Education on Artificial Intelligence for Healthcare: T-CAIREM's Approach and Education Mandate

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

INTRODUCTION

The Temerty Centre for Artificial Intelligence Research and Education in Medicine (T-CAIREM) is Canada's leading academic centre dedicated to advancing the application of artificial intelligence (AI) in healthcare through interdisciplinary research, education, and innovation. As the education branch of T-CAIREM, our objective is to equip learners, clinicians, researchers, and the broader community with the knowledge, skills, and critical understanding needed to responsibly develop, evaluate, and implement AI in healthcare.

Our education programming is grounded in the belief that AI literacy is essential for the future of healthcare. We aim to empower all involved parties – from medical students and practicing clinicians to data scientists and patients – to understand, engage with, and shape the evolving AI landscape. We do this through a wide array of offerings, including formal curricula, bootcamps, technical training programs, public-facing workshops, and resources that bridge the gap between technical AI development and its ethical, safe, and effective use in medicine.

This report outlines our approach, guiding principles, and the breadth of our programming. It explains how we pursue education as an organization that is independent of any specific degree program or educational system within the University of Toronto. This report identifies our priorities for educational initiatives, outlining the types of programs and resources we advance to achieve our mandate. In doing so, it describes our role as a leader in AI education, detailing how we guide our institution and other organizations in developing AI literacy, capacity, and responsible innovation in healthcare.

Together, we are helping to build a healthcare system prepared to harness the transformative potential of AI, ensuring its integration is evidence-informed, patient-centred, and equitable. We emphasize the value of inclusive multidisciplinary education in ensuring that these AI technologies are used to enhance, rather than replace, human care.

REPORT STRUCTURE

This report is structured to provide a comprehensive overview of the education branch's framework, mandate, and strategic priorities within T-CAIREM. It is organized into the following components:

1. T-CAIREM's 3x3 Educational Framework

We begin by introducing our 3x3 Framework, which articulates nine core values that broadly guide our approach to AI education. These values apply across all our programs and initiatives, serving as foundational principles for how we design, deliver, and evaluate our educational offerings.

2. 3x3 Framework Expansion

We then provide an in-depth expansion of each component within the 3x3 Framework, translating these broad values into actionable implementation objectives. This section outlines how each value is operationalized within our programming and organizational practices to create meaningful educational experiences.

3. Mapping of the 3x3 Framework to Current Initiatives

Next, we map the 3x3 Framework to our current educational initiatives, identifying strengths, gaps, and areas for growth. This analysis highlights how our existing programs align with our values and where opportunities exist to enhance our impact.

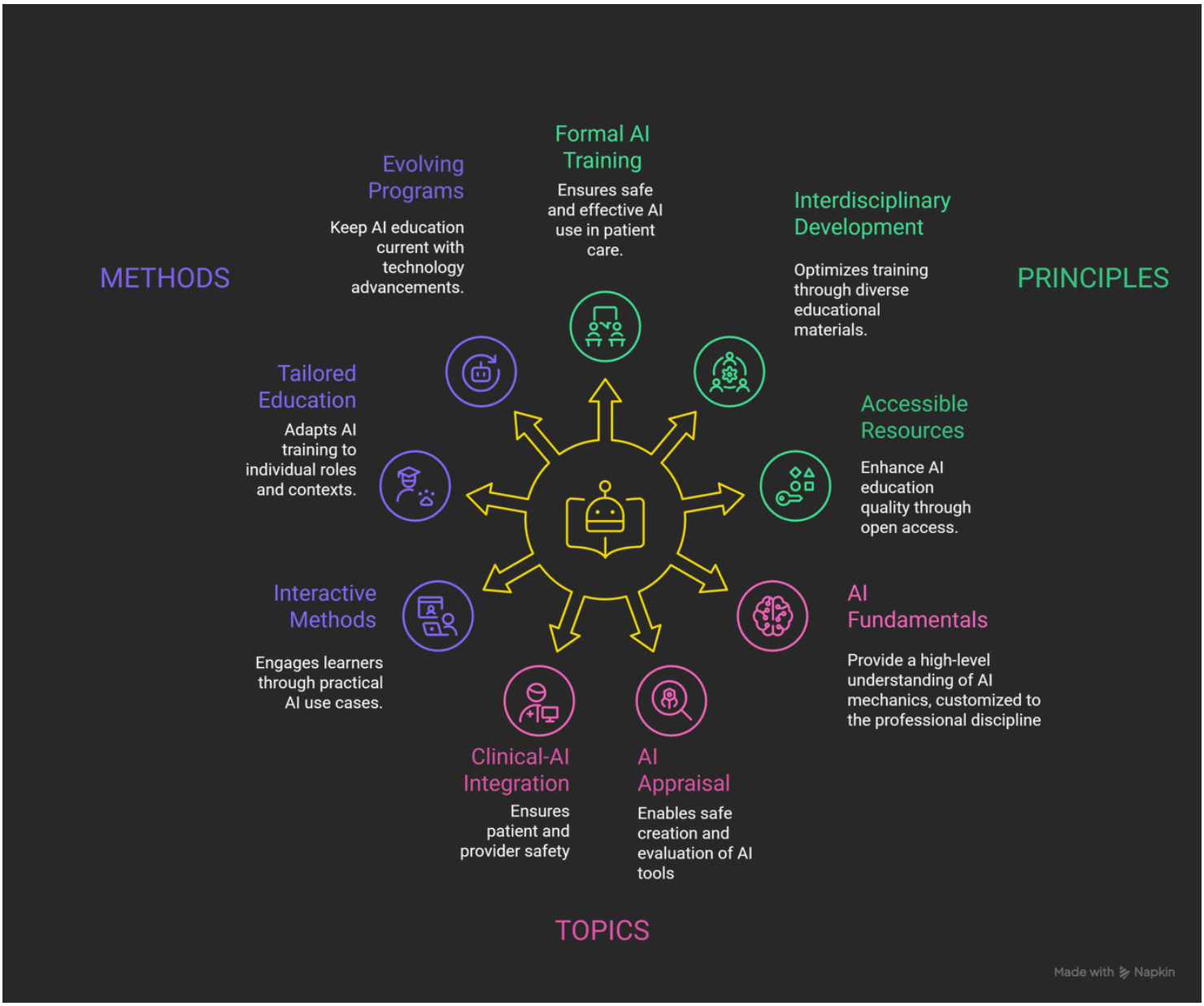
4. T-CAIREM's Educational Mandate

Finally, we describe how we pursue our 3x3 Framework. We explain our flexible, cross-cutting, and inclusive approach to AI education that enables us to meet diverse learner needs and foster multidisciplinary collaboration. Our mandate reflects our vision for AI education within and beyond the University of Toronto, emphasizing why we do this work and what we hope to achieve. Here, we also specify the scope of our educational activities.

T-CAIREM's 3x3 Educational Framework

Thoughtful use and development of patient-centered, high quality, AI tools with proven clinical value can improve care outcomes and reduce healthcare worker burnout. T-CAIREM believes that, in order to reach that goal, the following educational principles, topics, and methods must be met. Across these three domains, we identify three key ideas within.

Diagrammatic representation of the 3x3 Framework:



T-CAIREM's 3x3 Educational Framework

Principles

1. **Formal and integrated** AI training for people of all disciplines working at the intersection of AI in medicine (e.g., medicine, computer science, epidemiology, law, and humanities) is critical to ensuring AI tools are used safely and effectively for patient care.
2. **Interdisciplinary** development and delivery of educational materials and opportunities allows for optimal training of individuals fluent in using and appraising AI.
3. **Easily accessible** (e.g., public-facing, open-access) educational resources improve the overall positive impact of AI in healthcare as well as quality of AI education through feedback.

Topics

1. **AI Fundamentals**: All individuals involved in the development, implementation, or use of AI in healthcare should understand how AI works at a high-level.
2. **AI Appraisal**: All professionals involved in the development and implementation of AI in healthcare must be able to appraise the outputs (including quality, utility, and effectiveness) of said tools using up-to-date development guidelines.
3. **Integration of AI into clinical workflows**: All healthcare professionals (HCP) using AI tools in clinical roles should be able to use them critically and only as appropriate, in the context of other clinical variables, environmental variables, and confounding factors.

Methods

1. **Interactive**: AI education should include interactive use cases.
2. **Tailored**: AI education should be tailored to the professional role and clinical context of the individual receiving training.
3. **Evolving**: AI education programs should be constantly updated to reflect the current landscape of tools and technologies available. Programs should also align with current best practices in safe, ethical, and responsible AI.

3x3 Framework Expansion

Principles

P1: Formal and integrated AI training for people of all disciplines working at the intersection of AI in medicine (e.g., medicine, computer science, epidemiology, law, and humanities) is critical to ensuring AI tools are used safely and effectively for patient care.

1. Use of AI tools without critical thought or an understanding of their strengths and limitations jeopardizes patient care. Common ways in which this may happen include:
    a. Clouding clinical judgment through automation bias.
    b. Failure to recognize and adequately compensate for algorithmic bias when occurring.
    c. Jeopardizing patient privacy.
    d. Introduction of new ethical dilemmas (e.g., adhering to AI's output vs. clinical intuition).
2. and integrated training at all levels along the AI development, implementation, and use pipeline ensures that we minimize the concerns outlined in **P2.1.**

P2: Interdisciplinary development and delivery of educational materials and opportunities allows for optimal training of individuals fluent in using and appraising AI.

1. Different professionals interact with AI differently, and may use different technology, or the same technology in different contexts. This diversity in expertise aids in development of comprehensive and context-specific material.
2. Understanding the full scope of use of AI technology by learning alongside non-HCP allows for HCP to contextualize their own AI-assisted decisions, and the limitations of those decisions, thus allowing for better-informed clinical decision making.
3. Understanding the full scope of use of AI technology by learning alongside HCP allows for non-HCP to contextualize development and administrative decisions in the front-line context and limitations within which AI tools are used.
4. Training alongside other disciplines allows professionals to build collaborative relationships and ways of thought that will assist in the development and implementation of future AI technologies in healthcare.

P3: Public-facing, open-access educational resources improve the quality of AI education.

1. Open-access resources can be used by other institutions as they develop their own programming, thus promoting inter-organizational collaboration and building rapport.
2. These resources further increase awareness regarding AI in healthcare, leading to greater individual and institutional support for educational programming.
3. Public-facing, open-access educational resources allow for individually motivated professionals to enhance their AI qualifications, or re-learn content as needed.

Topics

T1: AI Fundamentals - All individuals involved in the development, implementation, or use of AI in healthcare should understand how AI works at a high-level.

1. This includes a fundamental definition of AI and how it differs from non-AI algorithms.
2. This includes a review of possible bias, limitations and interpretation of AI model outputs.

T2: AI Appraisal - All professionals involved in the development and implementation of AI in healthcare must be able to appraise the effectiveness of said tools using up-to-date development guidelines.

1. Individuals in development and research roles must be able to appraise the methods by which AI models are created, and any biases affecting said methods or the resultant model, when conducting or assessing AI research.
2. In addition to **T2.1**, individuals in translational roles must be able to appraise the methods and context in which AI models are created, to determine whether or not it is appropriate to implement an AI model in a given clinical context.

T3: Integration of AI into clinical workflows - All healthcare professionals (HCP) using AI tools in clinical roles should be able to use them critically and only as appropriate, in the context of other clinical variables, environmental variables, and confounding factors.

1. HCP in clinical-only roles must have a basic understanding of what makes an AI model relevant and trustworthy, or not, in the context of the clinical task at hand.
2. HCP must have a thorough understanding of the limitations of the specific AI models they use, as in **T1.2**, such that they do not use them to replace decision making.
    a. HCP must be able to defend how use of an AI tool fits into their clinical decision making algorithm for a given clinical task, choice, or diagnosis.
3. HCP must be comfortable integrating their own clinical judgment with AI tools and navigating situations in which AI model outputs conflict with their own clinical judgment.
4. HCP must feel empowered to critically evaluate the choices of colleagues when there is reasonable likelihood that AI tools are being used without critical thought and consideration of other clinical variables.
5. HCP must have a robust understanding of data privacy laws and medicolegal obligations, and thus when it is legally appropriate to use various AI tools.
6. HCP must be able to explain their use and assessment of a model to untrained stakeholders, including - but not limited to - patients and families.
7. HCP must be able to appropriately obtain informed consent from patients and families when using AI tools for which such consent is required.

Methods:

M1: Interactive - AI education should include interactive use cases.

1. For HCP, technical interactive use cases are appropriate only in contexts where HCP should have a more in-depth understanding of AI, such as in the case of clinician scientists, investigators, and other research in healthcare.
2. For HCP, clinical interactive use cases should be chosen to relate to **T2**, such that, prior to managing real patients with the help of AI, HCP have already:
    a. Developed comfort with using AI tools and integrating them into clinical decision making.
    b. Gained experience determining when it is not appropriate to use a model in a given clinical situation.
    c. Managed situations in which an AI model's output conflicts with their own clinical judgment.
3. For developers, interactive use of coding notebooks ensures trainees gain practical and translatable knowledge.
4. For individuals involved in ethics, law, policy, and translation, interactive scenarios relating to specific AI tools give learners the opportunity to explore and attempt to manage them.

M2: Tailored - AI education should be tailored to the professional role and clinical context of the individual receiving training.

1. Beyond **T1, T2,** and **T3**, in-depth technical education should only be required for individuals in technical and translational roles for which such education is necessary.
2. HCP using AI should be shown scenarios that demonstrate how AI has, or can, impact their particular profession and research/clinical role.
    a. Positive examples should be given to encourage critical use of AI as per **T2.2**
    b. Negative examples should be given to encourage caution in the use of AI as per **T3.3-3.5**.
3. For HCP using AI, Interactive use cases described in **M1** should be related to the discipline and role of the HCP receiving training, such that the experience the HCP gets in training, as described in **M1.2a**, is as close to the everyday context in which they will be using AI as possible.
4. Non-HCP in technical roles should receive education on the clinical context within which their work may be used.
    a. This should include a basic clinical overview of the field and clinical research area within which they are working.
    b. This should include scenarios demonstrating how AI has, or can, impact the clinical area in which their work may be used.

M3: Evolving - AI education programs should be constantly updated to reflect the current landscape of tools and technologies available.

1. Regular assessment of the state of the field must be part of any such program; ensuring sufficient organizational resources to do so is paramount.
2. Overall AI fluency in each new cohort of students is likely increasing with increasing technological competencies. Curricula must also assess and adapt to the level of the current cohort.

T-CAIREM'S EDUCATIONAL MANDATE

T-CAIREM's educational goals are to promote the above mentioned principles, topics, and methods. To that end:

1. T-CAIREM will act as a leader to other organizations, nationally and internationally, looking to develop and support educational infrastructure for AI in medicine.
2. T-CAIREM will actively promote and pursue collaborations with other educational institutions to develop increasingly robust and far-reaching educational infrastructure.
3. To combat siloed thought and promote AI fluency, T-CAIREM will actively prioritize the development of interdisciplinary learning opportunities that foster collaborative thought between disciplines.
4. T-CAIREM will develop educational programs to promote understanding and safe adoption of AI in healthcare.
5. T-CAIREM will ensure educational initiatives are created by teams with a diversity of expertise and educational backgrounds.
6. T-CAIREM will share easily-accessible, educational resources for use by other individuals and institutions.
7. T-CAIREM will provide standards and objectives for AI in medicine curricula at various stages of training, through the development of codified guiding principles and learning goals.
8. T-CAIREM will incentivise healthcare trainee engagement in the AI sphere by recognizing and promoting exceptional achievement in the field of AI and medicine.
9. T-CAIREM will continue to revise and revamp all educational standards, principles, and documentation regularly to reflect large paradigm shifts in the current state of knowledge.

Report Authors, Acknowledgements & Resources

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Resources

[1] RCPSC 2020 task force on AI - AI is a fundamental competency
[2] Cell Reports Medicine Artificial intelligence education: An evidence-based medicine approach for consumers, translators, and developers
[3] AI-RADS: An Artificial Intelligence Curriculum for Residents
[4] Curriculum Frameworks and Educational Programs in AI for Medical Students, Residents, and Practicing Physicians: Scoping Review
[5] Defining Medical AI Competencies for Medical School Graduates: Outcomes of a Delphi Survey and Medical Student/Educator Questionnaire of South Korean Medical Schools

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APPENDIX

Mapping of education initiative delivered in 2025 to the T-CAIREM Mandate.

Education Initiatives	Framework Item(s)
T-CAIREM Original Resources A repository of educational resources made by our education team, posted under an open license for other individuals and institutions to adapt and use.	P3 M3
Living Glossary for AI in Medicine An up-to-date glossary of common terms seen in AI in Medicine, with the opportunity for community contributions.	T1 M3.1
T-CAIREM Conferences An annual conference on AI in medicine with opportunities for trainees at all levels to submit AI work for presentation, feedback, and evaluation.	P2 T2
Summer Student Program Provides post-secondary school trainees with funded opportunities to pursue structured AI research projects with a T-CAIREM member as their principal investigator. Additional opportunities are provided to learn coding and data science skills, network, and get feedback from peers.	P1.2, P2.3, P2.4 T1, T2.1, M1.1, M1.3, M2.1, M3.2
Trainee Rounds A competitive speaker series for graduate-level trainees nationally, with weekly presentations on ongoing research.	P1.2, P2.1, P2.2, P2.3, P3 T2.1, T2.2
Speaker Series Talks from experts in the T-CAIREM community on a variety of subjects related to AI in medicine.	P3 T2
Hackathon: In collaboration with the T-CAIREM Infrastructure Team An annual hackathon using T-CAIREM Health Data Nexus data.	P2.1, P2.4 M1.3

Education Initiatives	Framework Item(s)
Seminars on AI to Clinical Audiences Including post-graduate medical education programs (e.g., academic half day talks) and talks for graduate research students.	P1, P2.1, P2.2, P3 T1, T3.1, T3.2, T3.3, T3.4, T3.5, T3.7 M2, M3
AI Learning Hub A curated and up-to-date online repository of educational resources for trainees and professionals of all educational backgrounds.	P3 T1
Technical Courses for Professionals Courses to teach the fundamentals of data science and AI to various professional audiences (e.g., Computing in Medicine Course)	P2.4 T1 M1.1
Undergraduate Medical Curriculum Support Consultation for the MD program at the University of Toronto, to enhance AI education for MD students at all stages of their clinical training.	P1 T1, T3.1, T3.3, T3.6, T3.7 M1.2, M2.1, M2.2b, M3.1
High School Healthcare AI Bootcamp A one-week bootcamp for high school students to introduce coding skills, AI literacy, and the field of AI in medicine at the early stages of career decision-making.	T3.6 M1.1, M2.2b
Workshops and Tutorials to enhance AI literacy among patients and the public Patient-facing talks and workshops designed for non-academic and non-industry audiences, including patients and caregivers, to build a public understanding of how AI is changing healthcare.	T3.6, T3.7
Workshops and Tutorials on AI in healthcare for AI developers Educational workshops designed to unpack the clinical challenges and barriers often encountered by developers when designing AI solutions for healthcare problems.	P2.1, P2.3 M4