limited, innovative technologies can mean the difference between recovery and deterioration, between hope and despair. When more people have access to medical tools, communities are empowered to manage their health. Moreover, the significance of our mission extends far beyond individual health outcomes. Improved healthcare access lays the foundation for socio-economic development, fostering thriving communities and unlocking human potential.



When individuals are freed from the shackles of preventable illnesses and debilitating conditions, they can pursue education, employment, and prosperity, catalyzing positive change on a societal level.

The Frugal Biomedical Innovations Program represents a beacon of hope in the fight for health equity. Partnerships within the program will not only contribute to truly sustainable biomedical solutions, but also have the power to impact the health and wellbeing of communities around the world, paving the way for a brighter, healthier future for generations to come.



¹ D. Piaggio, R. Castaldo, et al., "A framework for designing medical devices resilient to low-resource settings," *Globalization and Health* 17:64, 2021.



Empowering Change, One Innovation at a Time Our Work in Africa

In Sub-Saharan Africa, where healthcare disparities loom large, our program is making tangible strides toward equity and meaningful institutional partnerships. Through the active support of the Africa Institute, the Frugal Biomedical Innovations program has established a Global Research Coalition, resulting in research collaboration agreements with engineering, science, and medical programs at eight universities in six African nations, including:

- The University of Nairobi and Kenyatta University, Kenya
- Makerere University and Mbarara University of Science and Technology, Uganda
- Bahir Dar Institute of Technology, Ethiopia
- University of Rwanda, Rwanda
- University of Ibadan, Nigeria
- Universite Cheikh Anta Diop, Senegal

These partnerships have facilitated transformative research and innovation in medical technology development and deployment in Sub-Saharan Africa. Furthermore, the program has also established collaborations with medical device companies in Africa and the Middle East, including Global Auto Systems Limited in Uganda and Gearbox in Kenya.

The FBIP has also prioritized understanding healthcare priorities in partner communities and co-created medical technologies that are contextually and culturally appropriate. We have supported several partner-led projects through the Frugal Biomedical Innovations Catalyst Grant program, including the development of 3D-printed hands and legs to enable disabled people to live dignified lives in Ethiopia and a smart toothbrush/tele-dentistry system to improve oral health for children

² PATH.org, Market Dynamics for MNCH Medical Devices (MD4MD) Project, <https://www.path.org/our-impact/resources/market-dynamics-mnch-medical-devices-md4md-project/>

with neuro-developmental challenges in Kenya; efficient and effective solutions rooted in a true understanding of the community and the end-users.

However, the needs still outweigh the current scope of our program. A 2021 survey of 700 healthcare facilities in Burkina Faso, Kenya, and Malawi found that 90% of those facilities had insufficient access to critical technologies for maternal, neonatal, and child health care, such as blood pressure cuffs, hemoglobin monitors, neonatal resuscitators, infusion devices, and ultrasound and X-ray imaging systems².

We look to continue expanding our scope and network of partnerships in Africa and Canada and offering unique educational fellowships to our partners in Africa through our Frugal Innovation Scholars Program.



“With the Frugal Biomedical Innovations Program, Western University is spearheading innovative medical technology. As an effective institution of higher learning, this is but one among many commendable initiatives. We look forward to learning from LndOnt's finest.”

Dr. Stephen Kiama, Vice Chancellor, University of Nairobi



Empowering Change, One Innovation at a Time

Our Work in Northern Canada

In the vast expanses of Northern Canada, unique challenges in the country's most remote corners shape healthcare access. Many communities in Northern Canada are in remote, isolated areas that are difficult to access by road or air. These communities are underserved and have limited healthcare infrastructure, making accessing services challenging and impacting the quality and effectiveness of the care received. Rates of treatable mortality (that is, deaths that should not occur in the presence of timely healthcare) for people residing in the most remote communities are more than 60% greater than the rates for people living in cities with populations greater than 100,000. Those statistics disproportionately affect Canada's Indigenous People, living in some of Canada's most remote communities.

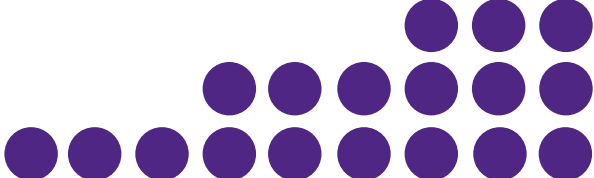
Underlying healthcare access challenges is a lack of capacity in Northern Canada's healthcare institutions. Living in an environment of social and economic inequality, education and training rates in Northern Canada suffer (particularly for Indigenous populations), and as a result, healthcare institutions are either understaffed or must fill vacancies with short-term/temporary staff from outside the region, due to a lack of trained healthcare providers. The primarily Indigenous residents of small hamlets in the North may not then receive timely, culturally appropriate healthcare and do not fully benefit from economic development opportunities in the region because of this lack of community-based expertise.

Travelling long distances for health care not only has negative effects on the people of the region, but the region itself. The demand for healthcare (and the need to travel for diagnostics and treatment) contributes to

increased emissions and impact on the environment. Bringing health care closer to home for Northern communities ensures accessible, quality and culturally appropriate care while integrating with the principles of planetary health.

To begin to address some of the challenges of health equity, access, and capacity in Northern Canada head-on, the Frugal Biomedical Innovations Program established a collaboration with the Northwest Territories Health and Social Services Authority (NTHSSA). Recently, the NTHSSA invited the FBIP to support efforts to understand and address the impact of wild forest fires on healthcare outcomes for first responders and communities in the region. As a result, the program will conduct more profound research and develop air filters to address this challenge. The FBIP will also explore opportunities to support Northern Communities in co-developing professional accreditation programs for individuals (e.g. 'micro-credentialing') to enable more local expertise and technical knowledge in the local health care system.

In 2023, the program announced fifteen FBIP Catalyst Grant Award recipients at Western who would receive funding to co-create, develop, test and advance medical innovations that meet patients' needs in remote and low-resource communities, including Northern Canada.



The 3 Catalysts that are active in the North are all related to X-ray imaging:

- A low-cost X-ray system for remote clinics
- A low-cost X-ray exposure meter that permits those clinics to perform their own basic quality assurance rather than waiting for itinerant technicians to visit.
- A wrist positioning apparatus that enables non-specialist healthcare providers to reliably obtain diagnostic-quality images of wrist fractures, thus minimizing treatment delays and repeat exposure to X-rays. Our team plans to expand the project to similar devices for other joints.

By leveraging our expertise in frugal biomedical engineering, we're co-developing innovative solutions to address the specific needs and challenges faced by communities in this region.

With your partnership support, we can continue to reshape healthcare access and delivery in Northern Canada.





Partner with Impact

Your Partnership with the Frugal Biomedical Innovations Program at Western has the power to propel impact in a various areas, benefiting students, researchers, health sector partners, and ultimately, patients in remote or low-resource communities around the world who need access to medical technology today.

Below are key priorities within the Frugal Biomedical Innovations Program that is looking to grow and expand in:

The Frugal Innovations Scholars Program

Sustainable improvement of health equity in remote and low-resource settings requires focused education that is collaborative, interdisciplinary, experiential, and accessible to all participants. Our program was recently awarded over \$1.6M in federal funding to establish a training program in “Design and Translation of Frugal Medical Technologies,” and additional support is needed to grow the program in Canada and is imperative to be able to provide equivalent opportunities to our partners in Africa.

Additional partnerships will help expand this cross-disciplinary program to support long-term graduate student involvement at Western and our partner sites in Africa and Northern Canada. Fellows will develop frugal medical technologies, help establish dual-degree graduate programs in biomedical engineering between Western and selected African universities to develop biomedical engineering capacity in Africa, and support field placements for Western students to carry out collaborative medical device research and development in African and Northern Canadian communities. The Scholars Program features field-based placements that take place over a period of eight or more weeks.

Partnership support of this program will help increase the number of fellowship positions available each year, establishing a productive international community of researchers that will be recognized for its collaborative approaches to problem-solving and its shared common vision of advancing health equity through frugal innovation.

The Frugal Innovations Incubator Program

Before medical devices can enter widespread adoption in clinical settings, they must undergo rigorous testing and be approved by international health regulatory agencies (e.g., FDA, CE, and Health Canada). Since its inception, our program's primary goal has been facilitating the commercialization and deployment of medical devices co-developed by Western researchers in partnership with colleagues in Africa or Northern Canada. If this goal is not achieved, our team's innovations risk being limited to academic research findings rather than benefiting the communities that inspired their development.

Through your invaluable support, the Frugal Biomedical Innovations Program will partner with Western's MedTech commercialization incubator, BioNext, to provide researchers with specialized business guidance to determine the most appropriate pathway to deploy a medical technology in a low-resource setting. Researchers will also receive services from experienced medical device regulatory affairs consultants, access during prototype development to calibrated testing equipment and conventional medical technologies serving as gold-standard performance benchmarks, and introductions and funding to contract with certified medical device manufacturers for scale-up and distribution of technologies. Your involvement will also help the program develop outreach and knowledge exchange programs to strengthen capacity at innovation and commercialization units in our African partner institutions.

Partnering in the Innovation Incubator Program will increase the technologies our team can deploy. It will ensure Western's biomedical engineering researchers focus on real-world impact as they develop disruptive medical technologies to address the high-priority needs of underserved people around the world.

The Sustainable Infrastructure Development Support Initiative

To facilitate the co-development of medical devices, it is essential that Western researchers and our partners have access to equivalent equipment and facilities for validation of device safety, performance, and regulatory compliance. At Western, the Frugal Biomedical Innovations program will cooperate with Western's MedTech commercialization incubator, BioNext, to provide researchers access to calibrated testing equipment and conventional medical technologies serving as gold-standard performance benchmarks. Establishing similar facilities in East and West Africa will be highly advantageous.

The Frugal Biomedical Innovations Program and several African academic partners are members of an international coalition advising the African Union's Centres for Disease Control on establishing five regional centres of excellence in biomedical engineering.

Partnership support of this initiative will facilitate the participation of the Frugal Biomedical Innovations Program in this international consortium, helping to create a centre of excellence, focusing primarily on local medical device innovation and commercialization. Such a centre would significantly contribute to capacity building in Africa, allowing for innovation beyond repairing and maintaining equipment supplied by multinational MedTech corporations (the current status quo) and would drastically enhance our capacity to develop and offer training programs in the region as well as deploy medical innovations that address the needs of underserved people in Africa with a level of readiness we do not have today. Through your partnership, we will procure equipment equivalent to that of our Frugal Innovations Incubator Program and provide funding to partners to scale up specific projects in Africa for field testing and commercialization. Scaling and testing projects will provide Scholars at Western and our African partner institutions with experiential learning opportunities and advance the technology itself.



Partnerships can help establish the Frugal Biomedical Innovations Program at Western as the Canadian leader in an emerging research field with enormous potential to propel healthcare equity and access for underserved people in Canada and globally. Join us in our vision of a world where access to quality and holistic health care for you and your family isn't defined by where you live.

Partnership, Impact, Global Reach

The Frugal Biomedical Innovations Program is developing ways to redress inequities in Canadian and global health by co-designing, co-developing, co-testing, and deploying biomedical devices that meet the communities' needs. Beyond addressing critical health access and equity challenges, there are many reasons to support the Frugal Biomedical Innovations Program:

- **Our Innovative Approach:** Every day, the FBIP explores innovative approaches to solving complex healthcare challenges, and we're doing it with the most cutting-edge technology and innovation. From artificial intelligence to open-source technology to advanced algorithms and manufacturing practices (like 3D printing), we are leveraging the newest and most progressive tools available to help us solve global problems. Our integrated program to accelerate progress in research, education, and clinical implementation sets us apart from our peers.
- **Our Long-Term Sustainability:** The FBIP is committed to providing sustainable solutions for long-term challenges considering a community's unique and specific needs. In all our programs, we are building capacity at Western and with our partner organizations abroad to be able knowledge exchange and promote local sustainability to ensure lasting positive change in the communities we serve.
- **Our Global Reach and Collaboration:** Since its inception in 2022, our program's global reach has built an extensive network of partners, collaborators, and stakeholders. Our collaborative efforts transcend borders and have the potential to make a meaningful difference in diverse communities worldwide.
- **Our Early Success and Program Uptake:** In the short time that the FBIP has run, we have seen incredible interest and early progress in the projects we work with. Our Summer Student program saw a 42% increase in participants from 2022 to 2023, our Scholars Program has placed 20 undergraduates in 8-week field placements, and there are currently fifteen multi-faculty projects underway, funded by Western Catalyst Grants, exploring biomedical innovations in Northern Canada and Sub-Saharan Africa in the program. We have also garnered over \$4M in early seed funding from Western and the federal government to support expanded learner programs and advance specific technology projects.
- **Our Impact on Sustainable Development Goals (SDGs):** The Frugal Biomedical Innovation Program directly aligns with and contributes to achieving specific UN Sustainable Development Goals such as Good Health and Well-being (SDG 3), Quality Education (SDG 4), industry, Innovation and Infrastructure (SDG 9), and Partnerships for the Goals (SDG 17).

Recognizing Our Impact

It's no exaggeration to say that partnership support for the Frugal Biomedical Innovation Program at Western will make a transformative impact on global health equity. Your engagement can leave a lasting legacy for students and researchers within our program, in addition to the thousands of patients in low-resource communities in Canada and around the world, who will depend on these insightfully designed and sustainably produced medical devices for integral health care.

As a partner, you will also receive regular updates on the impact of our program, with opportunities to engage with program leaders and beneficiaries where possible.

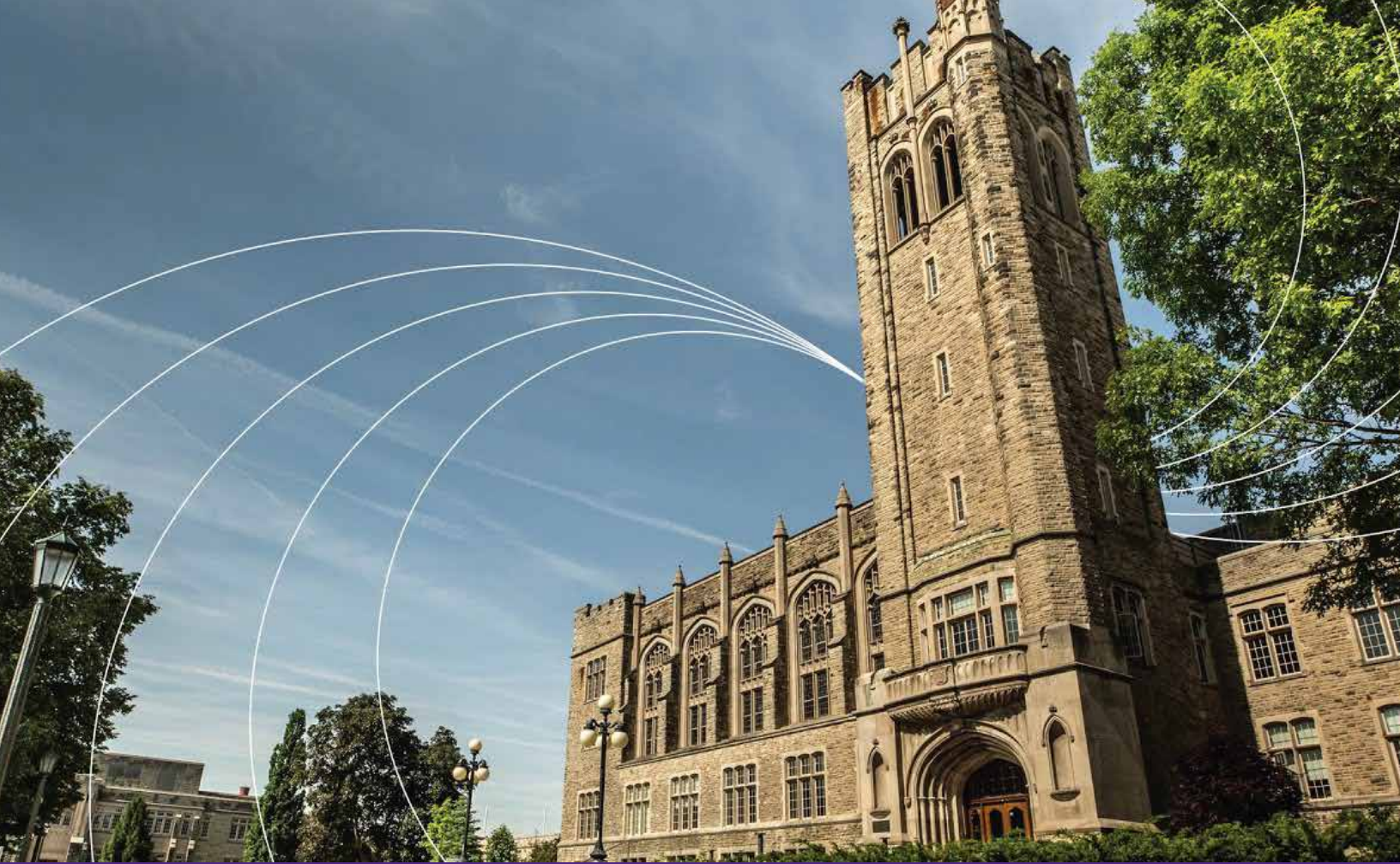
Join us in our mission to advance healthcare equity. Your support will be celebrated, recognized, and cherished. Together, we're shaping a healthier, more equitable world.





"Your partnership
isn't just an opportune;
it's a catalyst for change.
With your support, we're not
just imagining a better future;
we're building it, one innovation at a time."

Maria Drangova,
Professor, Medical Biophysics,
Director, BioNext



For more information on supporting the Frugal Biomedical Innovations Program at Western University, please contact:



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<https://www.eng.uwo.ca/biomed/research/Frugal-Biomedical-Innovations.html>

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