



**UNIVERSITY OF TORONTO TEMERTY CENTRE FOR  
AI RESEARCH AND EDUCATION IN MEDICINE**

# SELF-STUDY REPORT

**PERIOD**

October 2020 – December 2024

**ACADEMIC REVIEW**

February 4, 2025



Temerty Centre for AI Research  
and Education in Medicine  
UNIVERSITY OF TORONTO

Temerty  
Medicine



## T-CAIREM STAFF

### **DIRECTOR**

Muhammad Mamdani, *PharmD, MA, MPH*

### **MANAGER**

Zoryana Salo, *MSc, PhD*

### **ADMINISTRATIVE ASSISTANT**

Yolanda Durante

### **COMMUNICATIONS SPECIALIST**

Dominic Ali

### **BUSINESS DEVELOPMENT OFFICER**

Sedric Pankras

### **CURRICULUM AND EVENT COORDINATOR**

Marianne So

### **DATA GOVERNANCE AND QUALITY ANALYST**

January Adams

### **SOFTWARE ENGINEER**

Rutvik Solanki

### **Temerty Centre for Artificial Intelligence Research and Education in Medicine**

1 King's College Circle  
Medical Sciences Building, 6th floor  
Toronto, Ontario, M5S 1A8, Canada

[t.cairem@utoronto.ca](mailto:t.cairem@utoronto.ca)

[tcairem.utoronto.ca](http://tcairem.utoronto.ca)

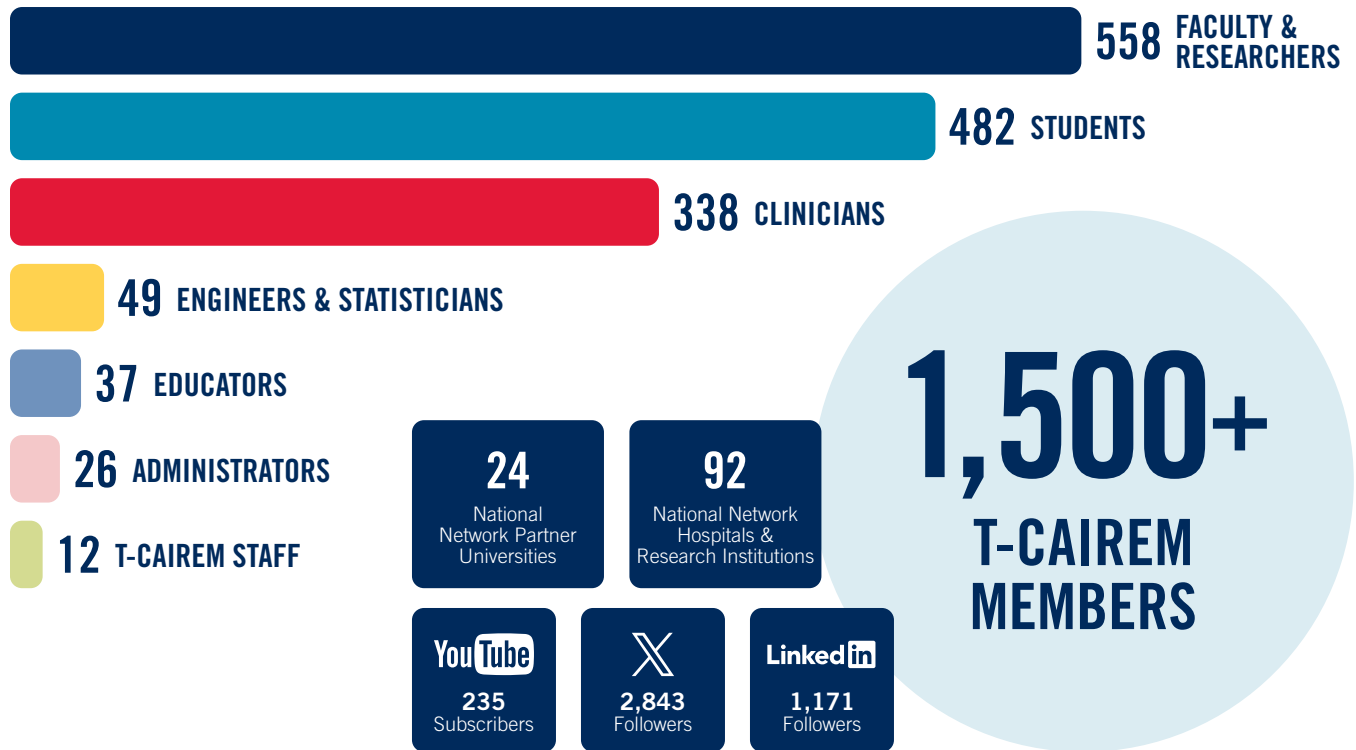
@UofT\_TCAIREM

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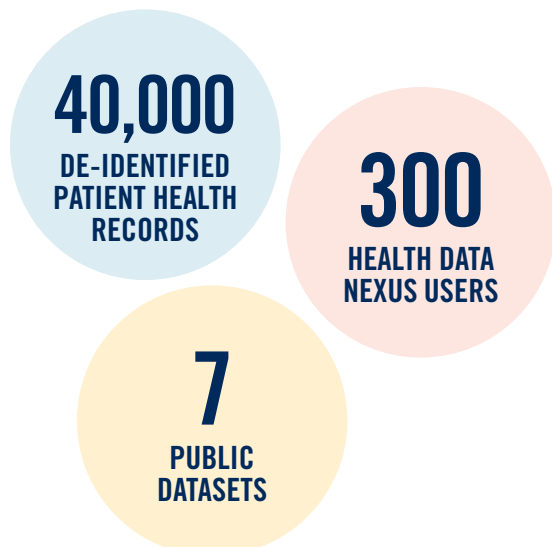
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# T-CAIREM AT A GLANCE

## Community



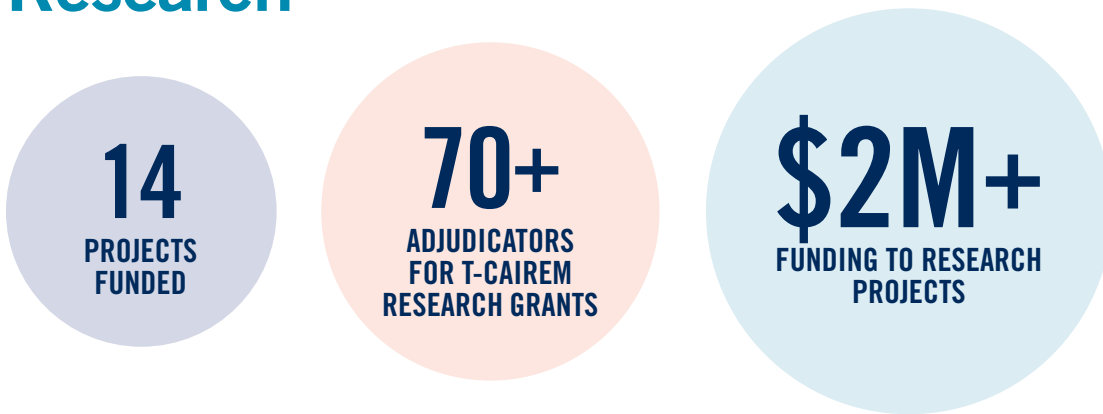
## Infrastructure



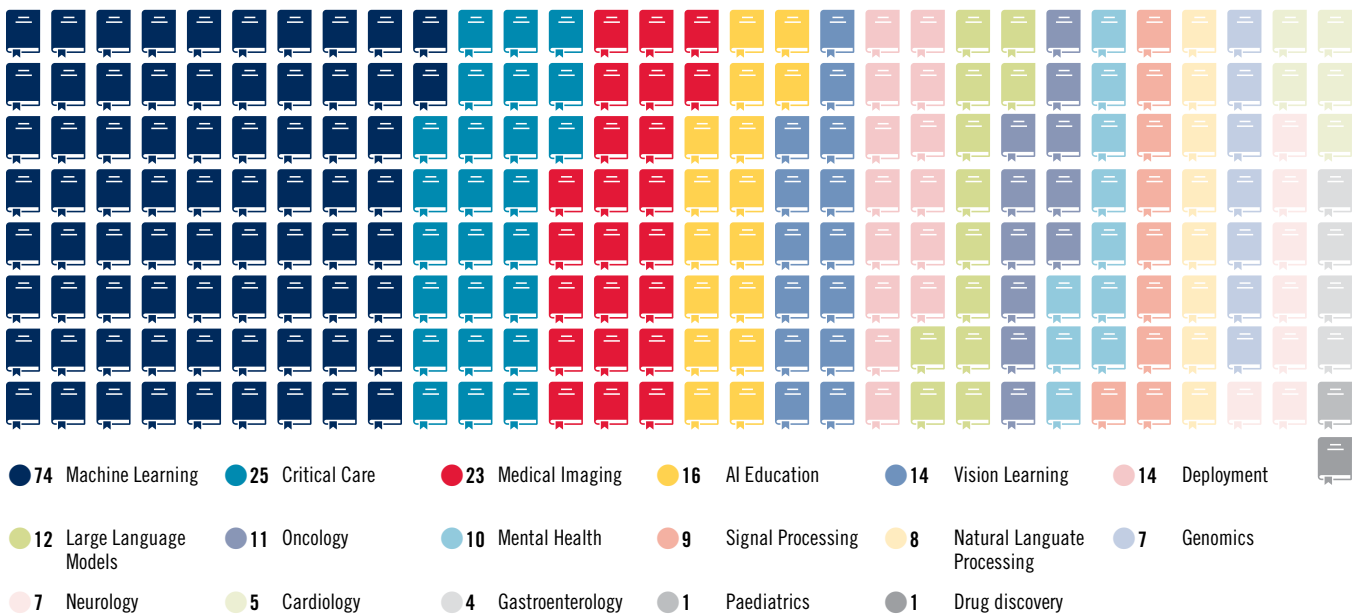
## Education



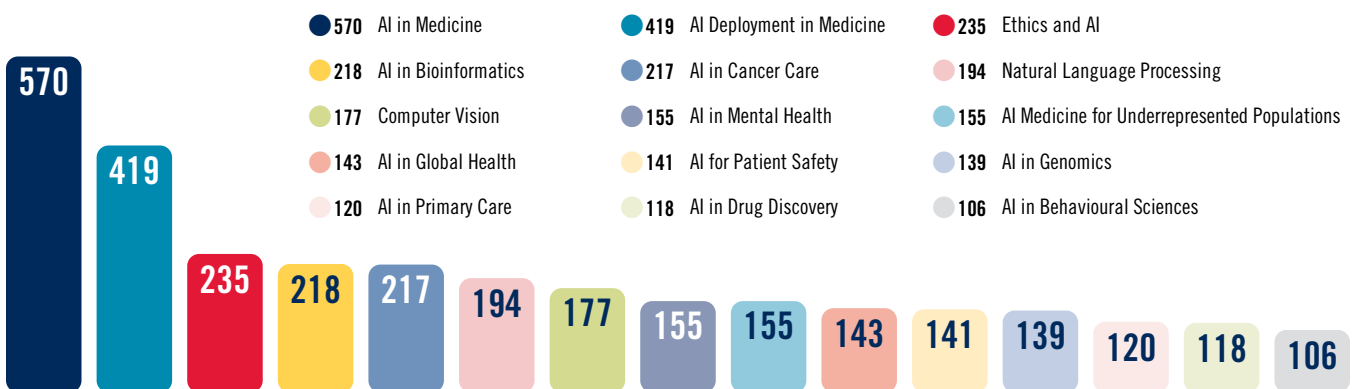
# Research



## RESEARCH AREAS



## RESEARCH INTERESTS





# DIRECTOR'S REPORT

**A**rtificial intelligence (AI) is rapidly permeating society and is poised to transform healthcare. The Temerty Centre for AI Research and Education in Medicine (T-CAIREM) was established in 2020 as an extra-departmental unit within the University of Toronto's Temerty Faculty of Medicine through a generous donation from the Temerty Foundation. While Canada has several excellent AI-focused organizations, such as the Vector Institute, Schwartz/Reisman Centre, Montreal-based MILA, and the Alberta Machine Intelligence Institute (Amii), none are solely focused on healthcare. From the onset, our vision was to be the landmark AI in medicine Centre in Canada. Indeed, in less than 4 years T-CAIREM has become the **largest AI in medicine network in Canada and among the largest in the world**, being recognized as the Institution of the Year by the international AI in medicine community in 2022.

Over the past four years, we have assembled an exceptional leadership team of clinicians, researchers, and staff to serve a multidisciplinary community of clinicians, computer scientists, statisticians, engineers, and others focused on advancing AI in medicine through education, research, and application. Our

core staff consists of 6 members, namely a manager, administrative assistant, communications specialist, curriculum coordinator, business development officer, and data governance analyst. Being a lean organization means we are nimble and able to react quickly to opportunities as they present themselves. For example, we were able to quickly decide to enter co-funding opportunities with external organizations and hold topical events such as our 2024 symposium devoted to the exciting subspecialty of multimodal AI.

Upon our launch in 2020, we purposely designed our programs to be accessible for a general audience unfamiliar with the nuances of AI in medicine while remaining substantial enough to attract and educate world leaders in diverse medical fields. Judging from our member feedback, attendance at our events, and enrollment in our workshops and courses, T-CAIREM is helping to make Toronto—and Canada, for that matter—a global hotbed of AI health innovation.

To date, we've **created a community of over 1,500 members across nearly 100 partner universities and research entities, established world-class AI in medicine training programs** for learners of all levels,

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**provided over \$2 million in funding to the research community**, and created a secure **health data platform to fuel applied AI learning and research**. Our cross-Canada community of talented AI health enthusiasts is working to advance this exciting field in the 21st century.

T-CAIREM's organizational structure is based on four overarching themes that mirror our programming: **Research, Education, Infrastructure, and Community**.

## RESEARCH THEME

Our Research theme, co-led by Anna Goldenberg and Devin Singh, seeks to advance scholarly work in basic science, clinical, translational, and responsible AI in health. We have established several awards aimed at supporting projects with the potential to greatly improve healthcare.

### Temerty Innovation Grant for AI in Medicine

This annual \$100,000 award funds novel health AI research projects with the potential to transform healthcare over the next 20 years.

### Family Medicine Innovation Grant

This annual \$100,000 award supports promising research that could impact family medicine by leveraging AI technologies.

### Vector Institute-Temerty Clinical AI Integration Grant

This \$300,000 award is intended for projects focused on translating health AI solutions into clinical practice.

### T-CAIREM Health Data Nexus Grants

These two \$50,000 grants encourage researchers to create unique datasets for T-CAIREM's flagship data and analytics platform - Health Data Nexus, which combines data publishing with cloud-based analytics.

## EDUCATION THEME

Our Education theme, led by Laura Rosella, also includes Education Trainee co-leads Abhishek Moturu and Gemma Postill. This team focuses on advancing health AI literacy and oversees training programs and workshops for students, researchers, and medical professionals.

### Applied AI Training

These courses, designed for medical professionals, help clinicians better understand AI principles and utilize AI solutions. We have also developed specialized training programs for non-clinicians and private sector.

### Workshops and Seminars

T-CAIREM frequently hosts events such as a monthly speaker series and professional development workshops to educate learners and trainees on the latest developments in AI for healthcare.

### Learning Research Competitions

Under the team's auspices, we host several initiatives, such as the T-CAIREM Annual Trainee Rounds Competition. This competitive seminar series showcases the work of emerging researchers to a larger audience.

## INFRASTRUCTURE THEME

Data remains the building block of AI. Unfortunately, health data is often difficult for researchers to easily access in a timely manner that maintains patient privacy. To fuel the development of AI models and algorithms, T-CAIREM has developed a secure platform – the Health Data Nexus – intended to make health data freely available to educators and researchers. Led by Benjamin Haibe-Kains and David Rotenberg, the Infrastructure team ensures the integrity of the datasets used by our members.

# DIRECTOR'S REPORT

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## Health Data Nexus (HDN)

T-CAIREM's unique online health data platform emphasizes patient privacy and security, provides transparent and speedy access to health data, and simplifies data discovery and analysis for researchers.

## HDN in the classroom

University of Toronto educators have used the Health Data Nexus for student assignments in graduate-level courses to teach the next generation of clinicians and researchers how to harness AI's incredible power.

## Datathons

In partnership with Google Cloud, T-CAIREM has organized two in-person datathons with dozens of participants in downtown Toronto. Attendees were divided into teams and tasked with using the HDN to address a healthcare research question. The participants' enthusiasm inspired us to launch a national datathon in 2024, undertaken in conjunction with the University of British Columbia and Dalhousie University.

## COMMUNITY ENGAGEMENT & PARTNERSHIPS

Our T-CAIREM Network of almost 100 partner Canadian universities and research institutions encourages collaboration among researchers, practitioners, and stakeholders from different disciplines. Led by Mamatha Bhat, T-CAIREM emphasizes the importance of community and collaboration in achieving its goals.

## International Partnerships

We have formed strategic alliances with global academic institutions and research centers, such as the Technion-Israel Institute of Technology and the Indraprastha Institute of Information Technology, Delhi (IIIT) to enhance the reach and impact of AI in healthcare and encourage global collaborations.

## Conferences and Events

We hosted academic symposia such as the two-day 2023 T-CAIREM Ideas to Impact Conference, which attracted more than 300 attendees and featured spirited discussions and more than 140 student presentations.

## University Departments

T-CAIREM routinely collaborates on co-funding and co-hosting opportunities with various faculties and departments at the University of Toronto, particularly the Data Sciences Institute, the Dalla Lana School of Public Health, and the Emerging & Pandemic Infections Consortium (EPIC).

## Hospitals and Research Institutes

We are fortunate to have theme leads who are working clinicians and health researchers with UofT-affiliated teaching hospitals such as the Princess Margaret Cancer Centre, University Health Network, Unity Health Toronto, CAMH, and the Hospital for Sick Children. Through established relationships with these hospitals and research institutes, we can draw on critical expertise to promote AI in biomedical and clinical research.

## National and International Networks

T-CAIREM is one of the few Canadian members in global AI in medicine consortiums, such as the Alliance for Centers of Artificial Intelligence Medicine (ACAIM) and the Pediatric Centers of AI in Medicine (PCAIM). We aim to be excellent representatives for Canada's AI health ecosystem and actively seek out global partners.

## COMMITMENT TO EQUITY, DIVERSITY, AND INCLUSION

T-CAIREM is deeply committed to equity, diversity, and inclusion. Our leadership team and staff are highly diverse with respect to age, gender, and ethnicity. This is also reflected in our membership policies and outreach efforts. For example, many of our events are



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free or provided at a reduced fee for students and those on a limited budget to ensure that diverse voices and perspectives are represented in our programs. Further, we strongly encourage considerations related to bias and equity in the research we support.

## FUTURE DIRECTIONS

From 2020-2024 we focused on establishing T-CAIREM's structure, core functions, and operations. Our next 3-5 years will focus on sustainability. Core areas of revenue growth that align with T-CAIREM priorities include private and public partnerships that enhance our education and research activities. Health AI literacy is routinely reported as being poor in both the public health sector and life sciences industry. Much needed health AI education initiatives in these sectors may serve a significant revenue source in the near-term. Further, there appears to be considerable interest in partnering with public and private sectors in advancing health AI research as well as establishing responsible health AI frameworks.

In achieving financial sustainability, we recently hired Sedric Pankras as our business development officer. With both a PhD and MBA, he's particularly suited to this role of negotiating arrangements with industry partners, public sector entities, and philanthropic organizations. Future theme-specific directions are outlined below.

### Research Theme

We will continue to build on our success with partnered research grants and funding opportunities and will grow our collaborations with the private sector as a new source of research funding. Further, we will continue to expand our collaborations outside of the University of Toronto ecosystem to explore research funding opportunities with other academic institutions and public sector entities. The types of research we will focus on will continue to be diverse and opportunistic, although we will aim to increasingly focus on the areas of responsible AI and health AI translation.

### Education Theme

While the field has seen substantial growth over the past few years, there continues to be a lack of high-quality AI training and education for medical professionals, not just in Canada but globally. We expect to expand our education program to include more AI health training opportunities and play a more prominent role in the recently established Master of Science in Applied Computing (MScAC) concentration offered by the Departments of Computer Science and Laboratory Medicine and Pathobiology (LMP). We anticipate considerable revenue generation opportunities through our education initiatives. In addition to more formal education initiatives, we are developing other training opportunities for different types of knowledge-seekers. For example, in 2024, we piloted a successful online Computing in Medicine course to train healthcare professionals in AI applications. We will also establish more workshops, seminars, and bootcamps for casual learners, like a March Break AI in Medicine Bootcamp for high school students. Further, we will have specialized education offerings for private sector to enhance revenue generation.

### Infrastructure Theme

Building the Health Data Nexus platform to ensure it is safe, secure, and easily accessible was one of the more complex challenges we have faced as an organization. However, we continued to refine it and used our datathons to stress test the platform for end-users. It now works smoothly for users of all levels. We expect this resource to become even more important in the future and will continue adding more datasets and improving accessibility for researchers and educators. In addition, as new threats such as hackers and computer viruses evolve, we will ensure the platform meets high security and governance standards to protect user data.

# DIRECTOR'S REPORT

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## Community Theme

One of T-CAIREM's greatest strengths is its community of passionate and talented members. To build on this success, we will build on the T-CAIREM Hive, an online AI in medicine community platform, to better facilitate collaboration and communication among members. Although the platform is helpful for some tasks, there are additional platforms that will encourage members to engage more with our programs and each other. Further, the annual T-CAIREM conference and symposium were extremely popular. Within days of opening registration, both events were filled. We will continue organizing these events to promote knowledge-sharing and networking among our diverse community of trainees, leaders, and decision-makers. Future plans include making these events accessible globally. Additionally, we plan on expanding our international relationships and more formally secure joint funding and research initiatives that address global health challenges using AI.

Finally, we plan on engaging with private sector through a membership model with annual membership fees that will generate additional revenue for T-CAIREM.

Through the outlined activities and future direction, we hope to further strengthen our global leadership position in AI in medicine.

This Self-Study Report is an excellent opportunity to reflect on T-CAIREM's growth, successes, and challenges. As AI healthcare continues to achieve mainstream acceptance, the need for solid education and research in this field will only become more significant. In this first Self-Study Report, we detail T-CAIREM's growth and accomplishments from 2020 to 2024. We also profile our activities and projects, research interests of our members, our current funding model, and our bold strategic plans.

Sincerely,



**Muhammad Mamdani,  
PharmD, MA, MPH (he, him)**

**VICE PRESIDENT** – *Data Science and  
Advanced Analytics, Unity Health Toronto*

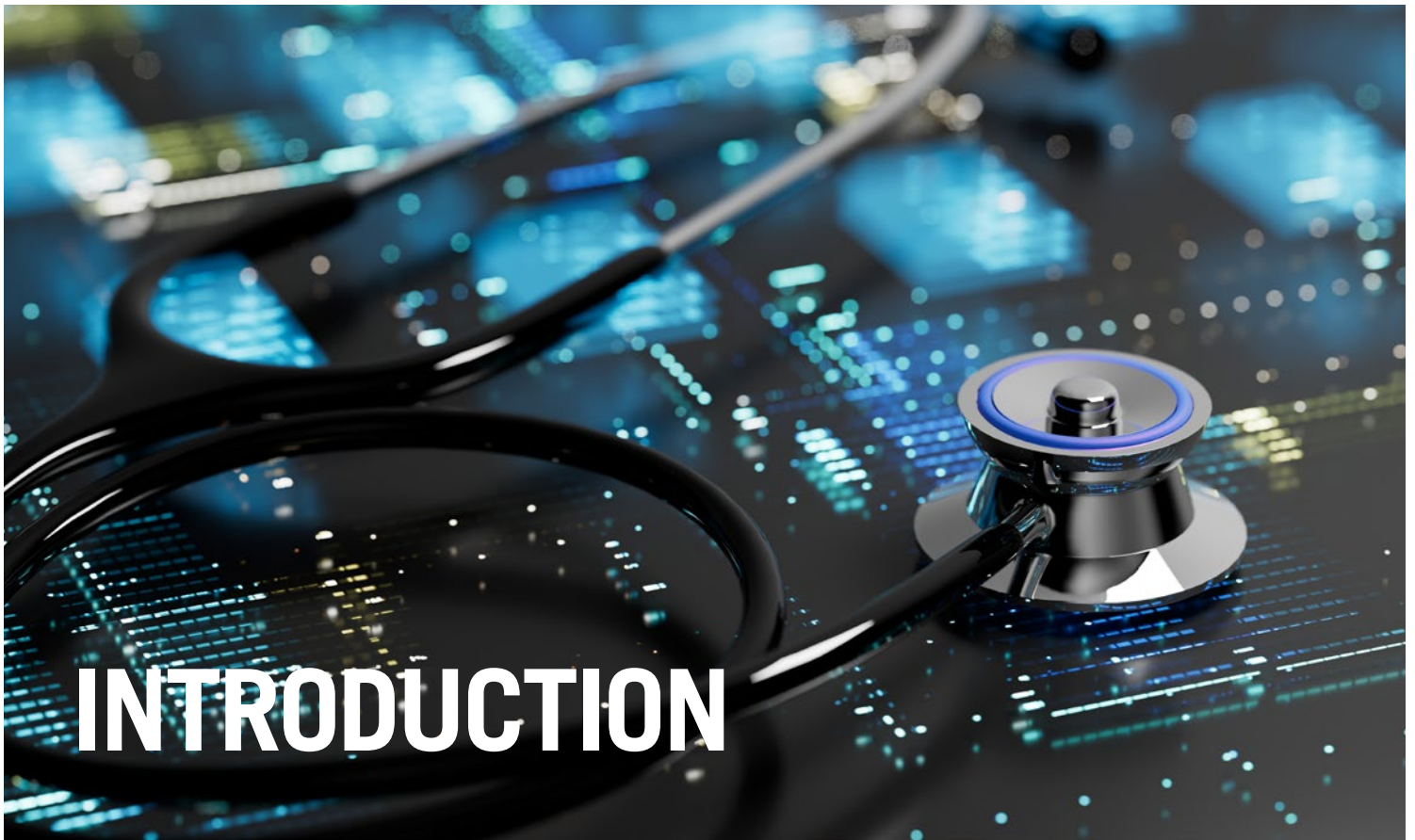
**ODETTE CHAIR** *in Advanced Analytics*

**FACULTY AFFILIATE** – *Vector Institute*

**DIRECTOR** – *University of Toronto Temerty  
Centre for Artificial Intelligence Research  
and Education in Medicine (T-CAIREM)*

**PROFESSOR** – *University of Toronto*





# INTRODUCTION

**A**rtificial Intelligence (AI) is widely considered society's next technological revolution. The University of Toronto (UofT) is uniquely placed to capitalize on this opportunity and become a world-leading AI hub. The institution already produces cutting-edge research in AI fields such as machine learning, deep learning, neural networks, algorithm development, voice and facial recognition, natural word analysis, robotics, and many others. When applied to medicine, this research has immense potential to transform the understanding of human disease and treatments, delivery of medical care, enable the implementation of precision medicine, and improve human health.

The Temerty Faculty of Medicine at the UofT is one of the top medical schools in the world and is recognized as a clinical research powerhouse. However, large organizations are often challenged with coordinating efforts within and across institutions to maximize learning and productivity. While many groups conduct AI in medicine research across Temerty Medicine and other UofT departments and faculties, several are unaware of complementary research activities taking place outside their specific area.

The rationale behind establishing the Temerty Centre for AI Research and Education in Medicine (T-CAIREM) was to bring together the core strengths across the University and create a collaborative environment where researchers could interact and catalyze collaborations. Since then, T-CAIREM has focused on bringing together researchers that develop AI algorithms (e.g., computer and data scientists, engineers) with end-users (health care practitioners). Our goal is to advance AI in medicine research, education, and translation into clinical settings to transform healthcare delivery around the world.

The sections that follow outline T-CAIREM's inception, vision, mission, goals, and organizational structure. They also explain T-CAIREM's commitment to equity, diversity and inclusion, and the research Centre's significant developments since its launch in 2020.

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# Background

T-CAIREM at UofT was formally established in July 2020 through a generous donation from the Temerty Family (Figure 1). T-CAIREM is an interdepartmental centre that serves as a focal point for collaboration between healthcare providers, trainees, researchers, computer scientists, engineers, and industry to advance healthcare through AI. In its initial strategic plan (Appendix 1 Document 1), T-CAIREM established core themes – research, education, and infrastructure – that are driven by community engagement efforts (Figure 2). T-CAIREM embodies Temerty Medicine’s current Ecosystem of Collaboration strategic plan pillar by supporting collaborations that fuse the diverse strengths of our members and creates new possibilities for research, education and AI health solutions. As an EDU:C, T-CAIREM does not offer degree programs and individuals cannot hold a faculty appointment with T-CAIREM.



**FIGURE 1:** James Temerty announcing donation to the University of Toronto in 2020

# INTRODUCTION

## T-CAIREM VISION

Transforming Health Through AI

## T-CAIREM MISSION

Advance research, education, knowledge dissemination, and digital infrastructure in the field of AI in medicine through an engaged community.

## T-CAIREM GOALS

T-CAIREM's goals are centred around four core themes of community, research, education, and infrastructure:

- Create a multidisciplinary, inclusive, and diverse community of engaged members united to advance healthcare through AI.
- Foster multidisciplinary, collaborative research in AI in medicine and health sciences and encourage clinical translation.
- Establish a leading education program in applied AI for medical and health science professionals and learners.
- Establish a robust environment enabling timely access to high-quality health data that fuels innovation, research, quality, and education programs.

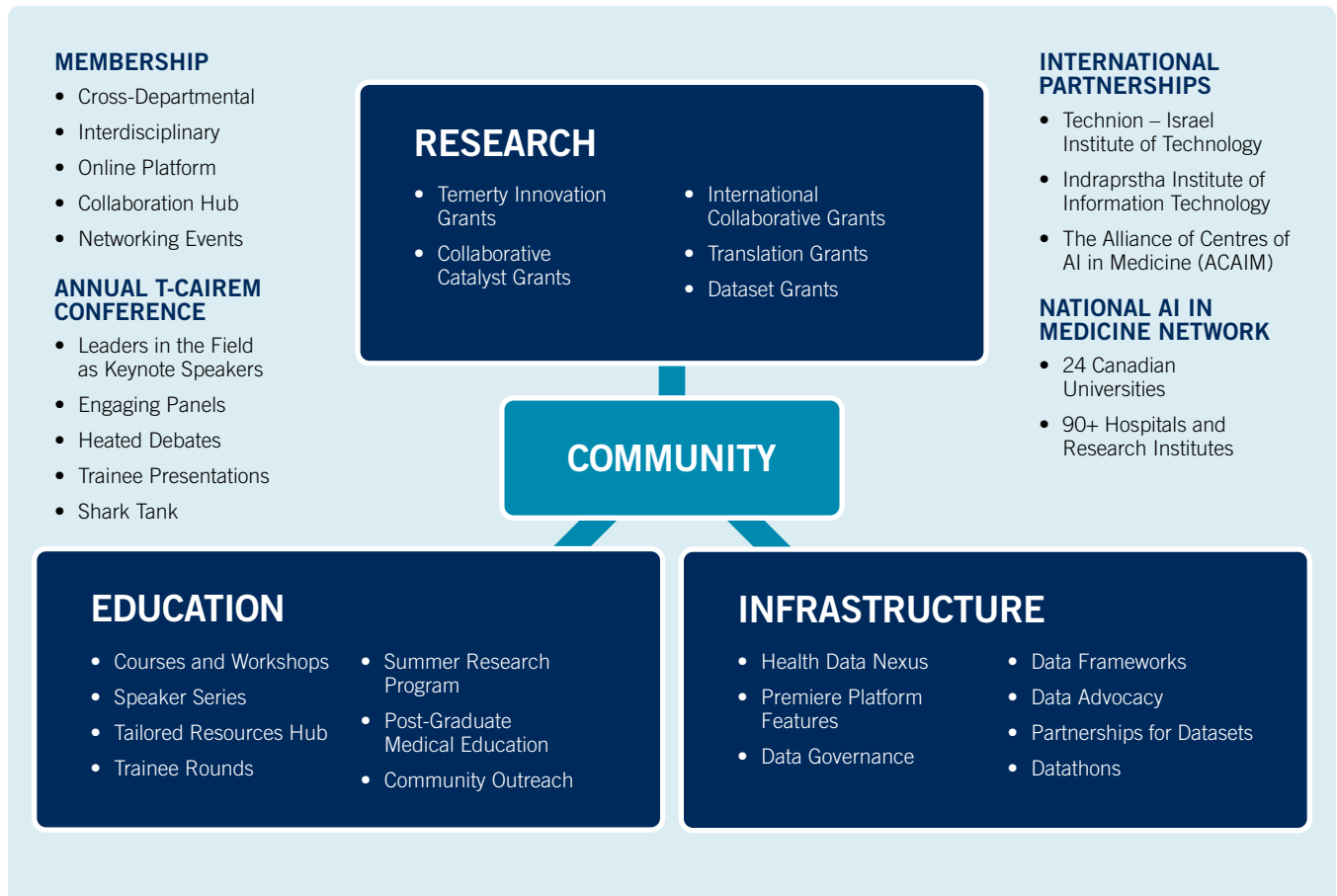


FIGURE 2: Initial T-CAIREM Strategic Overview

# Organizational Structure

T-CAIREM has set up a governance structure (Figure 3) that engages stakeholders through an efficient and transparent process that efficiently uses its financial and human resources. The T-CAIREM Director reports to the Executive Committee and the Dean of Temerty Faculty of Medicine. The Director and the Executive Committee form the principal decision-making body of T-CAIREM. The T-CAIREM Advisory Committee provides insights on the planned direction, mission, goals, and activities in addition to counselling on strategic partnerships, performance, and future directions. T-CAIREM's Theme Leads direct the development of programming within their areas and collectively comprise the principal working committee.

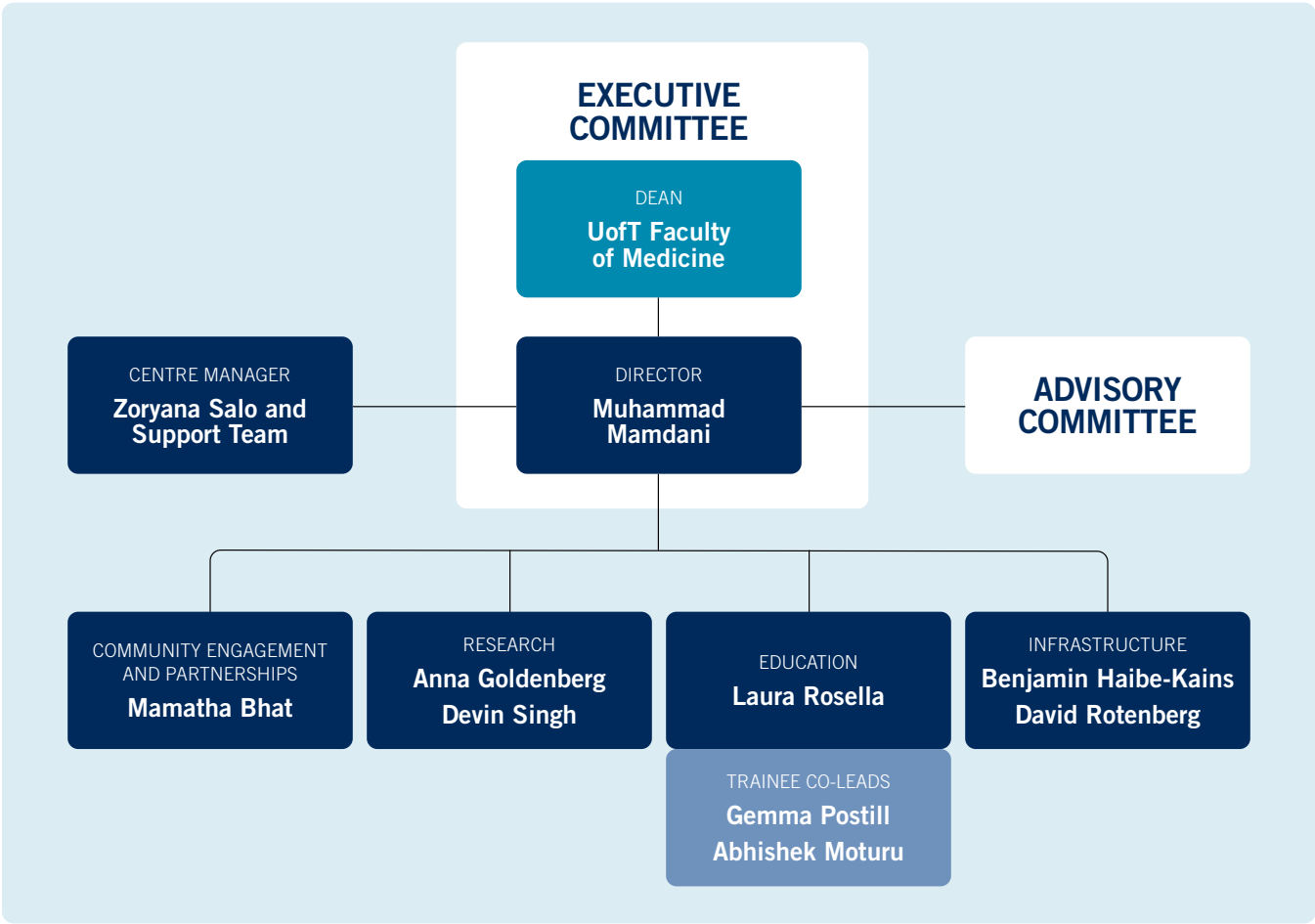


FIGURE 3: T-CAIREM Governance Structure

# INTRODUCTION

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## T-CAIREM DIRECTOR AND EXECUTIVE COMMITTEE

T-CAIREM's governance structure consists of a Director, Muhammad Mamdani, and Executive Committee. Together they provide oversight of all operations including finance and are responsible for promoting T-CAIREM. The T-CAIREM Director reports to the Dean of Temerty Medicine and is also a member of the T-CAIREM Executive Committee. The T-CAIREM Director is appointed for an initial term of five years, renewable for another five years following an external review. In accordance with University of Toronto policy, directors are limited to serve a maximum of two terms (ten years). T-CAIREM Executive Committee Terms of Reference can be found in Appendix 1, Document 2. The mandate of the T-CAIREM Executive Committee is to:

- Provide guidance for key strategic initiatives of T-CAIREM.
- Advise on matters related to the strategic direction and implementation of T-CAIREM Vision, Mission and Goals from T-CAIREM leadership.
- Ensure that T-CAIREM is operating in alignment with its Vision, Mission, and Goals.
- Endorse the strategic plan including a financial model on a rolling seven-year basis.
- Review and approve the annual operating plans, including the budget, ensuring they align with the strategic plan.
- Recruit and recommend the T-CAIREM Director to the Dean.
- Review the T-CAIREM Annual Report.
- Advise on potential opportunities including those that promote collaboration.
- Monitor compliance with UofT policies and processes relevant to academic and clinical activities, including ethics and standard practices.

## Current Executive Committee Members

### LISA ROBINSON

*Dean, Temerty Medicine (Chair)*

### MUHAMMAD MAMDANI

*T-CAIREM Director*

### RITA KANDEL

*Chair of Laboratory Medicine and Pathobiology*

### DANIELLE MARTIN

*Chair, Family and Community Medicine*

### MOIRA KAPRAL

*Chair, Medicine*

### HEATHER ROSS

*Scientific Lead, Ted Rogers Centre for Heart Research*

### BRIAN WONG

*Director, Centre for Quality Improvement and Patient Safety*

### JASON MANAYATHU

*Director, TAHSN*

### TIMOTHY CHAN

*Associate Vice-President and Vice-Provost, Strategic Initiatives, University of Toronto*

### DARINA LANDA

*Executive Director, Advancement, Temerty Faculty of Medicine*

### SUJAY NAGARAJ

*Student Representative, University of Toronto*

## T-CAIREM ADVISORY COMMITTEE

The T-CAIREM Advisory Committee provides insights on the research Centre's planned direction, mission, goals, and activities and advises on strategic partnerships and performance. T-CAIREM Advisory Committee members possess unique skills and backgrounds and represent a wide range of expertise from relevant disciplines. T-CAIREM Advisory Committee Terms of Reference can be found in Appendix 1, Document 3.



## Current Advisory Committee Members

### MUHAMMAD MAMDANI

Director, T-CAIREM (Chair)

### MIKE LORD

Temerty Group

### ADRIANO VISSA

Associate Director of Corporate Partnerships, Faculty of Applied Science and Engineering at University of Toronto

### PETER LEE

Corporate Vice President and Head of Research, Microsoft

### BRADLEY ERIKSON

Medical Director for AI, Mayo Clinic

### SUSAN MCCAHAN

Vice-Provost, Academic Programs and Vice-Provost, Innovations in Undergraduate Education, University of Toronto

### MARY JANE DYKEMAN

Managing Partner, INQ Law

### MICHAEL BRUDNO

Chief Data Scientist, University Health Network

### JETHRO KWONG

Trainee Representative, University of Toronto

## T-CAIREM LEADERSHIP TEAM

Along with the Director, Theme Leads comprise the T-CAIREM leadership team. Theme Leads are responsible for setting the direction and managing the deliverables of their themes. Theme Leads serve for a renewable one-year term and the current leadership team consists of experts dedicated to pioneering advancements in the field of AI in medicine (Figure 4).

### Current Theme Leads

#### MAMATHA BHAT

Community Partnerships and Engagement Theme

#### ANNA GOLDENBERG

Research Theme

#### DEVIN SINGH

Research Theme

#### LAURA ROSELLA

Education Theme

#### GEMMA POSTILL

Education Theme

#### ABHISHEK MOTURU

Education Theme

#### BENJAMIN HAIBE-KAINS

Infrastructure Theme

#### DAVID ROTENBERG

Infrastructure Theme

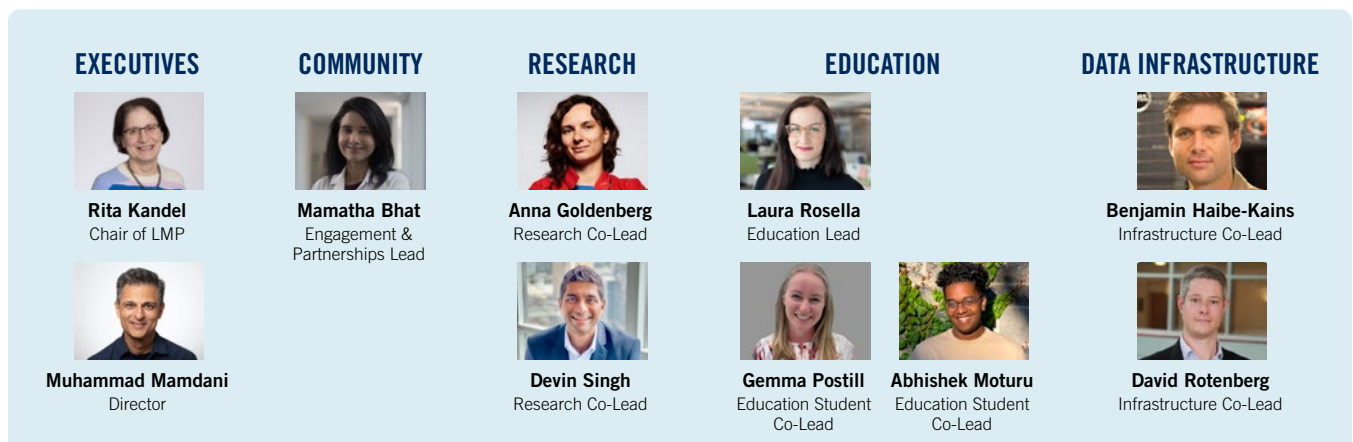


FIGURE 4: T-CAIREM Leadership Team

# INTRODUCTION

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## T-CAIREM ADMINISTRATIVE TEAM

Several individuals support the activities of T-CAIREM, including managing the day-to-day operations of the Centre, execution of Centre's programs, communications, education program, and data infrastructure.

### T-CAIREM Administrative Team

#### **NELSON CABRAL**

*Business Director, Director of Laboratory Medicine and Pathobiology*

#### **ZORYANA SALO**

*Manager*

#### **DOMINIC ALI**

*Communications Specialist*

#### **YOLANDA DURANTE**

*Assistant*

#### **SEDRIC PANKRAS**

*Business Development Officer*

#### **MARIANNE SO**

*Curriculum and Event Coordinator*

#### **JANUARY ADAMS**

*Data Governance and Quality Analyst*

#### **RUTVIK SOLANKI**

*Software Engineer*

## Equity, Diversity, and Inclusion Commitment

In alignment with Temerty Medicine's current academic strategic plan pillar of Excellence through Equity, T-CAIREM champions the principles of equity,

diversity, and inclusion in all aspect of its work. The development and implementation of AI health solutions work best when different professionals collaborate and bring together diverse knowledge, expertise, and training. The T-CAIREM leadership team is committed to using AI to improve healthcare, especially for those experiencing inequities resulting from identity, gender, geographic location, disability, or other socio-demographic factors. T-CAIREM strives to engage people with varied ethnocultural and life experiences in all its committees and programs. Indeed, the T-CAIREM leadership and staff reflect a wide variety of characteristics such as age, gender, and ethnicity. Inclusive, non-gendered language is encouraged in all T-CAIREM discussions, and the team aims to create a respectful environment where everyone is encouraged to share their viewpoints. T-CAIREM supports flexible working conditions and virtual meetings to maximize participation. Most of T-CAIREM events are free or carry a minimal registration fee to accommodate participants of different socio-economic backgrounds. In addition, T-CAIREM also promotes events nationally and internationally, giving interested learners and researchers from across the globe an opportunity to participate. Most of T-CAIREM events are also hybrid, in order to accommodate participants who may not be able to travel to in-person events.

## Significant Developments in the Last Four Years

T-CAIREM has achieved several significant milestones in the last four years. These milestones are addressed in detail throughout this report. Figure 5 outlines the highlights over the past four years.

# 2020

## T-CAIREM OFFICIALLY LAUNCHED IN OCTOBER

- Dr. Muhammad Mamdani appointed as T-CAIREM Director
- T-CAIREM Leadership Team selected
- T-CAIREM Staff onboarded
- T-CAIREM begins accepting members from across UofT and affiliate Centres
- T-CAIREM website launched

# 2021

## T-CAIREM WINS AIMED HOSPITAL / INSTITUTION OF THE YEAR AWARD

- T-CAIREM National AI in Medicine Network launched
- T-CAIREM membership opened to members of T-CAIREM Network
- T-CAIREM membership surpasses 1,000 members
- T-CAIREM signs MOU with Technion Israel Institute of Technology
- Dr. Amol Verma appointed as T-CAIREM Professor
- Vector Institute Temerty Clinical AI Integration Grant launched
- Family Medicine Temerty AI Innovation Grant launched
- Health Data Nexus Launched

## T-CAIREM PROGRAMMING LAUNCHED

- T-CAIREM Executive and Advisory Committees formed
- T-CAIREM Hive online member platform is launched
- T-CAIREM social media accounts launched
- T-CAIREM Buzz monthly newsletter launched
- T-CAIREM Collaboration Hub launched
- Dr. Bo Wang appointed as T-CAIREM Professor
- Temerty Innovation Grants for AI in Medicine launched
- Monthly Temerty Centre Speaker Series launched with Dr. Eric Topol
- T-CAIREM Summer Research Program launched
- T-CAIREM Trainee Rounds launched
- Ask a Scientist session launched with Toronto District School Board

# 2022

## T-CAIREM CONFERENCE: IDEAS TO IMPACT ATTRACTS OVER 300 ATTENDEES

- T-CAIREM social media followers surpasses 3,000
- T-CAIREM signs MOU with Indraprastha Institute of Information Technology Delhi
- T-CAIREM and Technion delegates participate in joint workshop in Israel
- T-CAIREM Technion AI in Medicine Catalyst Grant awarded
- Data Sciences Institute / Temerty Catalyst Grants launched
- AI for Population Health and Health Systems Implementation Grant launched
- Health Data Nexus Dataset Grants launched
- AI in Medicine curriculum introduced into the Temerty Faculty of Medicine's post-graduate medical education
- Inaugural Toronto Health Datathon
- Health Data Nexus available as educational resource

# 2023

## T-CAIREM SUSTAINABILITY PLAN LAUNCHED

- T-CAIREM Partners Program launched
- T-CAIREM AI in Medicine Professional Development courses launched
- T-CAIREM Symposium: Multimodal Data
- T-CAIREM hosts international ACAIM/PCAIM meeting
- T-CAIREM hosts National Datathon

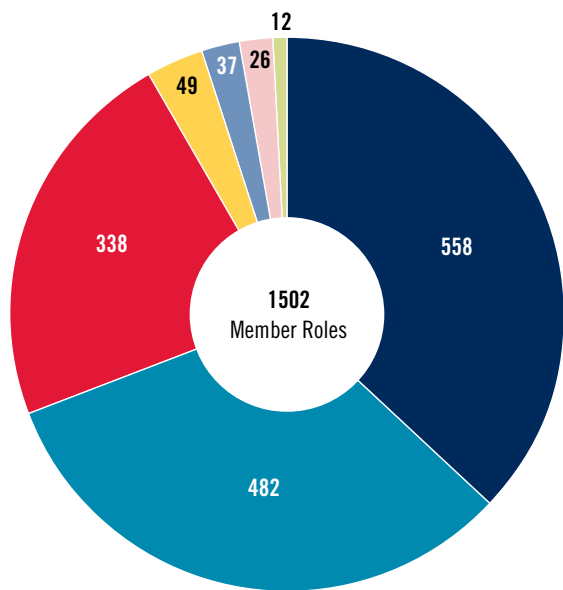
# 2024



**B**uilding a strong AI in medicine community is a key priority for T-CAIREM. The main benefit of the community is the connection that it offers to members. T-CAIREM's Community Theme is led by Mamatha Bhat, Hepatologist and Clinician-Scientist at University Health Network's Ajmera Transplant Centre. T-CAIREM has worked diligently to create a community that allows members to interact with one another, engage in collaborations, and share information. The sections below outline T-CAIREM community-building efforts including the Centre's membership model as well as internal and external relationships.

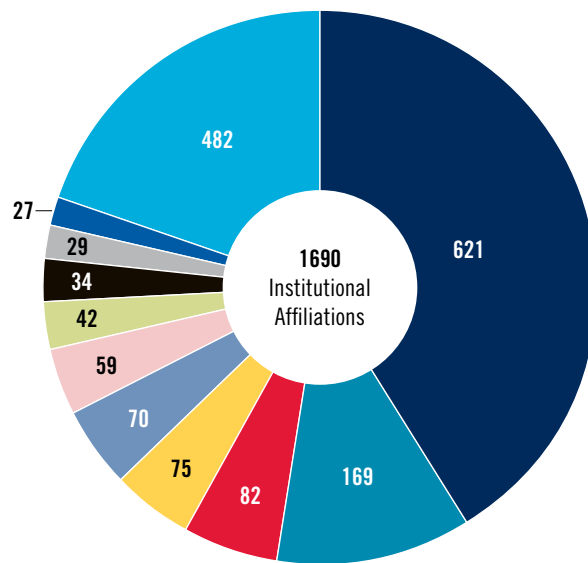
## T-CAIREM Membership

T-CAIREM is a cross-departmental, interdisciplinary academic Centre that strives to accelerate AI in medicine research and training throughout the University of Toronto and beyond. Current membership includes more than 1,500 faculty, clinicians, researchers, and trainees involved in AI in medicine from universities across Canada. A full list of T-CAIREM members can be found in Appendix 2, Table 1. T-CAIREM members are frequently profiled on the T-CAIREM website: [tcairem.utoronto.ca/our-members](https://tcairem.utoronto.ca/our-members) and monthly newsletter. As of April 2024, 32% of T-CAIREM members were students, 24% were scientists (6% specifically computer scientists), and 23% were clinicians (Figure 6). Most T-CAIREM members are affiliated with the University of Toronto and affiliate hospitals across Greater Toronto Area (Figure 7). Members also have a variety of research interests in the AI in medicine field (Figure 8).



- 558 Faculty & Researchers
- 482 Students
- 338 Clinicians
- 49 Engineers & Statisticians
- 37 Educators
- 26 Administrators
- 12 T-CAIREM Staff

FIGURE 6: T-CAIREM Member Roles (as of April 2024)



- 621 University of Toronto
- 169 University Health Network
- 82 Unity Health
- 75 The Hospital for Sick Children (SickKids)
- 70 Sunnybrook Health Sciences Centre
- 59 McGill University
- 42 McMaster University
- 34 Sinai Health
- 29 Centre for Addiction and Mental Health
- 27 McGill University Health Centre
- 482 Others

FIGURE 7: T-CAIREM Members' Institutional Affiliations

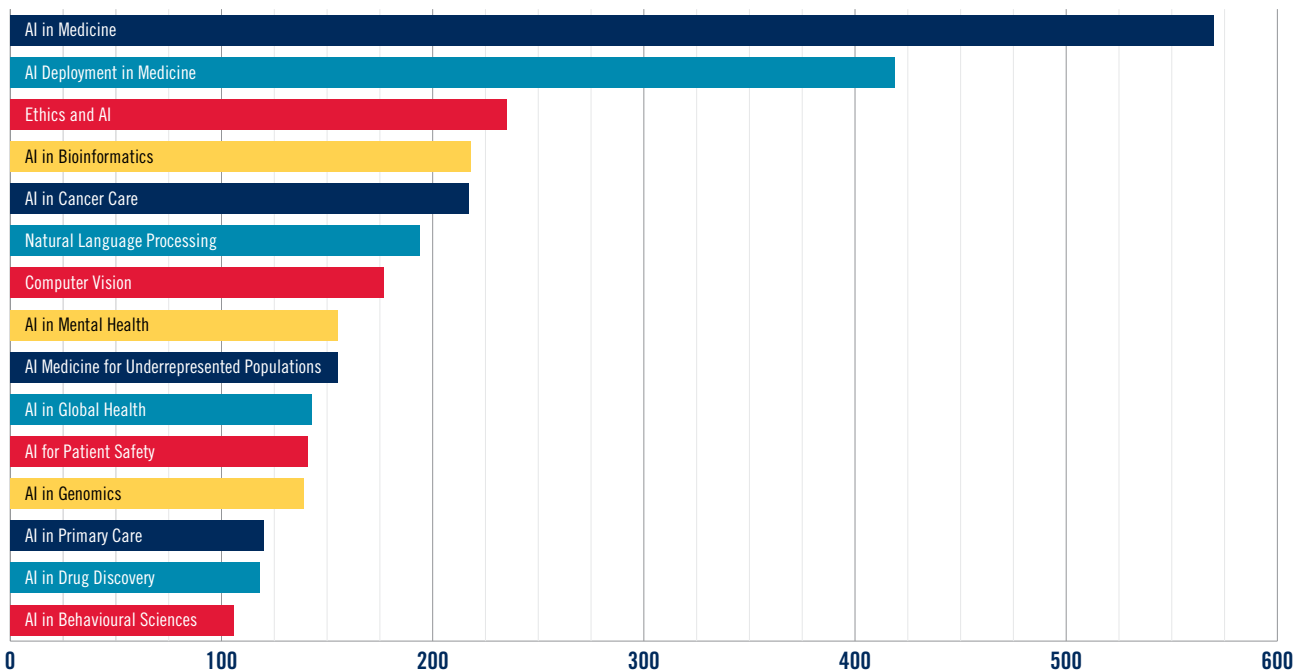


FIGURE 8: T-CAIREM Members' Research Interests

# COMMUNITY

## ELIGIBILITY

T-CAIREM membership is free and open to individuals with an interest in AI in medicine research or education who are affiliated with a Canadian university or more than 90 research Centres (i.e. scientists, physicians, computer scientists, nurses, engineers, etc.).

## BENEFITS OF MEMBERSHIP

T-CAIREM membership offers several benefits:

- Opportunities to be a part of Canada's largest AI in medicine network.
- Members receive our monthly newsletter, and notifications about events, funding programs, and educational opportunities.
- Members have the option to be listed in the public T-CAIREM directory, giving them and their research interests greater exposure to potential opportunities.
- Members receive invitations to attend T-CAIREM conferences, lectures, symposiums, and other events.
- Members are eligible to apply for our funding and educational programs.

## COMMUNICATION WITH MEMBERS

Communicating with our members is integral to T-CAIREM. We established several communication channels to ensure that members stay engaged with our programming.

### T-CAIREM E-Mail List

All T-CAIREM members are added to an e-mail list with approximately 2,600 unique subscribers. The list is also open to non-members around the world with an interest in our work. Subscribers receive information regarding the Temerty Centre

Speaker Series, funding announcements, the monthly T-CAIREM Buzz newsletter, in addition to announcements of upcoming events and activities.

### T-CAIREM Website

The T-CAIREM website ([tcairem.utoronto.ca](http://tcairem.utoronto.ca)) is an essential component of T-CAIREM's communications strategy (Figure 9). The website is used to share information about our events and activities, establishes our brand, and allows T-CAIREM to reach a global audience. According to Google Website Analytics, over the past year 34,000 active users visited the T-CAIREM website. The website receives about 8,000 views per month and an average user visits three T-CAIREM pages on the site.

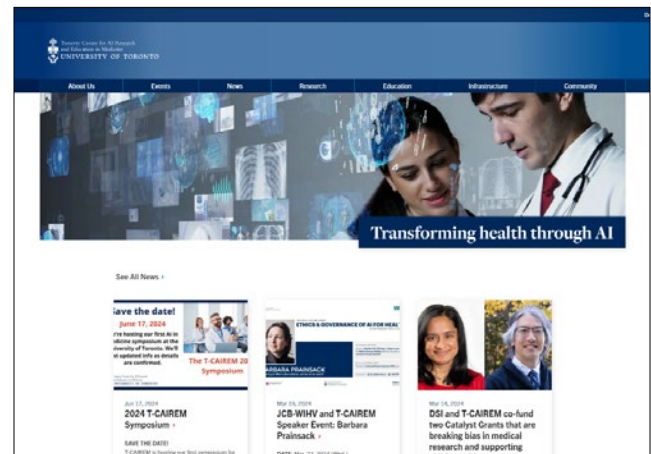


FIGURE 9: T-CAIREM Website

### T-CAIREM Social Media

Recognizing the importance of promoting the T-CAIREM brand globally, we operate social media accounts on LinkedIn and X (formerly known as Twitter) (Figure 10). Social media allows us to provide real-time information, connect with other clinicians and researchers, and form niche communities. Today, T-CAIREM's social media accounts have approximately 4,000 followers.

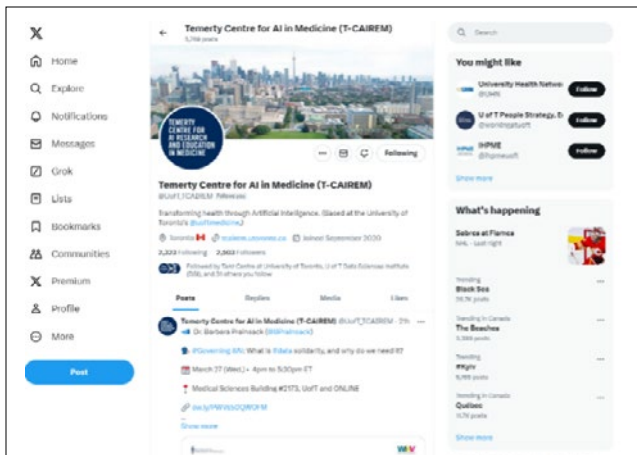


FIGURE 10: T-CAIREM X Account

## T-CAIREM Newsletter

The T-CAIREM Buzz is a free monthly electronic newsletter disseminated to all members and subscribers (Figure 11). Currently, the T-CAIREM newsletter goes out to approximately 2,600 unique subscribers. The newsletter highlights upcoming events, funding opportunities, award results, speakers, and provides us with an excellent opportunity to raise brand awareness and share important news. Current and past issues of the newsletter are available on our website: [tcairem.utoronto.ca/t-cairem-newsletter](https://tcairem.utoronto.ca/t-cairem-newsletter).

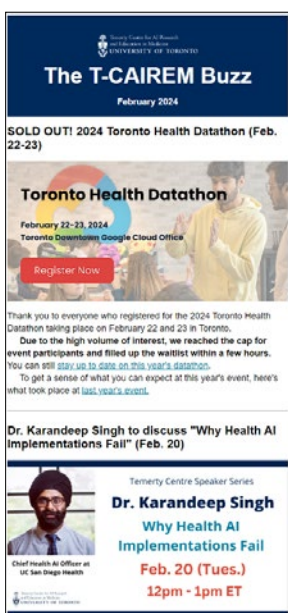


FIGURE 11: T-CAIREM Buzz Newsletter

## T-CAIREM Online Platform

The T-CAIREM Hive, hosted on the Hivebrite digital platform, is an exclusive online community available only to T-CAIREM members (Figure 12). It aims to foster a culture of teamwork by helping members connect and collaborate to transform AI in medicine. Within the Hive, members can learn about funding opportunities, directly communicate with one another, share information, launch online interest groups, and develop novel research with other members. The T-CAIREM Hive is also available as a mobile app and allows members continuous connection. Currently, over 62% of our members are active on the Hive.

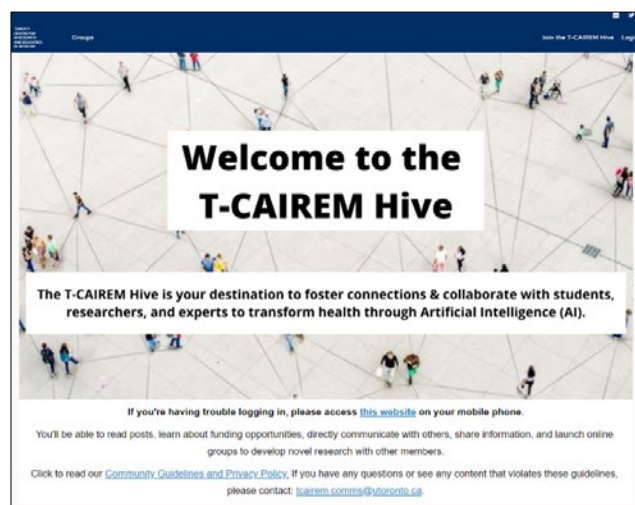


FIGURE 12: T-CAIREM Hive Community Platform

## T-CAIREM Collaboration Hub

As part of T-CAIREM's goal to build an AI in medicine community and encourage engagement (Figure 13), we launched the T-CAIREM Collaboration Hub ([tcairem.utoronto.ca/collaboration-hub](https://tcairem.utoronto.ca/collaboration-hub)). This is a free listing service that helps researchers connect with trainees to find data and skills required for their projects. It also helps individuals and groups with disparate needs connect (e.g., clinicians searching for data scientists to work with and vice versa). Anecdotal evidence suggests that it has helped many researchers find the talent they need to advance their projects.

# COMMUNITY

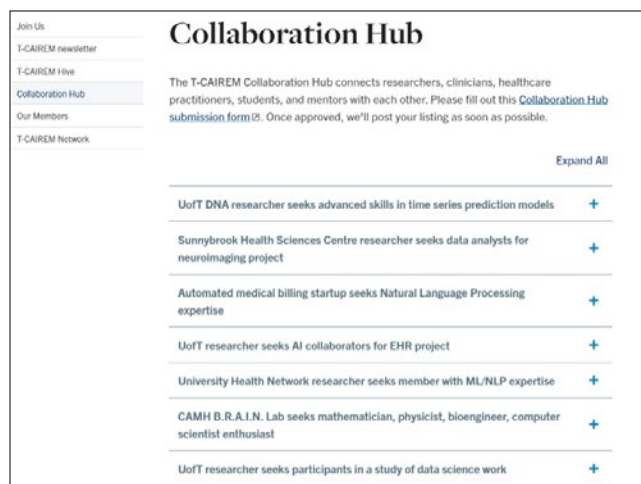


FIGURE 13: T-CAIREM Collaboration Hub

## Internal Relationships

T-CAIREM has established meaningful relationships across the University of Toronto's various departments, affiliated hospitals, and research institutes. We frequently contact staff members at other departments to collaborate on events and funding opportunities and amplify suitable events and information through each other's social media channels.

## UNIVERSITY OF TORONTO FACULTIES AND DEPARTMENTS

T-CAIREM is housed at the Department of Laboratory Medicine and Pathobiology (LMP) at the Temerty Faculty of Medicine and maintains a close working relationship with LMP Chair Rita Kandel. T-CAIREM's research, innovation, and education themes are integral components of LMP's 2023-2028 Strategic Plan. In 2023, LMP demonstrated its commitment to training future generations of healthcare researchers and clinicians by launching a Master of Science degree in Applied Computing in AI in Healthcare headed by T-CAIREM Research Lead Anna Goldenberg.

As an interdepartmental, multidisciplinary Centre, we also maintain relationships with other departments across the Temerty Faculty of Medicine. T-CAIREM regularly presents at the Temerty Medicine All-Chairs meeting and routinely seeks input and feedback from Department Chairs across the faculty. T-CAIREM's Communications Specialist frequently liaises with other communications colleagues to disseminate information about T-CAIREM's programs across the faculty's departments and divisions.

Many T-CAIREM community members are engineers, computer scientists, data scientists, mathematicians, and statisticians, who work in the field of AI in medicine. As a result, we maintain close working relationships with the Faculty of Engineering and Applied Science (FEAS), and specifically the Centre for Analytics and AI Engineering (CARTE) to engage faculty and staff. In fact, members from faculties across the U of T also sit on the T-CAIREM Executive and Advisory Committees. We also continue to engage important relationships with the Faculty of Arts and Science's Departments of Computer Science, Mathematics, Statistical Sciences, and Data Sciences Institute. Several members of the T-CAIREM leadership team are appointed and cross-appointed to the Department of Computer Science. T-CAIREM's Laura Rosella is also an associate director at the Data Sciences Institute. We work closely with departments such as the Dalla Lana School of Public Health on co-sponsored grant opportunities and the Joint Centre for Bioethics on collaborative speaker series events.

## UNIVERSITY OF TORONTO AFFILIATED HOSPITALS AND RESEARCH INSTITUTES

Toronto's hospitals and research centres are leading the way in research and innovation. To best harness this critical mass, T-CAIREM works with several UofT-affiliated hospitals and research institutes.

The T-CAIREM Executive and Advisory Committees include representation from most of the University of Toronto's fully affiliated hospitals and research institutes, and T-CAIREM membership is open to clinicians and researchers at these organizations. T-CAIREM has



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also established close ties with the Toronto Academic Health Sciences Network (TAHSN). Additionally, T-CAIREM has established a meaningful collaboration with the Vector Institute to draw on the expertise of its members, collaborate on grant opportunities, and leverage each other's educational opportunities. In addition, many of T-CAIREM's leads (Muhammad Mamdani, Mamatha Bhat, Anna Goldenberg, Devin Singh, Laura Rosella, and Benjamin Haibe-Kains) are also Vector Institute faculty affiliates. Appendix 2, Table 2 lists of all hospitals and research centres that are part of the T-CAIREM National Network. In 2023, T-CAIREM also signed a Memorandum of Understanding with FACIT, a commercialization venture that brings together entrepreneurial scientists, partner institutions, and other key players in oncology and life science innovations in Ontario. T-CAIREM and FACIT are currently exploring possible collaborations.

## External Relationships

T-CAIREM benefits from being based in a region with a diverse, multicultural population. This diversity has helped us forge relationships with institutions based in Israel, Ukraine, India, and Korea.

### NATIONAL AI IN MEDICINE NETWORK

Across Canada, researchers at various universities, hospitals, and research centres conduct invaluable AI in medicine work. Many of these researchers are constantly searching for ways to collaborate with and learn from others. Recognizing this, we established the T-CAIREM National AI in Medicine Network, which links researchers and educators and multiplies the transformative power of AI for full impact. Currently, 24 universities and more than 90 hospitals and research centres across Canada comprise the network. Appendix 2, Table 2 contains a list of all hospitals and research centers that are part of the T-CAIREM National Network.

When the network launched, each partner university appointed up to two university representatives. This National Network meets quarterly to learn from each other, discuss possible collaborations, and present innovations taking place across Canada.

Several collaborative activities are currently in progress with members of the T-CAIREM Network. In the Spring of 2025 for example, T-CAIREM, University of British Columbia, and University of Manitoba are partnering to co-launch Collaborative Catalyst Grants.

The T-CAIREM National Network Education Working Group is also developing a standardized medical education curriculum across Canadian universities. As a first step, the group is conducting an environmental scan of AI in medicine education initiatives taking place at different Canadian universities.

Lastly, T-CAIREM is also planning a National Datathon in the Winter of 2024, where groups from different universities will create models using datasets currently available on the Health Data Nexus.

### INTERNATIONAL PARTNERSHIPS

T-CAIREM is dedicated to fostering a holistic and inclusive approach to AI health research and education beyond geographical boundaries. The team recognizes that the global exchange of ideas leads to more innovative, comprehensive, and impactful research outcomes. At the same time, international research and education collaborations have the potential to significantly enhance the academic quality and reputation of the University of Toronto. With this mind, T-CAIREM is pursuing beneficial international collaborations. In particular, T-CAIREM has established formal collaborative agreements with Technion – Israel Institute of Technology and the Indraprastha Institute of Information Technology in Delhi, India, as well as engaging with the U.S.-based Alliance for Centers of AI in Medicine.

# COMMUNITY

## Technion – Israel Institute of Technology

Technion – Israel Institute of Technology in Haifa, Israel, is a leading science and technology research university. The University of Toronto has had a long-standing collaboration with Technion through student exchange programs. In March 2022, Technion set up a joint initiative with the Rambam Centre for AI in Healthcare to lead the development of advanced AI medical systems. In May 2022, T-CAIREM signed a Memorandum of Understanding with Technion to collaboratively expand scholarly ties, facilitate academic cooperation, increase educational opportunities at both institutions, enrich educational and research environments, and promote international and inter-cultural understanding.

In May 2023, T-CAIREM and Technion hosted an AI in Medicine Collaboration Catalyst Workshop in Ein Gedi, Israel (Figure 14). Both institutions put out a call for faculty and trainees engaged in AI in medicine. Twenty delegates (13 faculty and 7 trainees) from T-CAIREM and 26 delegates (19 faculty and 7 trainees) from Technion participated in the three-day workshop from May 8th to 10th, 2023. Workshop agenda and lists of participants from both institutions are available in Appendix 2, Documents 1, 2a, 2b, and 2c respectively. This workshop was a starting point and accelerator for the new T-CAIREM-Technion collaboration. On the first day, the two institutions presented their capabilities in the field and discussed areas of common interest and potential growth, as well as the types of cross-institutional collaborations that would enable joint teams to receive support for new activities. The second day was devoted to building collaborative teams and formulating cross-institutional project ideas. In all, six project teams comprised of members from both institutions were formed. On day three, the newly formed teams pitched their collaborative ideas to a panel of adjudicators from both institutions for a chance to win a \$50,000 USD grant towards their project. Abstracts of the six collaborative projects can be found in Appendix 2, Document 3. Project pitches were evaluated based on predetermined criteria, which can be found in Appendix 2, Document 4. Based on the adjudication scores, a project titled AI-assisted MRI fusion models for characterization of

inflammation spearheaded by Mary-Louise Greer and Mojgan Hodaie from T-CAIREM, and Moti Freiman, Rekefet Ackerman, and Noam Kaplan from Technion, was awarded the winning grant. Notice of Award Letter can be found in Appendix 2, Document 5.

As of April 2024, the T-CAIREM-Technion collaboration slowed due to the conflict currently taking place in Israel. However, both institutions plan on continuing collaborative activities and our fundraising teams are seeking funding to enable more joint projects.



**FIGURE 14:** Technion T-CAIREM Collaborative Catalyst Workshop, Ein Gedi, Israel

## Indraprastha Institute of Information Technology

Indraprastha Institute of Information Technology (IIIT) in Delhi, India, is a research-oriented post-secondary institution with a focus on computer science and allied areas. IIIT's Centre of Excellence in Healthcare is a cradle of innovation for digital health. Recognizing the cutting-edge scientific advances in data-driven public health and medical research taking place at IIIT, T-CAIREM signed a Memorandum of Understanding in April 2023 to explore educational and scientific collaborations. Collaborative activities between the two institutions are currently in development. Mamatha Bhat visited IIIT in March 2024, and engaged with Dr. Tavpritesh Sethi and trainees to reiterate the

background of T-CAIREM and explore potential collaborations. Several joint training and research grant opportunities are anticipated in 2025.

## Health AI Systems Thinking for Equity (HASTE) Workshop & Networking Event

T-CAIREM partnered with Dr. Leo Celi from Massachusetts Institute of Technology's Critical Data and Harvard Medical School to co-host a HASTE workshop at the University of Toronto on October 18th, 2024. Dr. Celi developed this program to analyze, discuss, and mitigate unintentional data bias when using machine learning and generative AI to make healthcare decisions. Over 70 participants broke into teams and worked on a case study identifying the worst possible scenarios that can occur with an AI algorithm in a clinical setting. Teams also developed safeguards to prevent such scenarios from occurring. Participants were encouraged to consider accountability, transparency, and fairness in their discussions.

**Somin (Mindy) Lee is an undergraduate student who's participated in several T-CAIREM events including the HASTE Workshop.**

“ I had the pleasure of being a mentor again for another HASTE Policy Camp— this time in (my now home city) Toronto!

*The paper our group reviewed was on the deployment of a prediction tool for acute kidney injury with results showing improved outcomes for large academic centers, but a doubled mortality in critical access hospitals.*

*As usual, the teams were composed of people coming from diverse backgrounds— clinicians, engineers, computer scientists, professors, and industry professionals.*

*Even if I've been to many of these workshops now, I still learn so much every time!*

*It was great meeting new people and catching up with some familiar ones. Thank you again to Leo Anthony Celi and to my group's co-mentor Alex Mariakakis for leading the group!”*

**Dr. Anushiya Ganeshalingam is a family physician with an engineering background who works at the Markham Heritage Health Clinic and participated in the HASTE Workshop.**

“ Thank you, T-CAIREM and Dr. Leo Anthony Celi, for hosting such an insightful and impactful HASTE (Health AI Systems Thinking for Equity) workshop!

*The discussion on AI's role in health systems was both timely and essential. While there is undeniable excitement around the potential of AI in healthcare, it is equally critical to mitigate unintentional data bias that can arise from machine learning and generative AI. This workshop highlighted the need for robust oversight, thoughtful regulation, and a commitment to equity in the design of these systems.*

*As clinicians increasingly interact with large language models (LLMs) and generative AI tools, it's vital to recognize any inherent limitations and potential biases that may exist. Understanding both the benefits and risks of these technologies ensures they complement clinical decision-making rather than compromise it.*

*It was inspiring to see such a diverse group— students, clinicians, scientists, engineers, and computer scientists—come together to exchange ideas. These interdisciplinary conversations are critical for shaping the responsible and equitable integration of AI in healthcare, ensuring it serves both patients and providers effectively.*

*Looking forward to continuing these conversations and contributing to this evolving field!”*

# COMMUNITY

## GLOBAL COMMUNITY

T-CAIREM is committed to connecting with the global AI in medicine community to facilitate research collaborations, foster better AI in medicine education, and develop mutually beneficial programs that make an impact.

### The Alliance for Centres of AI in Medicine (ACAIM)

T-CAIREM is a member of ACAIM, a coalition of leading centres around the world that have a dedicated leader and team devoted to scholarly AI in medicine activity. Currently, ACAIM accounts over 100 centres globally, including more than 30 AI-focused efforts in paediatric institutions (PCAIM). ACAIM/PCAIM is an international coalition that meets monthly to discuss important issues and learn from each other.

Every year one of the ACAIM/PCAIM members hosts an in-person meeting for the group. On June 18th, 2024, T-CAIREM hosted the in-person ACAIM/PCAIM meeting (Figure 15). More than 45 attendees from 33 institutions across North America, Europe, and Asia, attended the meeting. Several panel discussions took place throughout the daylong event that explored various topics ranging from the deployment of applied AI in clinical practice, the unique challenges faced by adult and paediatric AI, and issues of concern to clinicians and computer scientists working in this exciting field. The meeting Agenda and list of participants can be found in Appendix 2, Document 6.

In addition, the group plans to author several position papers on the topic of AI centres in medicine and healthcare, current accomplishments, future directions, important issues, special challenges, guidelines, and recommendations for the future centres of AI in medicine. One such publication titled Responsible Adaptation of Multimodal Artificial Intelligence in Healthcare: Promises and Challenges is currently in progress and is being led by Dr. Mamatha Bhat and Dr. Ghazal Azarfar,

post-doctoral fellow in Dr. Bhat's laboratory, with input from ACAIM members. This publication is now submitted for publication and under review.

As part of this meeting, T-CAIREM also held a one-day Symposium on June 17, 2024, with the theme of Multi-Modal Data and the Future of Health AI. Multi-modal AI promises to be the next revolution in medicine that combines multiple types of data (medical imaging, electronic health records, biosensors, and others) to radically improve AI performance and transform healthcare delivery. T-CAIREM's 2024 Symposium focused on ways multi-modal AI can improve clinical practice and enable broader understanding of a patient's health while raising important technical and ethical issues. The T-CAIREM 2024 Symposium Agenda can be found in Appendix 2, Document 7.



**FIGURE 15:** ACAIM members at an in-person meeting hosted by T-CAIREM at the University of Toronto.

### AI-Med Global Summit

AI-Med Global Summit ([ai-med.io](http://ai-med.io)) is a clinician-led, three-day annual event devoted to healthcare innovation that unites clinicians, data scientists, researchers, and industry-decision makers. This Summit attracts around 3,000 attendees from around the world who have an opportunity to discover tangible AI solutions, connect with the leaders driving the AI health revolution, and engage in practical implementation. Every year,

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members of the T-CAIREM leadership team have been invited to attend as keynote speakers and session panelists (Figure 16). The AI-Med Global Summit recognizes exceptional talent in healthcare AI through annual awards such as the AIMed Hospital/Institution of the Year Award, which recognizes a hospital or institution that has made outstanding, persistent, and continuous efforts to advance the field of AI in medicine. In 2022, T-CAIREM was awarded the prestigious AIMed Hospital/Institution of the Year Award at the AI-Med Global Summit in San Francisco, USA (Figure 17).



**FIGURE 16:** Alistair Johson, former Infrastructure Co-Lead, presented at the AIMed Global Summit 2023

## AI in Medicine Symposiums and Conferences

T-CAIREM frequently works with other AI in medicine Symposiums and Conferences. In 2022 and 2023, for example, T-CAIREM was an invited speaker at the Stanford Centre for AI in Medicine and Imaging (AIMI). In addition, T-CAIREM leadership are regularly invited to give keynote addresses and participate as panelists at international AI Conferences. In 2024, T-CAIREM is supporting the Machine Learning in Healthcare Conference, and Laura Rosella, T-CAIREM Education Lead, will be a keynote speaker.



**FIGURE 17:** Muhammad Mamdani receiving AIMed Hospital / Institution of the Year award on behalf of T-CAIREM



# RESEARCH

One of T-CAIREM's central goals is to foster multidisciplinary, collaborative research and encourage clinical translation. T-CAIREM researchers work on a variety of areas in health AI, ranging from foundational methods, algorithm development and validation, and full implementation of AI solutions in clinical settings. To encourage innovative research, T-CAIREM offers several funding programs to support researchers, healthcare professionals, postdoctoral fellows, graduate, undergraduate, and clinical students involved in AI in medicine. T-CAIREM's Research Theme is led by Anna Goldenberg, AI Chair at the Canadian Institute for Advanced Research, and Devin Singh, Assistant Professor in Paediatric Emergency Medicine and emergency medicine physician at the Hospital for Sick Children.

## Grant Funding Programs

T-CAIREM's grant funding program supports a vast range of research conducted by members of Canada's AI in medicine community. One successful approach of increasing the size of T-CAIREM's grants is to actively seek out collaborative funding partners. To date, T-CAIREM has awarded over \$1.5M (\$1.2M T-CAIREM funding and \$400,000 partner funding) in funding to deserving researchers. T-CAIREM grant reviewers have evaluated 186 grant applications to date.

## TEMERTY CLINICAL AI INNOVATION GRANT

In 2021, T-CAIREM launched its flagship funding opportunity, the annual Temerty Clinical AI Innovation Grant. The grant supports research teams working to transform healthcare through

AI over the next 20 years. Its objectives are to identify promising high-risk, high-reward ideas and encourage researchers to transcend boundaries by using diverse datasets and new technologies to improve care efficiency or patient outcomes. This grant competition is open to T-CAIREM members who hold a UofT faculty appointment, and priority is given to interdisciplinary project teams. Grant selection criteria include the innovative nature of the project, use of innovative data sets and/or new technologies, measurable outcomes, and long-term sustainability. Temerty Clinical AI Innovation Grant description, eligibility requirements, and adjudication criteria can be found in Appendix 3, Document 1a and 1b. Table 1 below lists past recipients of the Temerty Clinical AI Innovation Grants.

**TABLE 1:** Temerty Clinical AI Innovation Grants Recipients.

YEAR	PRINCIPAL INVESTIGATOR	CO-PRINCIPAL INVESTIGATORS	RESEARCH SITE	PROJECT TITLE	AWARD
2021	Shaf Keshavjee	Bo Wang	University Health Network	InsignTx: Advanced Ex Vivo Organ Assessments for Clinical Lung Transplant Using AI	\$200,000 CAD
	Devin Singh	Andrea Doria	The Hospital for Sick Children	Machine Learning-Based Innovation in Ocular Pediatric Assessment Using, Point-of-Care Ultrasound	\$200,000 CAD
	Mojgan Hodaie*	Frank Rudzicz	University Health Network	An artificial intelligence-based MR imaging reconstruction framework	\$130,000 CAD
2023	Girish Kulkarni	Alistair Johnson	University Health Network	NIMBLE: An early warning system for tumour recurrence and progression for non-muscle invasive bladder cancer	\$100,000 CAD

\*In partnership with Canadian Institute for Advanced Research (CIFAR)

## SPOTLIGHT: 2021 Temerty Research Innovation Grant Award

**Project:** *“InsignTx: Advanced Ex Vivo Organ Assessments for Clinical Lung Transplant Using AI”*

**PIs:** Dr. Shaf Keshavjee and Dr. Bo Wang

### PROJECT DESCRIPTION AND RESULTS TO DATE

Despite recent advances in lung transplantation focused on improving recipient quality of life, a significant gap remains between patient demand and donor lung availability—more clinically acceptable donor lungs need to be identified to enable more life-saving transplants. This scenario leads to long transplant waitlists, poor patient outcomes, and higher mortality rates.

Two main factors limit the potential of lung transplantation: (1) a chronic shortage of donor lungs due to conservative evaluation methods, resulting in low utilization rates and the potential discard of viable lungs; and (2) subjective clinical decision-making, which can lead to the transplant of injured lungs and poor recipient survival rates. Addressing these limitations is crucial for improving transplant success and patient outcomes.

Our T-CAIREM project aimed to enhance organ assessment and recipient outcome prediction during EVLP using Artificial Intelligence (AI) and Machine Learning (ML). We developed and validated a new approach called the “InsignTx” model—a cutting-edge ML model that leverages physiological, biological, and biochemical data during EVLP that was recently published in Nature Communications (Ref. 1). InsignTx was able to identify more viable donor lungs for transplant and identified a smaller set of donor lungs that were unsuitable.

# RESEARCH

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We expanded the InsignTx model by incorporating clinically significant radiographic imaging (X-rays) during EVLP; the resulting positive outcomes were published in the Journal of Heart and Lung Transplantation (Ref. 2). To address limited access to imaging data, we implemented a neural-network based approach and provided rapid radiologist-level information to the surgical team. Combining this imaging ML-based approach with the InsignTx model significantly improved performance, demonstrating the most accurate EVLP decision-making tool reported to date (Ref. 3).

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## PROJECT DISSEMINATION AND TRANSLATION

We have submitted the following patents related to these innovations:

- Assessment of Ex Vivo Donor Lungs using Lung Radiographs. United States of America. No. US63/314,930. 2022/02/28. Status: Pending.
- Systems and Methods for Predicting Outcomes for a Lung Undergoing an Ex Vivo Lung Perfusion. United States of America. No. US63/315,042. 2022/02/28. Status: Pending

This IP has been licensed to a Canadian company that plans to integrate artificial intelligence tools into EVLP hardware.

A prospective clinical study is currently ongoing at UHN that specifically evaluates the use of advanced machine learning tools during EVLP.

## LIST OF KEY PUBLICATIONS RESULTING FROM RESEARCH RELATED TO THE PROJECT

1. **Sage AT**, Donahoe LL, Shamandy AA, Mousavi SH, Chao BT, Zhou X, Valero J, Balachandran S, Ali A, Martinu T, Tomlinson G, Del Sorbo L, Yeung JC, Liu M, Cypel M, Wang B, Keshavjee S. A machine-learning approach to human ex vivo lung perfusion predicts transplantation outcomes and promotes organ utilization. *Nat Commun.* 2023 Aug 9;14(1):4810.
2. **Chao BT**, McInnis MC, Sage AT, Yeung JC, Cypel M, Liu M, Wang B, Keshavjee S. A radiographic score for human donor lungs on ex vivo lung perfusion predicts transplant outcomes. *J Heart Lung Transplant.* 2024 May;43(5):797-805.
3. **Chao BT**, Sage AT, McInnis MC, Ma J, Grubert Van Iderstine M, Zhou X, Valero J, Cypel M, Liu M, Wang B, Keshavjee S. Improving prognostic accuracy in lung transplantation by harnessing the unique features of isolated ex vivo human lung radiographic analysis using convolutional neural networks. *Nature Digital Medicine* (Under Review, May 2024).

## SPOTLIGHT: 2021 Temerty Research Innovation Grant Award

**Project:** *“Machine Learning-Powered Ocular Ultrasound for Detecting Raised Optic Disc Elevation in Children”*

**PIs:** Dr. Devin Singh, Dr. Andrea Doria, Dr. Lianne McLean

## PROJECT DESCRIPTION AND RESULTS TO DATE

Pediatric patients presenting with symptoms such as headache and vomiting may suffer from critical conditions, including raised intracranial pressure (ICP) due to brain tumors. Identifying raised ICP often relies on fundoscopy to detect papilledema. However, fundoscopy has low accuracy among pediatricians and poses challenges in children when determining who requires more urgent brain imaging (CT & MRI scans of the brain).



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Ocular point-of-care ultrasound (POCUS) provides a more accurate, portable method to assess optic disc elevation. Integrating POCUS with artificial intelligence (AI) can enhance papilledema detection through automation, improving upon or replacing traditional fundoscopy.

This project has developed a machine learning (ML) model to analyze ocular POCUS images for detecting optic disc elevation, indicative of raised ICP. A labeled dataset of ocular ultrasound scans was created, leveraging an annotation pipeline involving five experienced POCUS clinicians. The dataset included 484,452 normal images (1196 patients) and 31,447 images showing raised ICP (81 patients). A deep neural network binary classification model was trained and achieved incredible results on a held-out test set:

- AUROC: 0.98
- AUPRC: 0.97
- Positive Predictive Value: 0.99
- True Positive Rate: 0.88
- True Negative Rate: 0.99

### PROJECT DISSEMINATION AND TRANSLATION

The ML-powered POCUS tool has significant potential to transform pediatric ICP evaluation by providing a reliable, scalable alternative to traditional methods that can be disseminated to community practices across the country and beyond as a medical device. This innovation particularly benefits remote and underserved communities, where access to advanced imaging is limited. Future steps include:

1. **Hardware Integration:** Incorporating the ML model into handheld POCUS devices for automated detection.
2. **Clinical Trials:** Conducting prospective studies to validate clinical usability.
3. **Regulatory Pathway:** Preparing for FDA and Health Canada approval.

## SPOTLIGHT: 2023 Temerty Research Innovation Grant Award

Project: *“NIMBLE: An early warning system for tumour recurrence and progression for non-muscle invasive bladder cancer”*

**PIs:** Dr. Girish Kulkarni and Dr. Alistair Johnson

### PROJECT DESCRIPTION/METHODS

Non-muscle invasive bladder cancer (NMIBC) is a heterogeneous disease with varying risks of progression to potentially lethal muscle-invasive disease. Current guideline-recommended risk calculators are suboptimal, which impacts downstream management and patient outcomes. We aimed to develop a more reliable progression risk assessment tool using artificial intelligence approaches (PROGRxN-BCa; previously NIMBLE). PROGRxN-BCa, based on a random survival forest, was trained on 3324 NMIBC patients treated from Jan 1, 2005, to Jun 30, 2022, at four Canadian academic or community hospitals. External testing was performed on 9335 patients treated from Jan 1, 2005, to Dec 31, 2023, across 31 North American and European institutions. Primary outcome was time to progression, defined as development of muscle-invasive or metastatic disease. PROGRxN-BCa was compared to the guideline-recommended European Association of Urology (EAU) risk calculator and a LASSO Cox model using identical variables as PROGRxN-BCa. Model performance for predicting five-year progression risk was characterized using concordance index, calibration plots, instability assessments, decision curve analysis, and an algorithmic audit.

### RESULTS TO DATE

Of 12659 patients, 1405 (11%) developed progression over a median follow-up of 3.3 years (IQR 1.6-5.8). PROGRxN-BCa had the highest concordance index overall and across different subgroups (training: 0.83, 95% CI 0.81-0.84; external testing: 0.79, 95% CI 0.77-0.80) compared to the EAU risk calculator (training 0.76, 95% CI 0.74-0.78, external testing 0.71, 95% CI 0.70-0.72). It was better calibrated, more stable, and provided the highest net benefit. Compared to current guideline-endorsed recommendations, PROGRxN-

# RESEARCH

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BCa improved substratification of intermediate-risk patients into three distinct risk tertiles with five-year progression risks of 2, 7, and 17%, reclassifying 9% of patients to the highest risk tertile who would otherwise not be considered for treatment intensification. We conclude that the AI-based PROGRxN-BCa outperformed current NMIBC prognostication tools, offering improved substratification of the heterogenous intermediate-risk group and patient counselling.

## HOW THE TEMERTY INNOVATION GRANT HAS HELPED THIS PROJECT

The Temerty Innovation Grant allowed me to fund a graduate student (Dr. Jethro Kwong) in the IHPME Health Services Research AI Stream. Dr. Kwong was able complete the project to develop NIMBLE (an early warning system for non-muscle invasive bladder cancer) which was later re-branded as PROGRxN. The funding also allowed for multi-centre collaboration.

## AWARDS

### International

- 2024 Apr – *Best of EAU24 Abstracts*: Urothelial Cancer, European Association of Urology

### National

- 2024 Apr – *Canadian Bladder Cancer Forum Oral Presentation*: First Place, Canadian Urological Association
- 2023 Apr – *Canadian Bladder Cancer Forum Oral Presentation*: Second Place, Canadian Urological Association

### Local

- 2024 Apr – *Institute of Health Policy, Management and Evaluation Research and Impact Day*: Best oral presentation (Health Informatics and Machine Learning), University of Toronto
- 2024 Apr – *Robson Research Day*: Best surgeon-scientist trainee presentation, University of Toronto
- 2024 Mar – *Jethro Kwong MSc Thesis Defense*

- 2023 Dec – *Postgraduate Research Award*: Edward Christie Stevens Fellowships in Medicine, University of Toronto
- 2023 Nov – *Clinician Investigator Program Symposium Oral Presentation*: Third Place, University of Toronto

## PRESENTED AND PUBLISHED ABSTRACTS

### International

- 2024 May – [PD30-05 Development and external validation of an artificial intelligence-based tool for PROgression Risk assessment in Non-muscle invasive Bladder Cancer \(PROGRxN-BCa\). American Urological Association Annual Meeting. San Antonio, United States \(Podium\)](#)
- 2024 Apr – [A0352 Development and external validation of an artificial intelligence-based tool for PROgression Risk assessment in Non-muscle invasive Bladder Cancer \(PROGRxN-BCa\). European Association of Urology 39th Annual Congress. Paris, France \(Moderated Poster\)](#)
- 2023 Nov – [124 Development and external validation of NIMBLE, an artificial intelligence-based tool to predict progression in non-muscle invasive bladder cancer: A retrospective multi-institutional cohort study. Society of Urologic Oncology 24th Annual Meeting. Washington DC, United States. \(Unmoderated Poster\)](#)

### National

- 2024 Jun – [POD3.1 Leveraging artificial intelligence to predict 5-year progression risk in non-muscle invasive bladder cancer and improve substratification of intermediate-risk patients: A Canada-wide study. Canadian Urological Association 79th Annual Meeting. Victoria, Canada \(Podium\)](#)
- 2023 Mar – [Development of NIMBLE: An artificial intelligence-based prediction tool for tumour progression of non-muscle invasive bladder cancer using the WHO 2004/2016 grading system. Canadian Bladder Cancer Forum. Kingston, Canada. \(Podium\)](#)

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## PRESENTED ABSTRACTS

### International

- 2023 Sep – *Development and external validation of an artificial intelligence-based prediction tool for tumour progression in non-muscle invasive bladder cancer: A retrospective multi-institutional cohort study.* International Bladder Cancer Network Annual Meeting, Montreal, Canada. (Moderated Poster).

### National

- 2024 Mar – *An artificial intelligence-based model to predict progression risk in non-muscle invasive bladder cancer (PROGRxN-BCa) and improve substratification of intermediate-risk patients: A retrospective, Canadian-wide model development and validation study.* Canadian Bladder Cancer Forum, Toronto, Canada (Podium)

### Local

- 2024 Apr – *An artificial intelligence-based model to predict progression risk in non-muscle invasive bladder cancer (PROGRxN-BCa) and improve substratification of intermediate-risk patients: a retrospective, multi-institutional model development and validation study.* Robson Day, Division of Urology, University of Toronto, Canada (Podium).
- 2023 Nov – *Development and multi-institutional validation of PROGRxN: An artificial intelligence tool to predict tumour progression in non-muscle invasive bladder cancer.* Clinician Investigator Program Symposium, University of Toronto, Canada (Podium).
- 2023 Apr – *Development of NIMBLE: An artificial intelligence-based prediction tool for tumour progression of non-muscle invasive bladder cancer using the WHO 2004/2016 grading system.* Robson Day, Division of Urology, University of Toronto, Canada (Podium).

## FAMILY MEDICINE (FAFM & CFPC) TEMERTY INNOVATION GRANT

The Family Medicine (FAFM & CFPC) Temerty Innovation Grant was launched in 2022 in partnership with the Foundation for Advancing Family Medicine (FAFM) and College of Family Physicians of Canada (CFPC). This grant's objectives are to identify and encourage promising AI researchers who are developing new AI technologies that could improve family medicine efficiency and/or patient outcomes. The goal of this grant is to create a collaborative community focused on using AI to innovate in the field of family medicine.

This competition is open to T-CAIREM members who hold a UofT faculty appointment, and either the primary applicant or a co-primary applicant must also be a member of the CFPC. As with other T-CAIREM grants, priority is given to interdisciplinary project teams, and selection criteria includes the level of the project's innovation; the use of innovative data sets and/or new technologies to improve care efficiency and/or patient outcomes; a focus on equity, diversity, and inclusion; the level to which the interdisciplinary research team stimulates the creation of a collaborative community; and project impact in the context of family medicine, patients, providers, and systems. Family Medicine Temerty Innovation Grant description, eligibility, and adjudication criteria can be found in Appendix 3, Document 2a & Document 2b. The recipient of the Family Medicine Temerty Innovation Grant was Frank Rudzicz, along with Noah Crampton and Andrew Pinto as co-Principal Investigators for their project Artificial Intelligence Automation to Improve Family Medicine Workflow. The amount of the grant was \$100,000 (T-CAIREM contributing \$50,000 and FAFM/CFPC contributing \$50,000).

## VECTOR INSTITUTE-TEMERTY CLINICAL AI INTEGRATION GRANT

Launched in 2022, the Vector Institute Temerty Clinical AI Integration Grant was developed in partnership with the Vector Institute. The aim of this grant is to help researchers integrate their AI solutions into clinical practice. Despite the accelerating achievements of AI research in health, there has been limited AI integration in clinical practice. The Vector-Temerty Integration Grant is intended to facilitate the translation of AI models into clinical use, and this competition was open to T-CAIREM members who hold a UofT faculty appointment. Priority for selection criteria is given to interdisciplinary teams among other considerations including the project’s use of developed and validated AI models and solutions that are ready to be translated into clinical practice; an outline of the steps required to integrate the research project into a clinical setting; the project’s utilization of a variety of resources and novel data integrations; and approval from key stakeholders in the organization where the project will be integrated. Vector-Temerty Integration Grant description, eligibility, and adjudication criteria can be found in Appendix 3, Document 3. The recipient of the Vector Institute-Temerty Clinical AI Integration Grant was Yu Sun, along with Clifford Librach as co-Principal Investigator for their project Non-Invasive Selection of Single Spermatozoa

with High DNA Integrity for In Vitro Fertilization (IVF). The grant award was \$300,000 (T-CAIREM contributing \$200,000 and Vector Institute contributing \$100,000).

## DATA SCIENCES INSTITUTE (DSI) TEMERTY CATALYST GRANTS

The DSI Temerty Catalyst Grants were set up in conjunction with the DSI in 2023. These awards are competitive seed funding grants for multidisciplinary teams forming a Collaborative Research Team (CRT). The Catalyst Grants are focused on the development of novel statistical or computational tools or the use of existing methodology in innovative ways to address questions in health and medicine. To apply for DSI Temerty Catalyst Grants, scholars must assemble a CRT of cross-disciplinary experts to develop a new data science methodology or use an existing methodology in innovative ways. Criteria for selection includes the transformative nature of project, its impact, robustness of methodology, collaborative nature of the team, and project feasibility. The amount of each grant was \$100,000 (T-CAIREM contributing \$50,000 and DSI contributing \$50,000). DSI Temerty Catalyst Grants description, eligibility, and adjudication criteria can be found in Appendix 3, Document 4. Table 2 below lists past recipients of the DSI Temerty Catalyst Grants.

**TABLE 2:** DSI Temerty Catalyst Grant Recipients

YEAR	PRINCIPAL INVESTIGATOR	CO-PRINCIPAL INVESTIGATORS	RESEARCH SITE	PROJECT TITLE
2023	Aaron Conway	Babak Taati Sebastian Mafeld	Lawrence S. Bloomberg Faculty of Nursing	Pain Detection in Masked Faces during Procedural Sedation
	Sebastian Goodfellow	Mjaye Mazwi Melissa McCradden	Department of Civil Engineering	Accelerating machine learning in healthcare: Solving the labelling bottleneck
2024	Sharmitha Mishra	Rafal Kustra	Unity Health Toronto	Examining biases due to confounders and colliders in observational health data using individual-based simulation models
	Tom Chau	Monika Molnar	Holland Bloorview Kids Rehabilitation Hospital	Decoding unintelligible speech: a conversational context-aware assistive technology for children with complex communication needs

# T-CAIREM HEALTH DATA NEXUS DATASET GRANTS

Launched in 2023, the T-CAIREM Health Data Nexus Dataset Grants encourage users to create unique datasets that will be housed on T-CAIREM’s digital platform. The objective of these grants is to identify relevant problems in health care and medicine that could benefit from AI solutions requiring large datasets. These grants are open to University of Toronto faculty members, and faculty members at other Canadian universities who are working in collaboration with a University of Toronto co-principal investigator. Criteria for selection includes the impact of the dataset on AI in medicine research, reproducibility and sustainability of the dataset reproducibility pipeline, interdisciplinary make-up of the project team, project feasibility, and equitable access process to the dataset. T-CAIREM Health Data Nexus Dataset Grants description, eligibility criteria, and adjudication criteria can be found in Appendix 3 Document 5. The amount of each grant was \$50,000. Table 3 below lists 2023 recipients of the T-CAIREM Health Data Nexus Grants.

**TABLE 3:** T-CAIREM Health Data Nexus Dataset Grant Recipients

PRINCIPAL INVESTIGATOR	CO-PRINCIPAL INVESTIGATORS	RESEARCH SITE	PROJECT TITLE
Mark Boulos	Brian Murray Houman Khosravani Andrew Lim Karthi Umapathy	Sunnybrook Re-search Institute	Advancing Clinical Outcomes Using Comprehensive Sleep Health and Polysomnography Data
William Tran	Joachim Behar Yoav Strechtman	Department of Radiation Oncology	Advancing Artificial Intelligence Applications Using High-Resolution Digital Tumor Biopsies of High-Risk Breast Cancer

## AI POPULATION HEALTH AND HEALTH SYSTEMS IMPLEMENTATION GRANT

In 2023, T-CAIREM collaborated with the Dalla Lana School of Public Health to offer an AI in Population Health and Health Systems Implementation Grant. This grant was open to principal investigators with a research appointment at the Dalla Lana School of Public Health who are also T-CAIREM members. Criteria for selection included: AI Population Health and Health Systems Implementation Grant description, eligibility criteria, and adjudication criteria can be found in Appendix 3, Document 6. The amount of the grant was \$150,000 over two years. The recipient of the AI Population Health and Health Systems Implementation Grant was Andrea Tricco for her research titled Artificial intelligence decision support tool to assess the quality of systematic reviews on the same topic.

## TECHNION TEMERTY CATALYST GRANT

This grant was offered as part of the Technion T-CAIREM AI in Medicine Collaboration Catalyst Workshop in 2023 and was intended to inspire research collaborations among workshop participants. Criteria for selection included the innovative nature of the project, its potential impact in Israel and Canada, the robustness of methods and feasibility of the project, and the team comprised of Technion and T-CAIREM researchers. The \$50,000 USD grant was awarded to Mary-Louise Greer and Mojgan Hodaie from T-CAIREM, and Moti Freiman, Rekefet Ackerman, and Noam Kaplan from Technion for the project AI-assisted MRI fusion models for characterization of inflammation.

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## COLLABORATIVE GRANT APPLICATIONS

T-CAIREM actively pursues collaborative grant opportunities with partner institutions.

### International Centre to Centre Research Collaborations 2024

T-CAIREM has partnered with United Kingdom's The Causality in Healthcare AI with Real Data (CHAI) Hub on a proposal to the International Centre to Centre Research Collaborations 2024 Call for Proposals. This granting call seeks to enable world-leading partnerships. The CHAI – TCAIREM application has proposed setting up an environment for international exchange of expertise in the field of AI in healthcare. This collaboration will establish a comprehensive sandbox for expressing and evaluating real-world knowledge for machine learning for healthcare. CHAI and T-CAIREM will work closely on i) eliciting from the respective communities which principles for encoding structural knowledge are most useful and currently lacking; ii) developing formal approaches for exploiting such information sources; iii) performing cross-site evaluation of ideas and development of metrics that have a broader appeal compared to what could be achieved in isolation. Both Centres will document and share problems posed by healthcare experts that can benefit from causal AI. T-CAIREM and CHAI will exchange valuable experiences, fulfilling the need for AI in health researchers to have a direct channel into cutting-edge work from the perspective of different populations and systems. This will strengthen the relevance of both Centres' artificial intelligence research in the world stage via theoretical, practical, and translational impacts.

### 2024 Brain Canada Foundation Platform Support Grant

T-CAIREM has partnered with the Centre for Addiction and Mental Health (CAMH) on a Brain Canada Foundation Platform Support Grant (PSG). Dr. Tristan

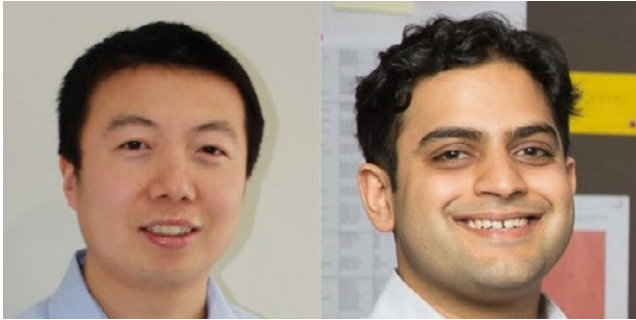
Glatard, scientific director of the Krembil Centre for Neuroinformatics (KCNI) at CAMH, has submitted an application entitled *Building Reproducible AI Frameworks for Brain Health with the Brain Health Data Challenge Platform*, a proposal which involves the construction of a data platform at CAMH. As the PSG includes 1 to 1 fund matching, T-CAIREM is contributing \$175,000 of funding to the project, which will be matched by Brain Canada. Funds from the PSG will go towards acquiring new datasets, advancing platform development through hiring new developers, and hosting workshops and datathons. Collaboration with the KCNI should help with the long-term acquisition of new datasets and new users.

## Funding Programs for Research

In addition to grants, T-CAIREM is committed to promoting research among faculty and students by funding several research programs.

## TEMERTY PROFESSORSHIPS IN AI RESEARCH AND EDUCATION IN MEDICINE

T-CAIREM has established two Temerty Professorships in AI Research and Education in Medicine to develop international-caliber research programs with an established record of success in achieving knowledge generation and dissemination. The Professorships are currently held by Bo Wang, Chief AI Scientist at the University Health Network, and Amol Verma, Assistant Professor in General Medicine at St. Michael's Hospital (Figure 18). Terms of Reference for Temerty Professorships can be found in Appendix 3, Document 7.

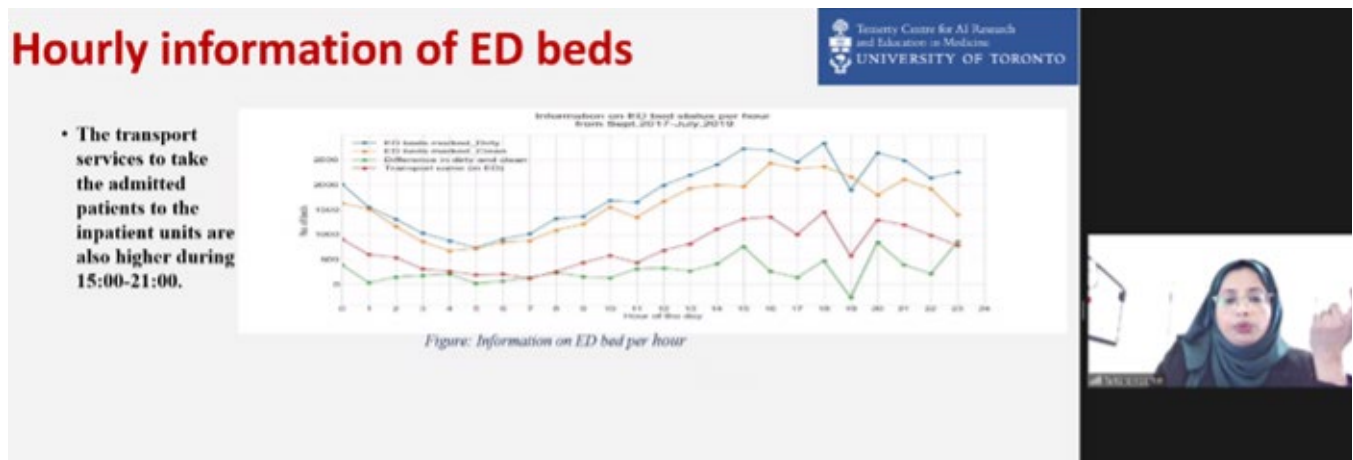


**FIGURE 18:** Temerty Professors Bo Wang and Amol Verma

## T-CAIREM ANNUAL TRAINEE ROUNDS COMPETITION

The T-CAIREM Annual Trainee Rounds Competition is a competitive seminar series that highlights innovative research at the intersection of AI and healthcare conducted by trainees across the T-CAIREM

National Network. Each year, graduate students, postdoctoral trainees, medical residents, and clinical fellows are invited to submit an abstract for this competition. The top ten abstracts are selected for virtual presentations during the summer months to adjudicators and the public. These ten abstracts receive a \$100 award while the final winner of the presentations receives a \$500 award (Figure 19). T-CAIREM 's trainee rounds have been extremely popular and provide valuable opportunities for trainees to develop presentation skills, abstract writing practice, and exposure for their research. Trainee Rounds presentations are watched on average by about 100 viewers. T-CAIREM Annual Trainee Rounds Competition description, eligibility criteria, application procedure, adjudication criteria, and past shortlisted winners can be found in Appendix 3, Document 8. Past presentation winners of T-CAIREM Annual Trainee Rounds Competition are listed in Table 4.



**FIGURE 19:** T-CAIREM Trainee Rounds Presentation

**TABLE 4:** T-CAIREM Annual Trainee Rounds Competition Presentation Winners

YEAR	PRESENTATION WINNERS	PROJECT TITLE
2021	Jethro Kwong	Development and external validation of an explainable machine learning model to predict risk of side-specific extraprostatic extension in men with prostate cancer
2022	Brokoslaw Laschowski	Computer Vision and Deep Learning for Robotic Exoskeleton Control
2023	Micaela Consens	Exploring the Interpretability of Transformers for Regulatory Genomics
2024	Armaan Malhotra	An Early Warning System for the Real-time Image-Based Triage of Patients Suffering Traumatic Brain Injury: Development of ASIST-TBI

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## T-CAIREM SUMMER STUDENT RESEARCH PROGRAM

T-CAIREM's annual Summer Research Program introduces undergraduates and medical students to AI in healthcare and encourages them to pursue careers in health-related fields to leverage AI in biomedical discoveries that improve clinical care and patient outcomes. Students chosen for this program come from across the T-CAIREM National Network and work full-time over the summer term (May to August) with leading researchers in the field. Participants spend the summer working with UofT faculty or UofT-affiliated research centres, while UofT students work with faculty members of partner institutions in the T-CAIREM National Network. This multidisciplinary program brings together students from a variety of fields including medicine, computer science, engineering, and statistics.

Each year, T-CAIREM awards up to 30 studentships valued at \$7,200 each (\$3,600 paid by T-CAIREM and \$3,600 paid by supervising faculty member). Since 2021, 93 students have been selected to conduct groundbreaking AI in medicine research. In addition, students participate in weekly professional development sessions, trainee rounds presentations, and gain valuable knowledge from AI leaders and experts. At the end of the program, students present their research during a half-day mini conference, where adjudicators determine the best presentations for a \$100 award (Figure 20). T-CAIREM Summer Research Program description, eligibility requirements, evaluation criteria, application process, and program participants can be found in Appendix 3, Document 9. Past presentation winners from the T-CAIREM Summer Research Program mini-conference can be found in Table 5 below. Research areas for past T-CAIREM Summer Research Program projects can be found in Figure 21.

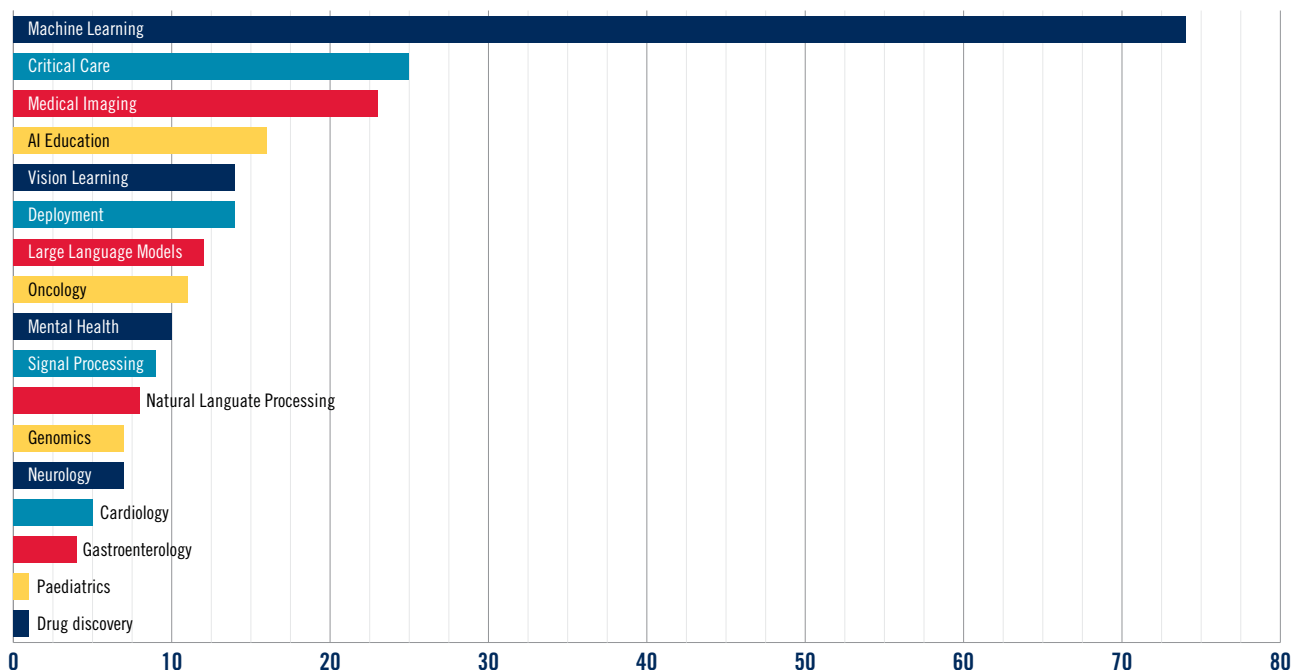


**FIGURE 20:** Participants in the T-CAIREM 2023 Summer Research Program



**TABLE 5: T-CAIREM Summer Research Program Mini-Conference Presentation Winners**

YEAR	PRESENTATION WINNERS	FACULTY MEMBER	PROJECT TITLE
2021	Samira Adus	Andrew Pinto	Exploring multiple perspectives on how patients can and should be involved in the development of guidelines for patient engagement in artificial intelligence (AI) health research
2022	Nicole Bodnariuc and Shamir Malic	Girish Kulkarni	Development of an early warning system for tumour recurrence and progression in non-muscle invasive bladder cancer patients using time-series forecasting with artificial intelligence
2023	Dimitrios Oreopoulos	Phedias Diamandis	PHARAOH: A crowdsourcing computational histology platform to integrate artificial intelligence into clinical pathology workflows.
	Lauren Pickel	Alexandre Zlotta	Silent trial of SEPERA – an AI tool to predict the risk of side-specific extraprostatic extension in pre-prostatectomy patients
	Nitish Bhatt	Kathryn Howe	Multi-modal deep learning for classification of carotid plaque vulnerability
2024	Dimitrios Oreopoulos	Phedias Diamandis	Integration of morphometric features improves prognostication of diffuse glioma subtypes
	Fan Ze (Alex) Wang	Tina Felfeli	Application of semantic segmentation models to quantify en-face optical coherence tomography imaging abnormalities in uveitis
	Cherry Xu	Mamatha Bhat	A Dynamic, Deep Neural Network Model of End-Stage Liver Disease for Equitable Liver Transplant Prioritization: Harmonising MELD and MELD Exception Points
	Tammy Zeng	Jose Zariffa	Hand pose estimation in augmented reality during real object manipulations for home-based rehabilitation



**FIGURE 21: Summer Research Program project areas**

# RESEARCH

## 2023 T-CAIREM CONFERENCE RESEARCH PRESENTATIONS AWARDS

In 2023, we hosted the T-CAIREM Conference: Ideas to Impact. A large component of the conference centered around trainee participation. The conference facilitated the development of networks and future research collaborations among emerging researchers. Trainees were invited to submit a first author abstract of their work for an opportunity to attend the conference and deliver a poster or podium presentation. Abstracts from all AI in health-related fields were eligible for submission, and more than 120 presenters were selected to participate (Figure 22). Podium presentations were adjudicated by field experts and eight presenters were awarded \$100 awards. 2023 T-CAIREM Conference Call for Abstracts, including description, eligibility requirements, selection criteria, application procedure and a full list of accepted presenters, can be found in Appendix 3, Document 10. A list of 2023 T-CAIREM Conference Research Presentation Award winners can be found in Table 6.



**FIGURE 22:** Poster Presenters at the 2023 T-CAIREM Conference.

**TABLE 6:** 2023 T-CAIREM Conference Research Presentation Award winners

PRESENTATION LENGTH	PRESENTATION WINNER	PROJECT TITLE
<b>3-MIN PRESENTATION</b>	Julia Plakhotnik	Classifier to predict drug cardiac activity using human stem cell-derived cardiac tissues
	Lauren Pickel	Temporal validation of SEPERA to inform nerve-sparing strategy during radical prostatectomy and comparison against expert surgeons
	Eptehal Nashnoush and Hamza Mahdi	Evaluating the Efficacy of Transformer Networks for Audio Signal Classification in Dysphagia Detection
	Brianne Laverty	Machine learning enables detection of Li-Fraumeni Syndrome using tumor whole-genome sequencing
<b>10-MIN PRESENTATION</b>	Bonnie Chao	A Machine Learning Approach to Processing and Interpreting Ex Vivo Lung Radiographs Predicts Transplant Outcomes
	Xuanzi (Elly) Zhou	A computational approach to breath-by-breath ventilator waveform data extraction and analysis during ex vivo lung perfusion enables enhanced physiological lung assessment
	Mingyue Xue	Serum Metabolomic Pathways in Predicting future onset of Crohn's Disease
	Christopher Smith	Artificial intelligence-based decision support predicts requirement for neurosurgical intervention in acute traumatic brain injury

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# Graduate Student Scholarships

T-CAIREM has established two Graduate Student Scholarship Awards for trainees entering the Master of Science in Applied Computing AI in Healthcare program. The goal of the scholarships is to encourage students to pursue careers that leverage AI to make biomedical discoveries, improve clinical care, and improve health outcomes. One of the awards is specifically earmarked for students from underrepresented groups, and the value of each scholarship is \$10,000 each. The first scholarships will be awarded to 2025-2026 incoming students.

## Benchmarks of Research Success

Research benchmarks are essential tools for advancing knowledge. T-CAIREM tracks research success of its members to ensure continuous progress.

### PROGRESS REPORTS

All T-CAIREM grant recipients are required to provide written progress reports at the end of the funding period. Recipients who received grants longer than one year in duration are also required to provide a written interim progress report at the halfway point that includes the following:

- A description of the project and results to date.
- Publications that were generated.
- A copy of all manuscripts published and submitted.
- Any new grants/funding for the project that resulted.

In addition, Summer Research Program students are required to submit an abstract and present their research at the Summer Student Research mini conference at the end of the program.

## PRODUCTIVITY OF T-CAIREM MEMBERS

The research data below represents T-CAIREM members.

### Research Funding

According to data quality indicators (Table 7) provided by the University of Toronto, T-CAIREM members collectively received 3,162 awards, totaling almost \$612 million over the past five years. The research data in Table 7 represents 331 T-CAIREM members, who are eligible to hold research funding. It should be noted that T-CAIREM membership does not include all investigators engaged in AI in medicine research at UofT or its allied hospitals and research centres. There are many investigators who directly and indirectly engage in AI in medicine research, who are not T-CAIREM members. As such, the research productivity of T-CAIREM noted below under-represents the full breadth and depth of AI in medicine science at UofT.

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**TABLE 7: T-CAIREM Members Funding Received**

SPONSOR TYPE	SPONSOR SUBTYPE	NUMBER OF AWARDS	FUNDING (M)
<b>GOVERNMENT</b>	Canadian Federal Government	138	\$32.89
	United States Government	69	\$32.00
	Networks of Centres of Excellence	51	\$30.34
	Ontario Provincial Government	110	\$22.19
	Foreign Government	13	\$1.44
	Provincial Centres of Excellence	8	\$0.58
	Municipal Government	5	\$0.44
	Other Provincial Governments	6	\$0.19
<b>GOVERNMENT TOTAL</b>		400	\$119.98
<b>TRI-AGENCY</b>	CIHR	488	\$135.84
	TIPS	95	\$34.38
	NSERC	171	\$22.96
	SSHRC	47	\$3.74
<b>TRI-AGENCY TOTAL</b>		801	\$196.92
<b>NOT-FOR PROFIT TOTAL</b>		1,509	\$194.54
<b>PRIVATE SECTOR TOTAL</b>		411	\$94.47
<b>OTHER TOTAL</b>		41	\$6.06
<b>GRAND TOTAL</b>		<b>3,162</b>	<b>\$611.97</b>

## Bibliometric Data and Global Comparators

T-CAIREM obtained bibliometric data on T-CAIREM's and University of Toronto's research members and compared them to six other universities with known strengths in AI (Table 8):

- Massachusetts Institute of Technology
- Stanford University
- University College London
- New York University
- Harvard University
- University of California Los Angeles
- University of British Columbia

This bibliometric data was obtained by Scopus, a source-neutral abstract and citation database. It includes publications, which contain the terms “artificial intelligence” or “machine learning” in their titles, abstracts, or indexed keywords for the period of January 2020 to December 2023. This approach may include publications unrelated to medical applications. Furthermore, publications relevant to AI may not include these specific terms, but include others (e.g., neural networks, deep learning). Such publications would not be included. Nonetheless, this information provides an overview of the productivity of T-CAIREM's and UofT's research community in AI as compared to other centres. T-CAIREM and UofT are leading in the average scholarly output.

**TABLE 8:** T-CAIREM's and UofT's research productivity in subject area of "artificial intelligence" and "machine learning" as measured against six other academic institutions for January 2020 to December 2023

INSTITUTION	NUMBER OF RESEARCHERS*	SCHOLARLY OUTPUT**	AVERAGE SCHOLARLY OUTPUT** PER RESEARCHER
<b>T-CAIREM</b>	<b>330</b>	<b>867</b>	<b>2.63</b>
<b>University of Toronto</b>	<b>1,438</b>	<b>3,021</b>	<b>2.10</b>
Harvard University	1,432	2,908	2.03
University College London	1,336	2,552	1.91
University of British Columbia	863	1,456	1.69
University of California Los Angeles	1,118	1,838	1.64
Stanford University	2,214	3,182	1.44
Massachusetts Institute of Technology	2,812	3,022	1.07

\*The number of researchers was estimated on a 2019–2023-time frame.

\*\*Scholarly Output can include articles, reviews, conference papers, notes, editorials, letters, book chapters, errata, books, data papers, and short surveys.

T-CAIREM specific bibliometric data is also provided. The research data below represents 330 T-CAIREM research members. It must be noted that T-CAIREM membership does not include all investigators engaged in AI in medicine research at UofT or its allied teaching hospitals. There are many investigators in the Faculty of Medicine, Faculty of Applied Science and Engineering, and Faculty of Arts and Science, who directly or indirectly engage in AI in medicine research and are not members of T-CAIREM. As such, research productivity of T-CAIREM noted below under-represents the full breadth and depth of AI in medicine science at UofT.

### BIBLIOMETRICS – T-CAIREM MEMBERS (JANUARY 2020 TO DECEMBER 2023)

This data includes publications specifically by T-CAIREM members, filtered by the terms "artificial intelligence" intelligence" or "machine learning":

- Scholarly Output (can include articles, reviews, conference papers, notes, editorials, letters, book chapters, errata, books, data papers, and short surveys): **867**
- Number of T-CAIREM Researchers analyzed: **330**
- Scholarly Output per Researcher: **2.63**
- Times Cited: **18,999**
- Citations per Researcher: **57.57**
- Citations per Publication: **21.9**
- Field-Weighted Citation Impact (is a measurement that compares

the number of citations an article receives to the average number of citations for similar articles): **2.53**

- Percentage of International Collaborations (refers to the percentage of publications that are international collaborations): **47.8%**
- Percentage of Academic-Corporate Collaborations (refers to the number of publications that are corporate collaborations): **5.7%**

The most prolific T-CAIREM publishers in the field of "artificial intelligence" and "machine learning" have been:

- Anna Goldenberg (T-CAIREM Research Co-Lead) with a total of 39 publications,
- Anna Goldenberg (T-CAIREM Research Co-Lead) with a total of 39 publications,

- Melissa McCradden (T-CAIREM member) with a total of 38 publications,
- Muhammad Mamdani (T-CAIREM Director) with a total of 28 publications,
- Benjamin Haibe-Kains (T-CAIREM Data Infrastructure Co-Lead) with a total of 25 publications.

### T-CAIREM PATENTS AND COMMERCIALIZATION OF INVENTIONS (JANUARY 2020 TO DECEMBER 2023):

For the January 2020 to December 2023 period, T-CAIREM members:

- Held 41 patents,
- Commercialized 58 inventions, and
- Filed invention disclosures to commercialize an additional 36 inventions.



# EDUCATION

**A**l in medicine is a relatively new field, with innovations frequently taking place. T-CAIREM works toward increasing knowledge and awareness of the field among researchers, trainees, and the public through a variety of educational initiatives. The T-CAIREM Education Theme is led by Laura Rosella, Professor at the Dalla Lana School of Public Health and by Trainee Co-Leads, Gemma Postill, MD/PhD Candidate at Temerty Medicine, and Abhishek Moturu, PhD Candidate in the Department of Computer Science. Every year, T-CAIREM also recruits a cohort

of Trainee Affiliates. Undergraduate and graduate students, post-doctoral trainees, clinical residents, and fellows are invited to apply to become T-CAIREM Trainee Affiliates. Selected Trainee Affiliates assist with developing programming, acting as adjudicators and advising on educational programming. T-CAIREM Trainee Affiliates are volunteer positions. A full list of current T-CAIREM Trainee Affiliates can be found in Appendix 4, Document 1, and Figure 23. Sections below outline T-CAIREM Educational programming that has been implemented over the past four years.



**David Chen**



**Vivian Chu**



**Anglin Dent**



**Claire Fine**



**Jethro Kwong**



**Armaan Malhotra**



**Julie Midroni**



**Sujay Nagaraj**



**Konrad Samsel**



**Samantha Unger**

**FIGURE 23:** T-CAIREM 2024-2025 Trainee Affiliates

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# Educational Activities

T-CAIREM has established numerous educational activities for medical and health science professionals and learners.

## AI IN HEALTHCARE: MASTER OF SCIENCE IN APPLIED COMPUTING (MSCAC)

The AI in Healthcare MScAC program was created and led by T-CAIREM Research Co-Lead Dr. Anna Goldenberg, Professor in the Departments of Laboratory Medicine and Pathobiology and Computer Science. Launched in the Fall of 2023, this 16-month professional master's program is offered jointly by the Department of Computer Science in the Faculty of Arts and Science in partnership with the Department of Laboratory Medicine and Pathobiology (LMP) at the Temerty Faculty of Medicine.

This program concentration focuses on the application of AI methods to healthcare and life science research data and helps trainees acquire the knowledge to succeed in the development and deployment of AI tools in healthcare. The courses that are available to students in the AI in Healthcare concentration include:

- Data science
- AI
- Visualization/systems/software engineering
- Approved LMP or Master of Health Informatics (MHI) courses
- Communication for Computer Scientists
- Technical Entrepreneurship

Additionally, students complete an eight-month internship working on AI projects in a clinical setting to gain practical experience as part of their coursework.

## 2023 T-CAIREM CONFERENCE

On October 12 and 13, 2023, T-CAIREM hosted “AI in Medicine Conference: Ideas to Impact” at the InterContinental Toronto Centre (Figure 24) with a focus on Canada’s role in the rapidly evolving field. The interdisciplinary conference brought together over 300 researchers, healthcare professionals, computer and data scientists, statisticians, engineers, and trainees from across the country to share research and advance knowledge. Local, national, and international experts participated as keynote speakers and panelists, and shared their knowledge with attendees. The T-CAIREM Conference was accredited for Continuing Professional Development for physicians.

The second day of the conference focused on trainee presentations with the goal of facilitating networking opportunities and future collaborations among upcoming researchers. The conference’s final event was a Shark Tank competition, where six startups pitched their AI in medicine solutions to an adjudication panel (Figure 25). The winner of the \$25K grand prize was PROVA Innovations founder Matthew Rosato, who presented his WithinStride Smart Wearable Insoles product. Full Conference Agenda can be found in Appendix 4, Document 2.



FIGURE 24: 2023 T-CAIREM Conference

# EDUCATION



**FIGURE 25:** Matthew Rosato presented his winning pitch during the 2023 T-CAIREM Conference Shark Tank competition

## TEMERTY CENTRE SPEAKER SERIES

Each month T-CAIREM hosts a Temerty Centre Speaker Series, consisting of a guest lecture by an AI in medicine expert (Figure 26). The Speaker Series provides members of the healthcare community, with opportunities to learn from a variety of thought-provoking AI leaders who can candidly share their experiences applying AI theory and research to fundamentally transform medicine and healthcare.

As AI rapidly changes healthcare systems around the world, this series illuminates the current state and emerging trends in data science, health informatics, machine learning, and analytics. Since the speaker series' inception in 2021, T-CAIREM has hosted over 30 AI in medicine leading experts, including a wide range of local and international speakers from US, UK, France, Austria, and Switzerland. Over 2,500 attendees have joined the sessions, including physicians, data scientists, public policy makers, clinicians and trainees.

Although the format of the speaker series is primarily virtual, some sessions have taken place in-person and as hybrid events. In-person sessions also include an informal meet and greet for students to interact with the guest speakers at roundtable discussions. T-CAIREM has partnered with other University of Toronto groups such as the Joint Centre for Bioethics

(JCB) and the Data Sciences Institute (DSI), and The Hospital for Sick Children to bring international speakers to campus. The Temerty Centre Speaker Series is accredited for Continuous Professional Development. A full list of Temerty Centre Speaker Series presenters can be found in Appendix 4, Document 3.



**FIGURE 26:** Globe and Mail health reporter and columnist André Picard delivered a lecture at the Temerty Centre Speaker Series in June 2023

## SUMMER RESEARCH PROGRAM: PROFESSIONAL DEVELOPMENT AND MINI-CONFERENCE

T-CAIREM is committed to developing and delivering programming for students to increase their AI in medicine engagement. For the past two years, T-CAIREM partnered with the Vector Institute to offer a course entitled “From Excel to AI” to summer students, which focused on the basics of the Python programming language and its medical applications. In 2024, we moved the introductory program within T-CAIREM to better tailor the content to students' specific project needs. T-CAIREM Trainee Affiliates developed a four-session bootcamp for the summer students, featuring:

1. Introduction to Python,
2. Developing Prediction Models,
3. Equity and Ethics in AI, and
4. Model Deployment and Evaluation.



Throughout the program, summer students also attend professional development sessions, led by T-CAIREM faculty focusing on navigating academia, career development, entrepreneurship, among other topics. At the midpoint of the program, students are invited to a half-day conference to present their project proposals and preliminary results. The in-person presentations take place in breakout rooms where T-CAIREM education affiliates and staff provide feedback and support. At the end of the program, summer students submit an abstract of their work throughout the program and deliver a ten-minute oral presentation to an adjudication committee. The committee then determines the best presentations based on a scoring system and each winner receives a \$100 award.

## TAILORED RESOURCES HUB

T-CAIREM has created and launched a tailored AI in medicine resources hub to amalgamate educational material around machine learning and artificial intelligence (Figure 27). The hub was created at the requests of previous summer trainees for a list of high-quality resources to guide their projects. To ensure

sustainability and the provision of the most recent up-to-date materials, T-CAIREM developed an interactive hub that allows users to request and suggest additional materials. The resources hub is continually updated and carefully curated with new high-quality national and international training resources. Suggestions for books, textbooks, reports, and research papers related to AI in medicine that are of interest to the T-CAIREM community are provided in an organized format for users such as T-CAIREM members, students, and clinicians. T-CAIREM's leadership with the International Education Working Group is anticipated to expand international resources from member countries.

## UNDERGRADUATE MEDICAL EDUCATION

The Royal College of Canadian Physicians and Surgeons has acknowledged that AI is poised to fundamentally reshape how medicine is taught and practiced. Equipping the current generation of medical trainees with the knowledge to leverage AI effectively is paramount. T-CARIEM facilitated this goal by implementing AI curricula into medical education

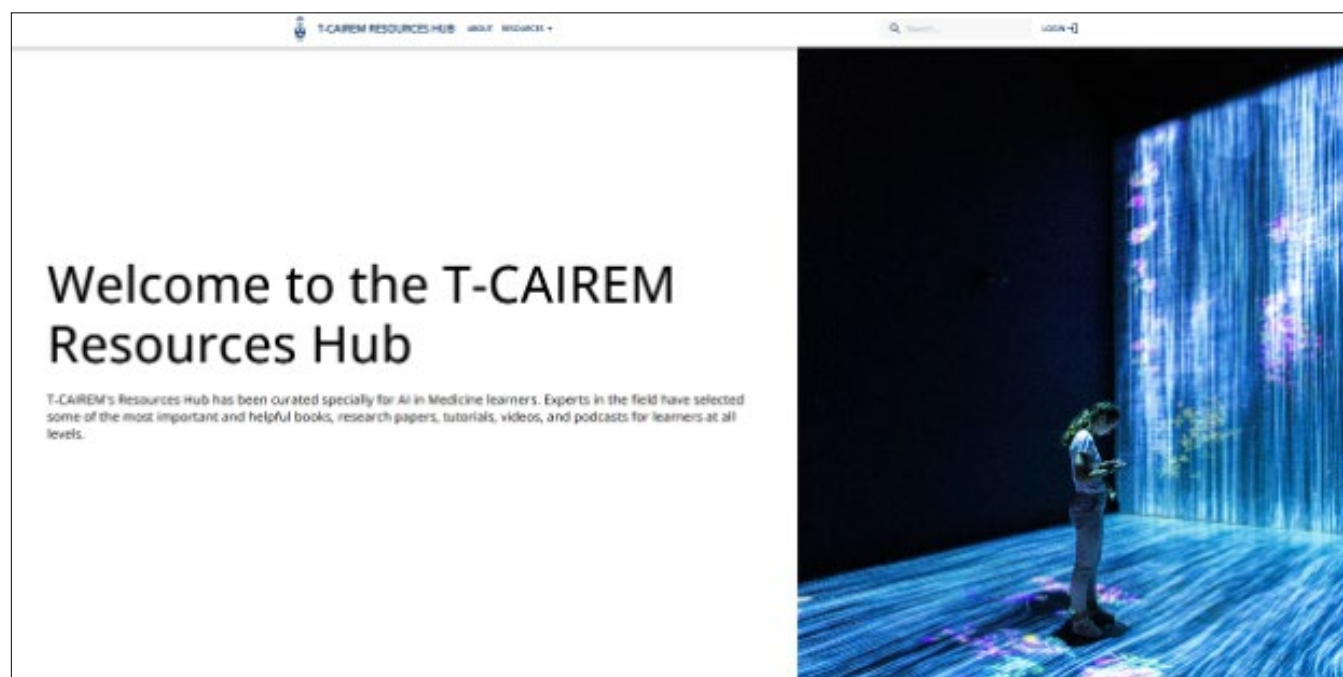


FIGURE 27: T-CAIREM Resources Hub

# EDUCATION

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at the Temerty Faculty of Medicine. T-CAIREM leadership and members advised on the design of this curriculum and are frequently called upon to deliver its components. In 2019/2020, one of the strategic initiatives of the Foundations Curriculum was to introduce educational opportunities for students to reflect on the emerging role of AI in Medicine and we introduced a lecture as part of the first-year coursework. T-CAIREM formally proposed a major update for 2022/23, which went through official curriculum approval in 2022 MD Program – Foundations Committee. The following proposal was made:

1. Introduce a self-learning module that students can review in advance of the workshop. The module will cover the learning objectives:
  - Define and apply fundamental concepts of AI and data use
  - Describe the current applications, appropriate use, and emerging trends of AI
  - Describe the strengths and limitations of AI, factors affecting AI accuracy and barriers to implementation
  - Identify potential consequences of artificial intelligence relevant to health inequities
2. Move the existing one-hour AI lecture from year two to year one (Week Seven). Describe the data pipeline from data collection to visualization. New learning objectives are:
  - Describe the strengths and limitations of AI, factors affecting AI accuracy and barriers to implementation
  - Describe AI's role and impact on clinical reasoning Identify potential consequences of artificial intelligence worsening and improving health inequities
  - Since a complete understanding of AI is neither practical nor necessary for most clinicians, understand when and where to seek help and collaboration
  - Understand there is a wide range of analytic approaches which may be appropriate depending on the nature of the problem/clinical application
3. Introduce a one-hour virtual workshop with around ten groups (Week Eight) with facilitators recruited from TCAIREM community to engage students to reflect on what they have learnt so far. New learning objectives include:
  - Describe AI's role and impact on clinical reasoning Identify the role of stakeholder (patients, clinicians, etc.) engagement in artificial intelligence development within health care and identify elements of collaborative decision making.
  - Since a complete understanding of AI is neither practical nor necessary for most clinicians, understand when and where to seek help and collaboration.
  - Understand there is a wide range of analytic approaches which may be appropriate depending on the nature of the problem/clinical application.
4. The current version of the curriculum was designed to meet the following learning objectives:
  - Recognize and define AI in the context of medicine and be able to identify the different types of AI applications used in clinical medicine.
  - Identify the role of stakeholder (patients, clinicians, etc.) engagement in artificial intelligence development within health care and identify elements of collaborative decision-making.
  - Identify the benefits and limitations of AI and the underlying data used for AI applications in the context of clinical decision-making and management.

- Describe and communicate to patients about common ethical concepts within artificial intelligence in medicine such as consent, data privacy, security, liability, responsibility, accountability, and unintended harms related to health inequities.

This curriculum was formally approved and implemented in 2022/23 and represents the first medical school in Canada with a comprehensive AI element in its medical curriculum. T-CAIREM leadership and UofT medical student partners continue to monitor progress in the field and have successfully implemented a proposal of concrete suggestions to revamp the Temerty Faculty of Medicine’s current delivery of AI medical education. This curriculum change expands on the current curricula, which recognizes the necessity of competency-driven training to ensure AI knowledge is a tool in physicians’ toolboxes. It also represents the strong collaboration between T-CAIREM and the undergraduate medical program.

## POST-GRADUATE MEDICAL EDUCATION

Temerty Medicine residency programs expressed a need for AI in medicine curriculum content for their academic half days. To assist the programs,

T-CAIREM education trainee affiliate co-leads developed an academic half-day session titled How Can I Use AI as a Clinician? What you need to know to improve patient care. This introductory session can be customized, depending on the AI experience of the residents, and covers the following topics:

1. Overview of AI: basic terminology, model types, and differences between model development vs. deployment.
2. Applications of AI in clinical and laboratory medicine – with specific pathology examples.
3. How to appraise – interactive section; format is journal club.

This session focuses on the practical aspects of machine learning in healthcare. Since September 2023, the education team has presented eight sessions to over 200 residents in the Departments of Paediatrics, Cardiac Surgery, Thoracic Surgery, Urology, Laboratory Medicine and Pathobiology, and Paediatrics residents (Figure 28). The sessions have been delivered both in person and virtually and provide meaningful engagement for residents starting their AI journey. Feedback was collected at these sessions in the form of pre/post session surveys. The T-CAIREM education trainee co-leads are currently revamping the session based on the feedback of medical and surgical residents.

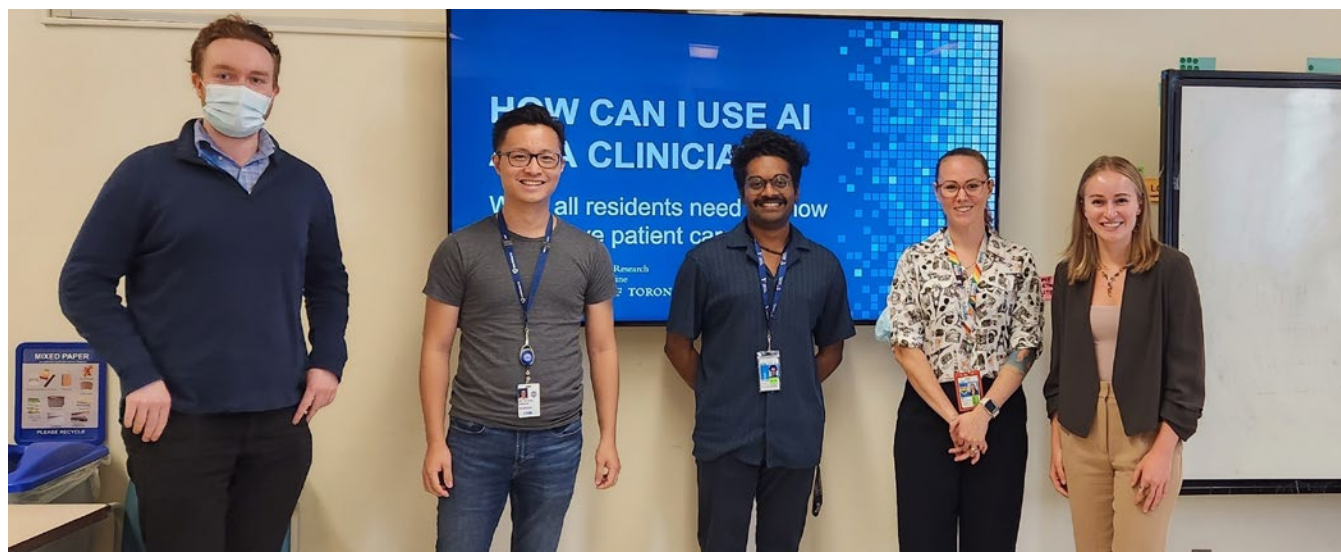


FIGURE 28: T-CAIREM Education Affiliates delivering an Academic Half-Day session to paediatric residents

# EDUCATION

## HEALTH DATA NEXUS: DATATHONS

To foster AI in medicine education, T-CAIREM organized an annual Toronto Health Datathon in 2023 and 2024 featuring the Health Data Nexus (Figure 29). Each year, the Datathon brings together 40 to 50 participants including students, trainees, graduates, and professionals in the medical and computational fields. Participants from across Ontario and the United States gathered in person at the downtown Toronto Google Cloud offices for a two-day session where they formed teams, identified a dataset of interest, developed a research question, and presented their results. Previous participants and experienced researchers also joined the Datathon as mentors to help support and guide the teams.

T-CAIREM is currently preparing a National Datathon, which will feature participants across the country working as local teams before presenting their work to a national audience of participants.

## HEALTH DATA NEXUS COURSES

The Health Data Nexus has been successfully used as a platform for providing educational content to students. One example of this includes the BME 1510 course for graduate students in the biomedical engineering program, which has twice used the Health Data Nexus for their final project. Students accessed different datasets on the platform to complete group projects, in which they investigated different datasets, then used machine learning methods to answer relevant research questions. Twenty-two students in the first run of BME 1510 and 31 in the second completed the projects as part of the course curriculum.

Other instances include the VADA Summer School, a week-long workshop which saw 18 students from the University of Manitoba and University of Victoria using the Health Data Nexus for research projects, and the Toronto Health Datathon (described in

more detail under the Data Infrastructure theme). T-CAIREM is also planning a series of workshops beginning in the summer of 2024, where data holders will host one-day workshops for students describing applications of the datasets.



**FIGURE 29:** 2024 T-CAIREM Health Data Nexus Datathon

## CAPACITY BUILDING OUTREACH

T-CAIREM is committed to building AI in medicine interest and capacity among future leaders in the field.

### Toronto District School Board (TDSB)

Since 2021, education trainee affiliates have facilitated seven virtual “ASK A SCIENTIST” sessions for over 100 high school students in Toronto. The team answers general science and medicine questions and provides general career-related guidance.

### March Break AI in Medicine Bootcamp

In March 2025, T-CAIREM plans on hosting an AI in Medicine March Break Bootcamp for senior high-school students. The Bootcamp will provide learning opportunities, hands-on workshops, and networking opportunities for 30 students. The Bootcamp will run virtually from 9:00 a.m. until noon over the five days of March Break. T-CAIREM Trainee Affiliates are currently developing content for the Bootcamp.

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# Educational Collaborations

T-CAIREM recognizes the importance of partnerships and collaborations in education to leverage the broad spectrum of intelligence and achieve our maximum potential. As such, T-CAIREM actively engages in educational collaborations.

## ASSOCIATION OF FACULTIES OF MEDICINE OF CANADA (AFMC)

AFMC has recognized that AI has gained considerable attention in health care. With that, AFMC has struck an AFMC AI, Data Science & Health Systems Task Force dedicated to developing AI and data science curriculum for undergraduate and post-graduate medical trainees. The working group is co-chaired by Deepak Kaura and Anna Karwowska, AFMC VP Education. Laura Rosella is the T-CAIREM representative on the Task Force. The task force has created a five-part introductory level presentation for residents and practicing physicians.

## NATIONAL AI IN MEDICINE NETWORK EDUCATION WORKING GROUP

The National AI in Medicine Network Education Working Group was formed to provide recommendations on the integration of AI education and training into medical school curriculums across Canada. The group has created surveys which will be disseminated to Canadian medical schools to better understand the current landscape of AI education across the country. The group is currently working on a Research Ethics Board submission for the study.

## ACAIM: INTERNATIONAL EDUCATION WORKING GROUP

Across the Alliance for Centers of Artificial Intelligence Medicine (ACAIM), there is a lot of interest in AI education for healthcare practitioners. As a result, in 2024 T-CAIREM formed an International Education Working Group under the umbrella of ACAIM that includes 15 participating organizations:

- American Board of Artificial Intelligence in Medicine
- Cambridge University
- Children’s Hospital of Orange County
- Cleveland Clinic
- Mayo Clinic
- New York University
- Ohio State University
- Ospedale Pediatrico Bambino Gesù
- University of California San Diego
- Stanford University
- University of Colorado Anschutz Medical Campus
- University of Southern California
- The University of Tennessee Health Science Centre
- University of Texas at San Antonio
- University of Wisconsin School of Medicine and Public Health

The group meets regularly to share innovations in AI education and is currently working on a deliverables plan.

## Benchmarks of Education Success

T-CAIREM regularly conducts evaluations for all its educational programs and scientific events. After each event, participants are asked to provide feedback and opinions on the program, speakers, and learning objectives. T-CAIREM always seeks feedback from participants on improving its programs. Regularly evaluating T-CAIREM's programs is essential for assessing the effectiveness of its activities. In designing programs, T-CAIREM always considers the evaluations from past events to understand the overall effectiveness of the event, the effectiveness of the participating speakers, the successful use of interactive methods, and the relevance of the content to the audience's learning needs. Past evaluations are essential in helping T-CAIREM create more effective educational programming that meets the needs of its target audiences.

The T-CAIREM Summer Research Program has been a great success largely due to regular program improvements based on participant feedback. Before launching the program, T-CAIREM conducted a needs assessment survey (Appendix 4 Document 4) to learn about specific program elements that students were interested in. One hundred percent of student responders reported that they were looking to establish mentorship-based relationships with AI in medicine scientists. Also 100% of student responders reported that they were looking to learn about different career paths in the field. Likewise, 100% of responders, reported that they wanted to gain competence in understanding and communicating core AI concepts (e.g. deep learning, neural networks, etc.).

As a result of the feedback received in the needs assessment survey, T-CAIREM focused on designing bi-weekly professional development sessions for the Summer Research program with a focus on career

planning in the field of AI in Medicine. T-CAIREM recruited Theme Lead Anna Goldenberg, a computer scientist at the University of Toronto, to talk about her career trajectory into academia and health care AI research. Melissa McCracken, a bioethicist at the Hospital for Sick Children, told students about her path from neuroscience to bioethics. Benjamin Fine a radiologist at Trillium Health Partners discussed his experience with entrepreneurship in the field. T-CAIREM also places an emphasis on recruiting supervisors with diverse interprofessional labs to provide students with ample mentorships opportunities. T-CAIREM also instituted a mini-conference at the end of the program, where each student must present the research that they conducted over the summer. This was designed to provide students an opportunity to practice communicating AI concepts and their research with an audience.

At the end of the program, T-CAIREM conducted a participant exit survey. Seventy one percent of student responders reported that they were able to establish mentorship-based relationships with scientists in the field of AI. Eighty six percent of responders reported that they learned about training paths for different careers in AI in medicine. Also 86% of responders reported that they gained competence in understanding and communicating core AI concepts. Furthermore, 57% of responders reported that the professional development seminars were not frequent enough and they wanted more. As such, for subsequent years T-CAIREM continued to improve the program and introduced weekly seminar series to give students even more opportunities to develop skills. Each year, T-CAIREM seeks student feedback and implements continuous program improvements. Similarly, T-CAIREM conducts surveys across all its educational programs and uses that feedback to drive program improvement.

Here's what some of this year's participants had to say about the summer research program in 2024:

**ABISHEK (NIRUPAN) BHUVANARATNAM**

(Reposted with permission.)

“ I am incredibly grateful for the opportunity to have been part of this year's T-CAIREM Summer Student Research Program. It was an enriching experience where I had the privilege to take part in various workshops focused on the latest advancements in AI in healthcare. These sessions deepened my understanding and ignited my passion for the field.

*Under the mentorship of Dr. Rageen Rajendram, I had the chance to work on a project titled "Utilizing AI to Predict the Need for Non-Invasive Ventilation in Duchenne Muscular Dystrophy." This hands-on experience was invaluable and has significantly shaped my perspective on the intersection of AI and healthcare.*

*A special thank you to the organizers, especially Gemma P. and Abhishek Moturu, for their unwavering support and guidance throughout the summer. Your mentorship was instrumental in my growth, and I am deeply appreciative of all that you've done.*

*To my fellow students, it was a pleasure working and learning alongside you. Wishing you all the best in your future endeavours!*

*Thank you all for making this summer truly memorable!”*

**ARIANA WALJI**

(Reposted with permission.)

“ It has been a true privilege to work alongside such brilliant minds this summer through Temerty's AI in Medicine program, T-CAIREM.

*What once seemed like a distant vision of the future has now become a powerful reality, and I'm genuinely thrilled to see AI's transformative applications come to life through each of our projects.*

*I would like to extend my deepest gratitude to my supervisor, Dr. Thomas Purdie, for giving me the opportunity to work on such an exciting project—developing an automated quality assurance platform for prioritizing complex breast radiation therapy plans.*

*This was my second summer in the Medical Physics department at Princess Margaret Cancer Centre, and I couldn't be more grateful for the incredible mentorship and valuable skills I've gained along the way. This journey has only deepened my commitment to exploring the boundless possibilities that AI offers in advancing healthcare.”*

**RAPHAEL KWOK**

(Reposted with permission.)

“ Last week, I had the really great opportunity to present the work I've been doing over the past summer as part of the T-CAIREM Summer Student Research Program.

*I really appreciate the support everyone at the SARA lab at University Health Network has given me throughout this project - especially my supervisors, Dr. Amin Madani and Dr. Allan Okrainec. I've also received an incredible amount of guidance from Dr. Takuto Yoshida and Dr. Simon Laplante.*

*I've learnt a lot over the summer program, from the other students as well as all of the great lessons led by Gemma P. and Abhishek Moturu.”*



**H**igh quality data is a core component of building clinical AI solutions. Allowing researchers timely access to real-world datasets is a core priority for T-CAIREM. T-CAIREM Data Infrastructure Theme is co-led by Benjamin Haibe-Kains, a Senior Scientist at the Princess Margaret Cancer Centre, and David Rotenberg, Director of Data Strategy and Business Intelligence at the Centre for Addiction and Mental Health. The data Infrastructure team has established T-CAIREM's Health Data Nexus, a dedicated data environment to facilitate research and education initiatives in AI in medicine.

## Health Data Nexus

The Health Data Nexus is T-CAIREM's **secure, streamlined, and scalable** flagship data repository for the storage and analysis of de-identified health data on Google Cloud. The Health Data Nexus was designed to meet the needs of three distinct user groups:

- **Data Holders** who require an easy, cost-effective way to store data, either for their own use or to grant access to other researchers.
- **Researchers** who want access to high-quality data and the tools and support needed to conduct their own analyses.
- **Educators** who want to use the platform to provide access to data for their students in a classroom, workshop, or datathon.

The Health Data Nexus consists of both a 'front-end' data access platform and a 'back-end' analysis platform. The front-end platform has been adapted from the PhysioNet platform developed by researchers at the Massachusetts Institute of Technology, with an eye to accessibility and usability. Researchers associated with academic institutions across the world can quickly log in via their institutional accounts and become credentialed users on the platform, able to view available datasets and manage access to these resources. This access policy puts equity and ease of access at the forefront of the platform.



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T-CAIREM is also developing ways to ensure that community members who are not associated with academic institutions can access the platform. Users can create a Google Cloud identity to access the back-end analysis platform, powered by a commercial cloud service. This allows users to load data into a bespoke research environment, where computing resources and costs can be scaled to suit their needs.

To ensure that the platform is secure and meets a high governance standard, it has been designed to meet stringent Canadian and Ontario privacy legislation and research guidelines. Data holders who want to upload resources to the platform must properly de-identify their dataset, gain REB approval for their project with explicit reference to the Health Data Nexus, and sign a Data Transfer Agreement with T-CAIREM that outlines data use. Additionally, users who want to access the data must be credentialed on the platform, complete training on conducting research with human subjects, and sign a Data Use Agreement outlining their responsibilities. These safeguards are outlined in the T-CAIREM Governance Outline (Appendix 5 Document 1).

The Health Data Nexus is uniquely positioned within the landscape of other data platforms, providing a balance of data security with accessibility. While it is based on the PhysioNet platform, it operates within the Canadian regulatory environment, providing an additional level of protection over data access. However, unlike other Canadian data platforms such as IC/ES, the Health Data Nexus avoids a great deal of administrative overhead, which requires approval from an associated research scientist to access data.

A publication describing the development of the Health Data Nexus and speaking to its important place within the health AI landscape has been submitted to the publication GigaScience. [A preprint is currently available for review.](#)

## DATASETS

While the Health Data Nexus primarily provides unique datasets, there has also been interest in offering high-value datasets which are publicly available elsewhere, as an additional incentive to attract researchers to the platform.

The following unique datasets are currently available on the Health Data Nexus:

- [GIM, a dataset for predicting patient deterioration in the General Internal Medicine ward](#) (GIM): GIM is the flagship dataset associated with the T-CAIREM Health Data Nexus. It is comprised of de-identified health data from over 22,000 patient encounters for 14,000 unique patients who were admitted under the GIM service at St. Michael's Hospital between 2011 and 2019. It includes demographics, laboratory measurements, medication, clinical orders, and outcomes.
- [Fracture Detection on Cervical Spine CT](#) (CSPINE): CSPINE is the primary source of imaging data on the Health Data Nexus. This dataset contains merged CT scans of the cervical spine in multi-frame Digital Imaging and Communications in Medicine (DICOM) format, collected from emergency patients at St. Michael's Hospital between May 1, 2004, and July 1, 2021.
- [COVID-19 Hospital Demographic, Clinical and Outcome Dataset](#) (THP-C19): This dataset comprises de-identified health-related data (demographics, clinical parameters such as vital signs and laboratory values, imaging findings and hospital outcomes) from a cohort of 509 patient visits admitted to Trillium Health Partners (THP) via the Emergency Department between November 1, 2020, to March 15, 2021, meeting criteria for likely COVID-19.

# DATA INFRASTRUCTURE

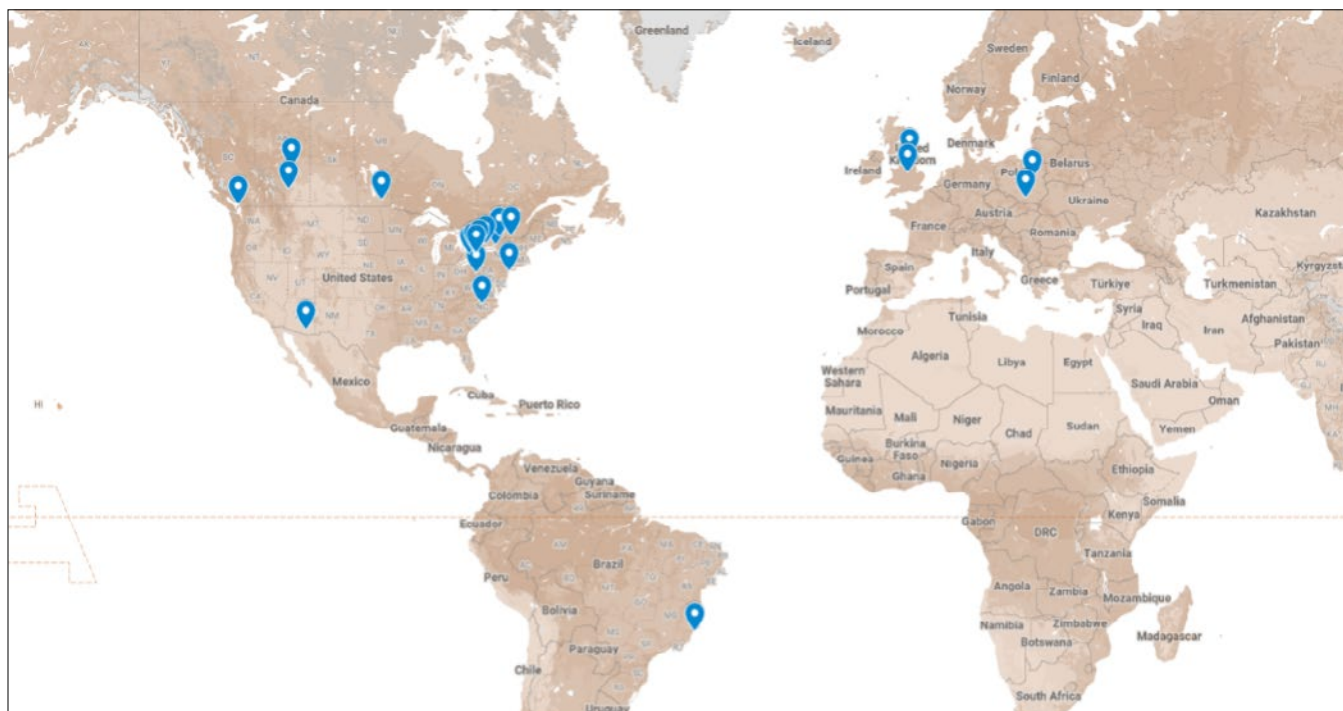
The following datasets are currently available elsewhere but are also offered on the Health Data Nexus:

- [COVID-19 Epidemiology and Vaccination Dataset](#) (C19-EPI): This is a daily snapshot of a publicly available COVID-19 epidemiological dataset collected by the COVID-19 Canada Open Data Working Group.
- [Canadian Heart Health Database](#) (CHHDB): This is a compilation of data from ten Provincial Heart Health Surveys conducted between 1986 and 1992. The database consists of two separate datasets: the Heart Health Dataset, consisting of a survey of core information from 23,129 entries collected by all Provincial Heart Health Surveys between 1986 and 1992, and the Family History Dataset, consisting of information on demographic information and health history collected by four provinces (Quebec, Ontario, Saskatchewan, and Alberta) from 9,286 respondents between 1989 and 1992.

- [Canadian Community Health Survey Public Use Microdata File](#) (CCHS-PUMF): This dataset is a nationwide project initiated by Statistics Canada, aimed at collecting information related to health status, healthcare utilization, and health determinants among the Canadian population.

## Users

Figures 30 and 31 demonstrate the users of the HDN platform. Figure 30 is a map of all institutions with users who have accessed the platform. While most users are based in Toronto and southern Ontario, there are also users from the United States, Poland, the United Kingdom, and Brazil.



**FIGURE 30:** Health Data Nexus users around the world

Figure 31 shows the number of users on the platform over time, beginning with the upload date for the GIM dataset. It demonstrates how events like the two Toronto Health Datathons led to a significant increase in HDN users.

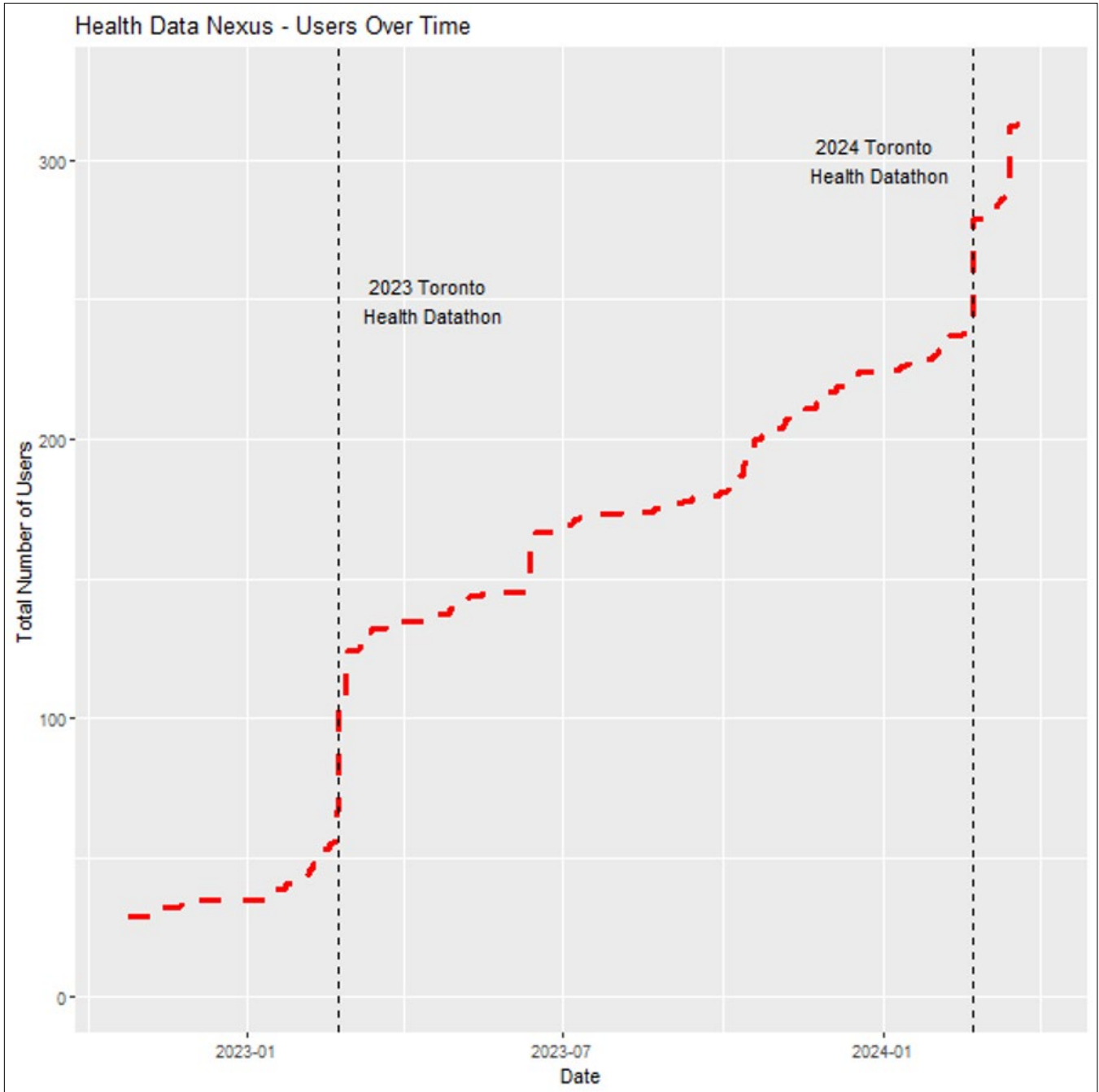


FIGURE 31: Health Data Nexus users since the inception of the platform to 2024



**T**-CAIREM is funded through a generous donation from the Temerty family. T-CAIREM was allocated \$26 million, of which \$10 million is endowed and \$16 million is expendable, for seven years of operations. The sections below outline T-CAIREM’s spending to date, plans for future revenue generation, and anticipated challenges over the next five years.

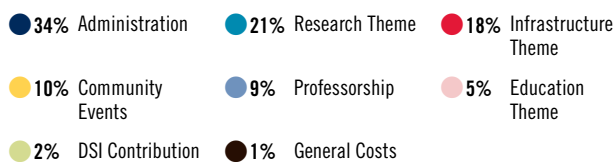
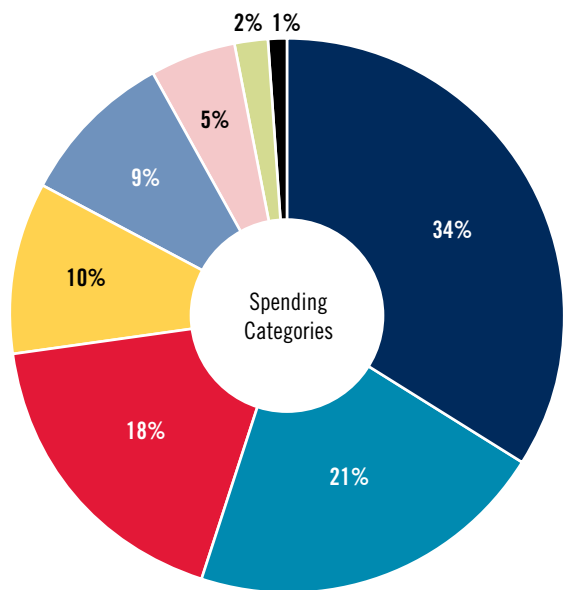
## Overview

Over the past four fiscal years (October 2020 to April 2024), as T-CAIREM ramped up operations and rolled out programs and initiatives, its operating budget increased accordingly. Table 9 outlines T-CAIREM’s spending over the past four fiscal years. Figure 32 shows the main spending categories in FY 2023-2024 were: administration (staff compensation,

T-CAIREM Directorship, and Theme Leads stipends); research (grants); data infrastructure (Health Data Nexus); community events (Conferences, datathons, international events); T-CAIREM Professorships (Bo Wang and Amol Verma); and education (summer research program, trainee rounds).

**TABLE 9:** T-CAIREM Expenditures Over the Past Four Fiscal Years

YEAR	SPENDING (CAD)
FY 2020-2021	\$375,000
FY 2021-2022	\$1,479,000
FY 2022-2023	\$1,556,000
FY 2023-2024	\$2,501,000
<b>Total</b>	<b>\$5,911,000</b>



**FIGURE 32:** T-CAIREM Spending Categories in FY2023-2024

## Plans for Revenue Sources

Until FY 2026-2027 T-CAIREM is funded with the Temerty Family donation.

### ENDOWMENT INCOME

Ten million dollars of T-CAIREM Funding is invested in the University of Toronto Long-Term Capital Appreciation Pool (LTCAP). The annual endowment income available to T-CAIREM is normally about 4% of the endowment’s market value. This can change depending on market conditions. Table 10 below outlines endowment income received over the past three years. Average annual endowment income for T-CAIREM going forward is estimated at \$400,000 dollars. Endowment income is used to support T-CAIREM Directorship, T-CAIREM Professorships, staff salaries, and operating costs.

**TABLE 10:** T-CAIREM Endowment Income Received Over the Past Three Years.

FISCAL YEAR	ENDOWMENT INCOME RECEIVED
FY 2021-2022	\$217,000
FY 2022-2023	\$281,000
FY 2023-2024	\$381,000
<b>Total</b>	<b>\$879,000</b>

### NON-ENDOWED INCOME

T-CAIREM is taking proactive steps to ensure its future sustainability beyond the Temerty Foundation donation. As such, T-CAIREM has drafted a 2024-2027 Partnerships Plan (Appendix 6, Document 1) with a focus on becoming self-sufficient. New operating activities are outlined in this plan to generate revenue while still enabling T-CAIREM’s core programs. These activities are designed to generate \$4 million annually for T-CAIREM’s operating budget. The following revenue-generating programs rely on establishing working relationships with public and private sector partners as primary target audiences:

1. Partners Program
2. Research Partnerships Program
3. AI in Medicine Education Program
4. Health Data Nexus Services
5. CRO (Contract Research Organization) Services

T-CAIREM has hired a Business Development Officer responsible for securing external funding by promoting T-CAIREM’s research and educational offerings to prospective public and private enterprises. T-CAIREM also works closely with UofT Advancement Office for sourcing philanthropic funding.

## Challenges Over the Next Five Years

T-CAIREM is widely viewed across UofT as a key hub for AI in medicine community. The Centre does not receive any operating funds from the University and operates entirely on the Temerty Foundation donation. T-CAIREM is gaining global recognition for its programming and for the achievements of its member scientists and educators. Our members are highly engaged and enthusiastic about the Centre. However, T-CAIREM faces future challenges as it moves towards introducing revenue-generating programs. The following may pose major threats to T-CAIREM's sustainability:

### FINANCIAL SUSTAINABILITY

As T-CAIREM depletes its resources, and moves towards revenue-generating activities, the Centre may face difficulty establishing a consistent revenue flow. Generating revenue through partnerships with industry is becoming increasingly competitive. This is further challenged by Canada's lower research and development footprint, as most large companies have their research and development headquartered in the U.S., which tend to support U.S. academic institutions. T-CAIREM has invested resources into business development and has started pursuing industry partnerships and revenue-generating activities well in advance of the Temerty donation running out.

### INTERNATIONAL REPUTATION AND BRAND

Currently, UofT is the global leader in AI in medicine. However, as the field of AI becomes more widespread, every major university across the globe is forming AI in medicine centres and competing to recruit top researchers and students. Maintaining T-CAIREM's reputation and brand as the global leader for AI in medicine will become increasingly more difficult. T-CAIREM plans to invest further resources in communications to keep our reputation and brand in the spotlight.

### INNOVATIVE GROWTH

Since T-CAIREM does not have the level of funding and access to industry as private academic institutions in the U.S. do, maintaining growth becomes increasingly challenging. T-CAIREM has allocated funding in the form of grants specifically to encourage innovative growth. Our Centre continuously seeks to find public and private partners to collaborate with on projects that support innovation in the field of AI in medicine.

### SUCCESSION PLANNING

As the field of AI grows, T-CAIREM faces the issue of losing its intellectual capital within the leadership team to private sector and to the U.S. T-CAIREM has implemented a faculty affiliates model to ensure that we have a pool of tested and tried leaders to draw on, if necessary.





# FUTURE DIRECTIONS

**T**he current T-CAIREM organizational structure, leadership team, and administrative elements are highly functional. T-CAIREM is embedded in a world-class University, with outstanding faculties, and supported by world-renowned hospital-based research institutes. This ecosphere attracts many of the world's leading AI in medicine researchers. As a result, T-CAIREM can engage in multiple streams of AI in medicine research and educational activities. T-CAIREM's goal for the future is to further strengthen our national and international reputation as a centre of excellence and innovation.

A high priority for T-CAIREM is to build up and sustain the future of AI in medicine research in Toronto. Creating a collaborative environment between UofT, other Canadian universities, and hospital-based research institutes is important for solidifying Canada's role in this field. T-CAIREM has already established the largest AI in medicine network nationally and will continue to strive to be the global reference for AI in medicine. As the next steps locally, T-CAIREM will formally approach TAHSN hospitals with the proposal

to create a TAHSN-based AI in medicine community to bring together core strengths across medical organizations and create a collaborative environment where clinicians and scientists can interact and catalyze innovative ideas and solutions to solve complex medical problems with AI. This community will share best practices in relevant issues related to AI in medicine, including data governance, responsible AI, adoption of AI in clinical settings, and development of novel methods in health AI. In this forum, partner hospitals will be able to share their learnings and explore partnerships and collaborations with other partner hospitals.

T-CAIREM is taking proactive steps to explore and implement revenue streams and financial supports, including industry partnerships, government grants, and professional development courses. Considering the growing interest in health AI, it is only a matter of time before T-CAIREM attracts a stable level of financial support. A secure flow of funding will enable T-CAIREM support for Research Chairs, Professorships, Postdoctoral fellowships, and graduate students. This will attract world-class researchers to Toronto and



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further strengthen and build T-CAIREM. Additional funding will permit more grant competitions providing T-CAIREM researchers with the opportunity to test new ideas and acquire preliminary data for larger external peer-reviewed grant competitions. There is virtually unlimited need for funding for foundational, innovation, implementation, and feasibility grants.

T-CAIREM will also work to position itself as the global leader in AI in medicine education. With the current efforts to incorporate AI in medicine education into the curriculum of UofT's medical school, T-CAIREM is poised to be a global model for AI education. T-CAIREM will secure its global leadership position by driving national and international efforts to create materials for clinician AI education.

In summary, the T-CAIREM model, developed over the past four years is highly effective in supporting a diverse community of AI in medicine researchers and educators. T-CAIREM will continue to refine this model. Forging fruitful partnerships and collaborations with government, industry partners, and influential groups will now be the focus for T-CAIREM to secure additional funding. T-CAIREM will strive to grow our presence and brand globally and be a major international force in AI in medicine research, education, and innovation.



# REPORT OF MEMBERS

**T**-CAIREM invited several of its members to provide input on the Centre's activities. Members were asked to reflect on the successes and challenges of the Centre over the past four years and to provide suggestions for future directions. T-CAIREM selected members that represent a range of UofT departments and hospital research institutes.

Members were asked for their views and visions of T-CAIREM, specifically:

- Over the past four years what have been the successes and strengths of T-CAIREM?
- Over the past four years what have been the challenges and weaknesses of the T-CAIREM?
- Moving into the next five years (sustainability phase), do you have any suggestions for new directions for T-CAIREM or modifications to existing activities?

## T-CAIREM Member Reports

### LAURA C. ROSELLA, PHD

Canada Research Chair in Population Health Analytics

Professor and Epidemiology Division Head, Dalla Lana School of Public Health, University of Toronto

Education Lead, Temerty Centre for Artificial Intelligence Research and Education in Medicine (T-CAIREM)

[laura.rosella@utoronto.ca](mailto:laura.rosella@utoronto.ca)

The Centre for AI Research Education and Medicine (T-CAIREM) has achieved several notable successes and strengths over the past five years. This includes strengthening interdisciplinary collaboration to advance AI and Medicine. T-CAIREM has fostered strong partnerships between researchers, clinicians,

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and industry leaders. This interdisciplinary approach has rapidly advanced training and innovation related to real-world applications and improved healthcare outcomes. T-CAIREM has also developed and implemented several training educational programs that integrate AI and data science into medical training, exposed undergraduate and graduate trainees to hands-on learning opportunities (e.g., summer program) and held a CPD-accredited speaker series with world-class speakers working at the interface of AI and medicine. These initiatives have equipped healthcare professionals in the Toronto community with the skills and confidence needed to engage and leverage AI technologies into practice. T-CAIREM has secured substantial research funding and grants from various sources, enabling T-CAIREM to support various innovative projects and initiatives. This funding has led to high-impact publications and research breakthroughs. Importantly, through collaboration, research funding and training, T-CAIREM has supported the development of AI tools and solutions that have been adopted in clinical settings. These tools have enhanced diagnostic accuracy, treatment planning, and patient management across various clinical areas. T-CAIREM has also created a data infrastructure environment to enable more collaboration and data sharing, a key barrier to AI and medicine development. Finally, T-CAIREM has engaged with the broader community through public lectures, workshops, and collaborations, creating one of the world's most rich and vibrant AI and medicine communities. T-CAIREM has already gained international recognition for its contributions to AI in medicine. Their work has been featured at global conferences and has been awarded international awards. The past 5 years have been a tremendous success.

There are some challenges with any new centre and fast pace of AI development. With respect to the data infrastructure, several challenges are encountered with respect to privacy and governance. These challenges have been overcome; however, do take time. Engagement is another challenge, as finding the right mechanism to make sure the members can routinely interact virtually and outside of formal training and grants has been a work in progress. Designing and updating curricula to keep pace with rapid advancements in AI and medicine has been a challenge. Ensuring that educational programs are relevant and comprehensive requires continuous effort and adaptation. Partnerships with industry are of interest; however, navigating these partnerships with industry can present challenges, including aligning academic goals with commercial interests and managing conflicts of interest. These are issues that will continue to be worked on with transparency and discussion. Finally, finding the space between academic programming and professional development is an ongoing challenge to navigate to ensure T-CAIREM adds value and complements other initiatives across the university.

Moving forward, it would be fantastic to see T-CAIREM expanding its training offerings to build more capacity in the healthcare system and across to postdoctoral and faculty fellows. Secondly, it would be valuable to see strengthened collaborations with hospitals and industry partners to accelerate the translation of the incredible research happening at U of T into real-world applications. Efforts to ensure that the research addresses practical healthcare challenges and has a measurable impact on patient outcomes would be transformative. This involves strengthening collaborations with healthcare providers to ensure that research aligns with clinical needs and priorities. Finally, strengthening international collaborations, including bolstering student and faculty exchanges, is critical for international impact and constant contact with the latest ideas globally in AI and medicine.

# REPORT OF MEMBERS

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## **YU SUN, PHD, P.ENG.**

Canada Research Chair in Micro and Nano Engineering Systems

Professor, Mechanical Engineering, University of Toronto

Director, Robotics Institute

[sun@mie.utoronto.ca](mailto:sun@mie.utoronto.ca)

One strength of T-CAIREM was the establishment of partnership with other disciplines and divisions. I was the director of the University of Toronto Robotics Institute (RI), during which T-CAIREM and RI formed a strong partnership to promote robotics and AI in medicine. Such multidisciplinary partnership and collaboration make T-CAIREM unique and powerful in solving demanding medical problems with innovative approaches.

T-CAIREM's impact could be even stronger with more funding to support more collaborative projects. With T-CAIREM's limited funding, over the past four years, only a few collaborative projects were funded, and many potentially high-impact projects were not supported financially.

T-CAIREM needs to build a richer portfolio of funding and more pro-actively seek funding (e.g., from donors). More funding will result in stronger impact via supporting more collaborative projects. Another area is to broaden its activities in purely computation-based AI to embodied/physical AI (intelligent physical systems) such that broader impact can be attained for patients, clinical practitioners, and hospitals.

## **AMOL VERMA MD, MPHIL, FRCPC**

Clinician-Scientist, Unity Health Toronto

Associate Professor, University of Toronto

Temerty Professor of AI Research and Education  
in Medicine, University of Toronto

As a Temerty Professor of AI Research and Education in Medicine at the University of Toronto, I have greatly enjoyed being a part of the T-CAIREM community. I have specifically been a part of T-CAIREM's educational initiatives for undergraduate and postgraduate medical learners and participated in its webinars

and conferences. Since its inception, T-CAIREM has had a major impact on AI research and education in medicine, in Toronto and across Canada. The founding of T-CAIREM coincided with the explosion of AI into mainstream public consciousness and a growing focus on AI technologies both within and outside of medicine. This is particularly relevant for students and health professions learners, who increasingly express interest in studying AI in medicine. T-CAIREM has provided accessible pathways for learners to get exposed to AI in medicine as well as opportunities for deeper learning and cutting-edge research. I believe T-CAIREM has filled an important void at a perfect time and has strengthened the Faculty of Medicine's place as a true global leader in this arena. The specific initiatives of T-CAIREM that I feel have been successful include: the webinar series that brings world-class researchers to share their work, the summer student program that supports an extraordinary community of students who are doing exciting work, the in-person conferences and datathons that cultivate a dynamic community of practice, and the educational programs for undergraduate and postgraduate medical learners that are being incorporated into core curricula.

On a personal note, my own program of research has been supported by a Temerty Professorship in AI, which came at an essential time during my transition away from early career start-up salary support and before I was senior enough to be competitive for national salary awards, and this has been a critical enabler of some of the exciting and impactful work that my team and I have been able to accomplish. With this support, I have been leading GEMINI, Canada's largest hospital electronic health records research dataset, which is being used extensively for AI research, and deploying and evaluating CHARTwatch an AI early warning system that reduced unexpected deaths by 26% on the general internal medicine unit at St. Michael's Hospital and was published in the CMAJ.

An important challenge for T-CAIREM, and AI in medicine in general, is accelerating the responsible deployment of AI technologies into clinical care, so that promising solutions don't "die on the shelf" as research projects. It would be exciting to see T-CAIREM

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help advance the ability to implement and evaluate AI solutions in medicine. One of the challenges, and opportunities, in the Toronto AI ecosystem is that there are many players, including the Vector Institute and the Data Sciences Institute. Sometimes, it can be difficult for T-CAIREM to articulate its unique contributions and differentiate from other entities.

Over the next 5 years, I would like to see T-CAIREM continue to grow its network in Canada and foster greater international collaborations. I am hoping that there will be an even greater focus on AI safety and responsible deployment, and T-CAIREM's impact in this space could be amplified by collaborations with healthcare organizations and the Vector Institute. I would like to see continued enrichment of the educational programs for health professional learners, increasingly reaching beyond the medical school to other health professions. The need for T-CAIREM's services is only growing as AI technologies evolve, and I look forward to seeing how T-CAIREM will embrace these opportunities.

## MARY-LOUISE GREER

Staff Radiologist and Co-Section Head of Body MRI,

Department of Diagnostic and Interventional Radiology, The Hospital for Sick Children

Project Investigator, Research Institute, The Hospital for Sick Children

Professor and Pediatric Imaging Division Lead,

Department of Medical Imaging, University of Toronto

Member, T-CAIREM, Temerty Faculty of Medicine, University of Toronto

Member, Faculty Council, Temerty Faculty of Medicine, University of Toronto

Chair, Pediatric MRI Study Group, International Society of Magnetic Resonance in Medicine

I have been a member of the Temerty – Center for AI Research and Education in Medicine (T-CAIREM, formerly the Centre for Machine Learning in Medicine), since October 2020. My rationale to join T-CAIREM was to increase my understanding of AI in medicine, an area I was aware was evolving rapidly, and for which the University of Toronto was

already recognized as a center of excellence. This was driven by my limited involvement in AI research advising on imaging, and as a pediatric radiologist with an interest in MRI, my experience advocating for children in relation to medical imaging technology.

I would first like to detail the very positive influence membership of T-CAIREM has had on my professional development. As a testament to the dynamic, engaging and very inclusive environment that is T-CAIREM, I have gone from being a passive bystander to an active participant in the AI “revolution” in medicine. My membership has provided me with the confidence to get more involved. It has provided tremendous research opportunities, including being the recipient of a T-CAIREM grant as a co-principal investigator. It has also fostered collaboration with colleagues from a variety of disciplines, locally and globally. As well, it has given me the impetus to pursue further education in AI in my own specialty. I completed a Radiological Society of North America (RSNA) Spotlight Course, Implementing and Evaluating AI for Radiology, in March 2024, and am currently enrolled in the RSNA Imaging AI Certificate Program.

More broadly are my observations of key successes and strengths of T-CAIREM in the past 4 years:

- it has created a multidisciplinary network of members and learners at all levels, from trainees to professors, research scientists and physicians, within the TFOM and across Canada.
- it has provided a catalyst for collaboration and peer support to develop ideas in AI through formal and informal networking opportunities, research funding, and knowledge dissemination:
  1. the Temerty Centre Speaker Series - monthly virtual meetings with leaders, innovators and novices in the field sharing their experiences at all levels, providing a forum for Q&A, and creating additional opportunity to network
  2. the inaugural T-CAIREM AI in Medicine Conference October 12-13, 2023

# REPORT OF MEMBERS

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3. Summer Student Research Programs/Internships
4. a presentation by T-CAIREM Director Professor Muhammad Mamdani to the TFOM Faculty Council on April 15, 2024, that was informative, engaging and very well received
5. the inaugural T-CAIREM Technion Collaboration Catalyst Workshop May 6-10, 2023, held in Ein Gedi, Israel.

I was fortunate to be selected to attend the catalyst workshop that brought together over 40 faculty and trainees from the two centers. It was incredibly successful in achieving its stated goals of (i) expanding scholarly ties between the two institutions, (ii) facilitating academic cooperation among faculty members between both institutions drawing on the expertise of faculty members to increase educational opportunities at both institutions, (iii) enriching each other's educational and research environments, and (iv) promoting international and inter-cultural understanding. By applying the same principles of inclusivity and multidisciplinary engagement created within TFOM in Toronto, T-CAIREM in collaboration with Technion, created an incredibly dynamic, diverse and creatively rich binational research environment. This brought together individuals from many disciplines from both institutions. My own research group that emerged from this collaboration includes biomedical engineers, neurosurgeons, a geneticist, a cognitive scientist and pediatric radiologists. While our group's proposal was fortunate to be awarded a seed grant at the workshop, several very exciting proposals developed by other research groups also newly forged at this workshop have since been awarded funding. The workshop members and research groups have had ongoing interaction virtually and in-person ever since, including site visits and attending scientific meetings here in Canada, and providing education, such as the Temerty Centre Speaker Series.

While there has been great success for T-CAIREM fostering interdisciplinary engagement amongst individual members, my perception is that there remain challenges breaking down silos that continue to exist at an institutional level. This includes different

hospitals under the umbrella of the TFOM and their individual departments, and different departments within the TFOM at the University. These may stem from overlapping research ideas/areas of interest, creating potential conflicts of interest. As well, I understand commercial translation of AI research tools has been slow to be realised. This may stem from significant roadblocks within hospitals approving AI research projects at the development and/or application stage for AI tools. This likely relates, at least in part, to differing institutional requirements and levels of complexity around AI governance, research and ethics board approval and obtaining permission for data sharing.

Over the next 5 years, T-CAIREM should continue to expand its existing initiatives around the guiding themes of research, education, infrastructure and initiative. I also suggest that T-CAIREM leverage its successes to take the lead role in creating a centralised process within TFOM to address the above-described roadblocks. It could develop a standardized process detailing all necessary approvals to conduct AI research in healthcare within the TFOM. This could then be implemented by the TFOM network of hospitals and university departments in a uniform manner, eliminating redundancies, and promoting institutional collaborations. It may also assist in breaking down some of the silos.

## HOUMAN KHOSRAVANI, MD PHD

Assistant Professor, Division of Neurology, University of Toronto  
Medical Director of Stroke Care, Sunnybrook Health Sciences Centre

I have had the distinct privilege of engaging with the Temerty Centre for Artificial Intelligence Research and Education in Medicine (T-CAIREM) over the past four years. This period has been transformative, both for the integration of artificial intelligence into healthcare and for the collaborative spirit fostered among researchers, clinicians, and trainees. My contribution to this report highlights the successes and strengths of T-CAIREM, discusses some headwinds encountered, and offers some humble thoughts on positive future directions for the great organization that is T-CAIREM.

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T-CAIREM has established itself as a vital hub for AI research and implementation in healthcare. One of its most significant achievements is the creation of a collaborative ecosystem that brings together researchers and trainees across multiple disciplines. One example is T-CAIREM HIVE has been an outstanding platform for fostering connections and facilitating the exchange of ideas, effectively bridging gaps between emerging talent and established experts. The development of the Health Data Nexus has set us off on the much-needed path for AI research in data-sharing practices within the University of Toronto framework, standardizing access and enabling groundbreaking research. Additionally, the summer studentship program has been exceptionally successful, attracting talented students from diverse institutions and fostering an inclusive research environment. Similarly, T-CAIREM has partnered with other U of T organizations in offering grant applications. This emphasis on inclusivity and collaboration has significantly strengthened our research capabilities, solidifying T-CAIREM's reputation as a leader in the safe implementation of AI in healthcare.

All our U of T AI centres face some challenges, as does T-CAIREM. The rapid pace of AI advancements in the industry often outstrips the regulatory and ethical frameworks established within academic settings. This discrepancy creates a pressing need for enhanced collaboration with industry partners to bridge the gap between swift technological progress and the cautious rigor of academia. Strengthening the framework for industry partnerships could leverage resources and expertise from major technology companies like Nvidia, Google, and Microsoft, while maintaining academic independence and ethical standards. Furthermore, there is a need for additional funding to host dedicated symposia across T-CAIREM's pillars. These can include AI implementation, safety, data sources, and computational & methodology advancements. These events would foster knowledge exchange, address standardization challenges in research ethics, and enhance data inclusion protocols across affiliated institutions.

Looking ahead, T-CAIREM can lead by establishing robust frameworks for collaboration with industry leaders without compromising its commitment to responsible AI implementation in healthcare. Securing dedicated funding for quarterly symposia focused on the center's core pillars would facilitate interdisciplinary dialogue and innovation. Funding can be smaller micro-grants to researcher members, which when combined with industry partners (who can perhaps supply compute) can build on innovation. There are other AI labs at U of T, such as the Vector Institute. I would advocate that T-CAIREM be designated as the leading lab for all matters related to healthcare including fundamental AI research. A dual-track approach: actively implementing existing AI technologies to deliver immediate benefits to the healthcare system while simultaneously supporting the development of new capabilities through research led via T-CAIREM. Identification of the four future pillars of focus informs this. This balanced strategy will ensure that T-CAIREM continues to lead in responsible healthcare AI innovation, maintaining its impact and relevance in the years to come.

Overall, T-CAIREM has been pivotal and a superb organization and AI Lab/Unit within the University of Toronto, and singularly the best positioned for impactful transformative change using AI technologies in medicine and healthcare.



T-CAIREM has invited several individuals to provide input on the activities of T-CAIREM and their experience as learners. T-CAIREM asked these individuals to reflect on the successes and challenges of the Centre over the past five four years and to provide suggestions for future directions. T-CAIREM has selected learners that represent a range of involvement with T-CAIREM.

Learners were asked for their views and visions of T-CAIREM, and specifically:

- Over the past four years what have been the successes and strengths of T-CAIREM?
- Over the past four years what have been the challenges and weaknesses of T-CAIREM?
- Moving into the next five years (sustainability phase), do you have any suggestions for new directions for T-CAIREM or modifications to existing activities?

## T-CAIREM Learner Reports

### GEMMA POSTILL, MD/PHD CANDIDATE

T-CAIREM Education Trainee Co-Lead

#### Successes and Strengths of T-CAIREM Over the Past 5 Years

Over the past five years, the Temerty Centre for Artificial Intelligence Research and Education in Medicine (T-CAIREM) has made remarkable progress in integrating AI into the medical field. A key strength, driving our success, has been the passion of everyone involved at T-CAIREM. This passion, combined with the substantial Temerty donation, has allowed T-CAIREM to make significant upfront investments in quality products and platforms, laying a strong



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foundation for long-term impact. Over the past few years, the T-CAIREM team has grown, fostering an environment where new members are encouraged to innovate and expand the center's offerings.

Another notable strength is T-CAIREM's commitment to medical education and, both at the undergraduate and postgraduate levels. We have taken a needs-based approach, creating and integrating AI-related educational offerings into medical curriculum. As one example, we developed in-house an educational curriculum tailored to various residency programs, delivered through their half-day program. The curriculum enriched by the diverse team that developed it, comprising experts from medicine, epidemiology, computer science, and engineering.

Other prominent strengths include bridging the gap between academia and industry (exemplified by its successful conferences), supporting top quality student projects (summer studentship), amalgamating AI resources to a centralized resource hub, creating a centralized and secure data access platform, and actively engaging and growing through use of our large social media platform.

## Challenges and Weaknesses of T-CAIREM Over the Past 5 Years

Despite these successes, T-CAIREM has faced several challenges. The rapid initial growth spread resources thin, making it difficult to manage and invest resources in all initiatives. With numerous projects and a wide array of offerings, ensuring follow-up has been difficult. Dedicated T-CAIREM supports, such as Marianne So, have begun to address this challenge. For education, competition with other medical education topics has also been a persistent challenge. General apprehension towards AI in medicine has also posed a barrier, although this sentiment is gradually shifting.

Institutional memory is another weakness; much information about T-CAIREM's resources, offerings, and roles is held among individuals (vs. written), which can hinder smooth transitions and continuity.

## Suggestions for New Directions or Modifications for T-CAIREM in the Next 5 Years

Looking ahead, T-CAIREM should focus on creating structures that ensure fair compensation for academic experts, moving away from the reliance on unpaid contributions. Commercializing T-CAIREM's educational offerings and providing asynchronous delivery (e.g., recordings) of programs can expand our reach and accessibility. Partnering with Temerty to improve the integration of AI into the medical education curriculum can also be beneficial. Additionally, developing a T-CAIREM AI in medicine certification program, focused on creating AI stewards, could further solidify the center's educational impact.

Over the past five years, T-CAIREM has achieved significant success in advancing AI in medicine. As a new organization, the next five years are pivotal for T-CAIREM. With the continued support of Temerty and the leadership of Dr. Muhammad Mamdani, Dr. Laura Rosella, and others, T-CAIREM is poised for exponential growth in its impact and reach. By addressing sustainability challenges, continuing to foster interdisciplinary collaborations, and focusing on practical applications, T-CAIREM can continue to lead the way in revolutionizing healthcare through artificial intelligence.

## SUJAY NAGARAJ

T-CAIREM Executive Committee Trainee Representative

## Successes and Strengths

Over the past four years, T-CAIREM has made strides in fostering a thriving community of AI in medicine researchers across Toronto. One of its most notable successes has been its ability to bring together researchers from diverse institutions, encouraging innovative research collaborations. These collaborations have not only resulted in a stronger AI research network but have also been instrumental in establishing international partnerships, such as with the Technion, which further enhance T-CAIREM's global reach.

# REPORT OF LEARNERS

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Additionally, T-CAIREM has been successful in inspiring and educating the next generation of researchers and clinical practitioners. The organization's initiatives aimed at introducing summer students to the domain of AI in medicine have sparked interest and facilitated student involvement at all levels. Furthermore, its educational efforts directed towards MDs have been crucial in bridging the knowledge gap between clinical practice and up and coming AI innovations.

T-CAIREM has also been effective in securing and providing grant funding, for researchers which has enabled it to support numerous projects and educational programs. From a student perspective, T-CAIREM's activities have been invaluable in helping students like me stay current with this rapidly evolving field. The numerous opportunities for student involvement have created an inclusive environment that encourages both learning and contribution to meaningful research.

## Weaknesses and Challenges:

One key area for improvement is fostering collaboration with other AI-focused institutions in Toronto, such as the Vector Institute. Currently, these institutions operate somewhat independently, which has led to missed opportunities for synergy. To truly leverage the city's diverse AI ecosystem, building stronger partnerships with these institutions will be essential.

Another ongoing challenge is managing data silos. Data silos remain a common issue in the field of AI and within Toronto's research community. The inability to seamlessly share and access data across institutions can limit the scope and impact of research. If T-CAIREM aims to maximize its research contributions, a key focus should be on promoting open datasets that are accessible for external research with external computation. This approach would not only increase the utility of the datasets but also encourage external citations and collaboration, thereby contributing to new research findings.

## Suggestions for Sustainability:

As T-CAIREM moves into its next five-year phase, focusing on sustainability will be crucial. One important consideration is understanding how T-CAIREM can best integrate into the broader Toronto AI ecosystem. Establishing clear roles within this ecosystem will prevent overlap and duplication of efforts, ensuring that the collective efforts of all AI institutions are more impactful. Coordination between these groups will be vital, as competition for similar goals could hinder progress if not effectively managed.

Maintaining and expanding the successful education initiatives will also be important to T-CAIREM's sustainability. However, given the natural turnover of students, it is essential to formalize these initiatives to ensure their longevity. This could involve hiring a dedicated manager to oversee educational programs, allowing for continuity and further growth – such as a curriculum coordinator, perhaps with an educational background. Alternatively, forging stronger, formal partnerships with medical education administrators could help solidify these programs within the broader MD curriculum. Curriculums are sustainable and can be standardized, whereas student-led presentations are not. While informal relationships and friendly connections (i.e., connecting to residency program directors) have been helpful at driving our educational initiatives, formal arrangements would provide a more stable foundation for expanding educational offerings.

## ARMAAN MALHOTRA MD PHD(C),

Division of Neurosurgery, Department of  
Surgery, University of Toronto

T-CAIREM Education Affiliate

I served as a Temerty Centre of Artificial Intelligence Research and Education in Medicine (T-CAIREM) education affiliate for the 2024-2025 academic year. Outside of this I am a graduate student pursuing doctorate studies in Clinical Epidemiology through the Institute for Health Policy, Management and Evaluation whilst completing neurosurgical residency

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training at the University of Toronto. My thesis work is focused on understanding traumatic brain injury outcomes using population health data as well as developing computer vision solutions to optimize transfer decisions for brain injured patients.

Participation in T-CAIREM has been a phenomenal way for a healthcare provider to connect with the larger multidisciplinary community focused on AI research and education. Breaking down these barriers and fostering collaboration is one of the remarkable achievements of T-CAIREM within a fairly short time. As an example, the T-CAIREM Summer Research Program identifies Faculty supervisors from a variety of disciplines and interested undergraduate, graduate and professional degree students who seek to delve into real-world AI research projects. During my time as a T-CAIREM affiliate, I have had the opportunity to adjudicate student presentations and am consistently blown away by the quality, innovation and potential for real-world application that these summer students achieve in such a short period of time. Another strength is the trainee rounds presentations, which provides a venue for more senior graduate students to present novel AI research findings to the broad T-CAIREM community. This facilitates increased visibility for AI researchers whilst allowing an opportunity for important and constructive feedback directed at trainees. Finally, the multidisciplinary nature of T-CAIREM has been a strong signal to investigators emphasizing the commitment to cutting edge AI research. From an academic productivity standpoint, T-CAIREM (and the University of Toronto) remains an internationally recognize hub for AI innovation.

Despite the numerous strengths and accomplishments, T-CAIREM does face challenges in the future. With the explosion of AI research funding, there are innumerable investigators around the University of Toronto that are adopting these methods. As a result, there can be multiple groups working on the same problems without knowledge of the others. This is a natural result of a large academic campus spread across multiple centers, however, breaking down these sometimes-disparate silos remain an important future goal for T-CAIREM. This may take the form of a centralized repository of T-CAIREM affiliated researchers that is

updated regularly. It should be noted that without T-CAIREM, these silos would be far more disconnected. I also think that it will be important for T-CAIREM to continue embracing novel ways of information dissemination to maintain its position on the cutting edge of the field (such as instructional YouTube channel videos or a formal T-CAIREM podcast).

Moving into the next five years I am confident T-CAIREM will continue to excel as a leading community in AI. It will be important to continue investment into education at all levels of training, which is a major strength of the program today. From a research perspective, increasing the efficiency of academic output will be facilitated through enhanced visibility of existing research groups within the community. Fostering an environment of collaboration rather than competition will ensure a sustainable future for T-CAIREM.

## ANGLIN DENT, MSC

T-CAIREM Education Affiliate

MD/PhD Student

University of Toronto

I have been involved with T-CAIREM since 2020. As a young research trainee entering the field of AI in Medicine, T-CAIREM has provided me with extensive opportunities to learn from experts within the field, expand my skillset, and present my research to a broad academic audience at an early stage in my career. Now as a member of the T-CAIREM Education Affiliates, I have a comprehensive understanding of the expansive and transformative programming T-CAIREM has developed to advance AI in Medicine at the University of Toronto.

### Strengths

T-CAIREM is a crucial organization at the University of Toronto, filling the need for a dedicated department and collaborative hub for AI in Medicine. T-CAIREM brings together researchers from diverse departments across the University to foster innovative collaborations and research projects that push the envelope of technology and innovation in Medicine. This is accomplished

# REPORT OF LEARNERS

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through dedicated community building initiatives and networking opportunities, led by an interdisciplinary team of experts (spanning medicine, computer science, data science, ethics, and technology deployment). T-CAIREM collaborative initiatives include the T-CAIREM newsletter, T-CAIREM Hive, and the T-CAIREM collaboration hub. T-CAIREM additionally supports the advancement of AI in Medicine by hosting multiple large scale academic meetings each year. These meetings bring together experts to deliberate on overarching themes of emerging topics and identified challenges within the field. As a PhD trainee in the field of AI in Medicine, I have been able to leverage the T-CAIREM collaborative opportunities to identify and collaborate with multiple Principal Investigators spanning diverse departments across the University of Toronto. T-CAIREM excels in bringing awareness to such transformative AI in Medicine research occurring at the University of Toronto through their Speaker Series, which elevate the experiences of experts within the field of AI in Medicine, and their Trainee Rounds, where exceptional trainees across all disciplines at the University of Toronto showcase their AI research projects.

Further, T-CAIREM promotes the foundational understanding and appreciation for AI in Medicine among current and future medical trainees. This is accomplished through targeted educational initiatives to medical residents, dedicated undergraduate-level summer research programming, and an intensive week-long bootcamp to introduce motivated high school students to the field of AI in medicine. Beyond establishing proficiency among trainees, these programs serve as informal mentorship opportunities for junior trainees to learn from established researchers in the field.

## Challenges/Opportunities for Improvement

I am not aware of many challenges or weaknesses of T-CAIREM. Next steps within the organization should focus on expanding from current successful initiatives. This may include broadening events to involve institutions across the country and re-

invigorating the speaker series to include dedicated sessions regarding successfully deploying developed technologies highlighted in current Speaker Series. As a significant portion of the educational programming at T-CAIREM is developed by volunteer trainees, scaling up such initiatives may require a larger hired team of education affiliates.

An additional opportunity for improvement in T-CAIREM is the creation of formalized mentorship programs that expand beyond the informal mentorship received in dedicated education programming initiatives (e.g. Undergraduate Summer Program). As we move forward in our understanding of how AI will successfully be integrated in Medicine, it will be critical to elevate the voices of researchers who have successfully deployed and integrated their developed tools and connect them with junior trainees striving for the same goals.

## Conclusions

Overall, I strongly believe T-CAIREM fills a crucial need for a dedicated AI in Medicine program at the University of Toronto. I believe with dedicated efforts towards expanding the established T-CAIREM initiatives, this organization has the potential to significantly impact the field of AI in Medicine across all Canadian institutions.

## JETHRO KWONG

Resident physician

Division of Urology, Department of Surgery, University of Toronto

T-CAIREM Advisory Committee Trainee Representative

I'm delighted to provide a learner report for the Temerty Centre for AI Research and Education in Medicine (T-CAIREM). I have been a member of T-CAIREM since Sept 2020, and have been closely involved with the organization over the past few years. These roles included the Trainee Advisory Member, Education Theme Volunteer, and supervisor of several recipients of the T-CAIREM Summer Research Studentship. In this capacity, I believe I can provide an accurate and thorough assessment of the successes and challenges of T-CAIREM over the past few years.

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## Success and Strengths

T-CAIREM has excelled in creating a collaborative environment for advancing AI in medicine, both within the University of Toronto and on a national scale. Through a strategic, multi-pronged approach, T-CAIREM has positioned itself as Canada's leading institution for training the next generation of healthcare professionals in AI. A major achievement has been the integration of an AI curriculum directly into the medical school program, giving medical students early exposure to AI concepts and applications. This curriculum has now expanded to the postgraduate level, benefiting residents and fellows across various specialties – those who are at the frontlines of interacting with clinical AI tools – making it an invaluable resource.

Additional successes include the Summer Studentship Program and Trainee Rounds, which have both grown to reach a national audience. These initiatives offer hands-on research opportunities and presentation platforms that equip students with critical AI skills, fueling nationwide interest in AI-driven medical innovation. T-CAIREM has also bolstered clinical AI research at the University of Toronto through the Temerty Innovation Grant and its Speaker Series, strengthening research initiatives and knowledge-sharing within the clinical AI community.

## Challenges and Weaknesses

One challenge has been expanding the T-CAIREM Health Data Nexus, an online repository designed to house de-identified clinical datasets. Although some datasets have been successfully uploaded, contributions from the broader University of Toronto AI community have been limited. It appears that the bottleneck is not due to a lack of streamlined data submission processes by T-CAIREM, but rather a lower-than-expected level of engagement and interest from other researchers.

## Suggestions for New Directions or Modifications

Looking ahead to the next five years, I think T-CAIREM can pursue several strategic directions to further its impact. To enhance the deployment of AI tools in our real-world clinical environments, T-CAIREM could develop “fast-track” pathways that assist researchers in navigating the complex regulatory and validation processes needed for clinical adoption. Opportunities to collaborate with policy and healthcare implementation experts would further facilitate this transition. In addition, establishing community-centered programs that involve patients and local healthcare providers from the beginning stages of AI projects could enhance trust and ensure these tools serve a broader population. By engaging diverse voices, T-CAIREM can foster patient-centered AI developments that reflect real healthcare needs. Finally, expanding mentorship initiatives to cover not only technical but also ethical and policy-oriented skills will further prepare learners for leadership roles in AI-driven healthcare.

Overall, I believe T-CAIREM has been a powerful catalyst in sparking interest in AI in medicine for myself and other trainees. I am confident that it stands as a true leader in the field, and I look forward to seeing its continued growth in the coming years.



## APPENDICIES

All appendices can be found on the [T-CAIREM SharePoint site](#).



**UNIVERSITY OF TORONTO  
TEMERTY CENTRE FOR AI  
RESEARCH AND EDUCATION IN  
MEDICINE SELF-STUDY REPORT**

**PERIOD**

October 2020 – December 2024

**DEPARTMENTAL REVIEW**

February 4, 2025



Temerty Centre for AI Research  
and Education in Medicine  
UNIVERSITY OF TORONTO

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