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Evaluation of an Upskilling Program for Jobs in Digital Health and Data Analytics

Final Report to the Future Skills Centre

by

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FSC is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead. The Future Skills Centre was founded by a consortium whose members are Toronto Metropolitan University, Blueprint ADE, and The Conference Board of Canada

The opinions and interpretations in this publication are those of the author(s) and do not necessarily reflect those of the Future Skills Centre or the Government of Canada.

This document represents the final report of a research project funded by a grant from the Future Skills Centre to the Michener Institute of Education at UHN. The project, entitled *Evaluation of an Upskilling Program for Jobs in Digital Health and Data Analytics*, was developed to address the need for more digital and data-literate individuals to work in health care. The commitment to offer the program was made in the Fall of 2020 when serious program design and curriculum development began. Formal approvals of the program by the Michener Board and the Academic Approvals Committee occurred in Spring 2021 and the first cohort was admitted in September 2021.

RATIONALE FOR THE DIGITAL HEALTH AND DATA ANALYTICS (DHDA) PROGRAM AND BASIC DESIGN FEATURES:

The Digital Health and Data Analytics (DHDA) program was designed to address a growing, understood and critical skills gap in the healthcare labour market. Significant investments and advances in healthcare technologies have created a need for more digital- and data-literate healthcare professionals. For example, the discipline of radiology is being transformed as artificial intelligence (AI)-assisted technologies are enhancing the way clinicians see, analyze, and diagnose disease. Advances in genetics and the advent of precision medicine are resulting in the accumulation of complex, massive data sets being used by clinicians to diagnose and design effective treatment protocols. Modern medicine increasingly requires skillsets to enable computation, data visualization and a deep understanding of the way algorithms work and impact health decisions and outcomes. These large data sets force greater consideration of issues related to privacy and data governance. These new skills are becoming essential for new graduates entering the workforce, and for professionals already in practice.

Aside from some obvious and necessary content health care workers working in the more digital- and data-related fields would need, the program was designed to incorporate progressive and lifelong learning strategies such as virtual learning, workplace learning, data simulation and modelling, and cross-institutional collaboration, while considering curricular pathways that may include micro-credentialing. Michener, as a post-secondary institution devoted exclusively to education in the applied health sciences and as Canada's only "school in a hospital" (as it is integrated within one of Canada's largest and celebrated hospital systems, University Health Network), was an ideal location for such a program given the labour market need. The Michener Institute of Education at UHN ("Michener") is uniquely positioned to prepare professionals by bridging the gap between new and emergent skills and competencies as AI and data become more deeply entrenched as hallmarks of 21st century care.

The DHDA program leveraged some already existing programs and coursework at Michener, particularly a Certificate program in Artificial Intelligence ("AI") offered by Michener's Continuing Education division. The program was designed in anticipation that graduates would be the pioneers driving protocol development and quality improvement processes forward on the frontlines of care.

The DHDA program was also designed to attract students prepared to explore and develop new roles in healthcare. The program was designed to attract students from two target groups:

- Students with clinical backgrounds and a keen interest in exploring technology enhanced solutions for care. It was understood that these individuals would likely continue to work during the program and, therefore, academic programming needed to be accessible, virtual and engaging.
- Digital or information technology graduates with a keen interest in healthcare and /or clinical impacts.

Given the novelty of the program, and the desire to keep it practical, pragmatic and job-oriented, it was important that the program include opportunities for extensive experiential, hands-on learning.

The program was designed as a six-semester program leading to an Advanced Diploma credential. An important feature of the program was flexibility as it was anticipated that some, perhaps many, of the students would be working during their studies. So, the coursework was predominantly to be delivered online. Programming would as flexible as possible with a breadth of coursework to expose students to the multiple directions, issues and opportunities in the digital health and data analytics domains. Finally, the program was designed to offer students an exit ramp to receive a Graduate Certificate after four semesters of study as per the Ontario Qualification Framework if they chose not to take the two semesters of practicum in semesters five and six.

THE PROGRAM ADVISORY COMMITTEE (PAC) AND THE LABOUR MARKET ASSESSMENT:

Throughout its design and development phase, the program was guided by a Program Advisory Committee ("PAC") consisting of individuals knowledgeable about digital and data issues in the health care sector. The initial PAC was Chaired by Dr. David Wiljer, Executive Director, Education Technology Innovation at University Health Network (UHN). Other initial members of PAC included:

- Harvey Weingarten, Principal, Michener Institute

- Fiona Cherryman, Vice-Principal Academics & Operations, Michener Institute
- Gillian Strudwick, Chief Nursing Executive, Centre for Addiction and Mental Health
- Jeff Hatcher, Director Advanced Analytics Branch, Canadian Institute for Health Information
- Muhammad Mamdani, Vice President Data Science & Advanced Analytics, Unity Health Toronto
- Michael Brudno, Chief Data Scientist UHN, Professor Computer Science, University of Toronto
- Mohammad Salhia, Director, Continuing Education, Michener Institute
- Naveen Ahmed, Project Analyst, Michener Institute
- Catherine Wang, Joint Department of Medical Imaging, Laboratory Medicine Program, UHN
- Wanda Peteanu – Director, Information Management, Michener Institute

Aside from the expert advice offered by the PAC, Michener also conducted a more formal labour market assessment to evaluate the need for more digital- and data-literate workers in health care and to inform the specific courses and their content to provide graduates with the competencies and skills needed in these areas.

Three main sources of data informed the labour market opportunity for graduates of the DHDA Program: the Labour Market Information Council ("LMIC"), Burning Glass Technologies' database of online job posting activity, and interviews with key stakeholders. The LMIC, experts in labour market assessment in Canada, and our own experience have identified that quantitative data in these fields is difficult to access and interpret due to the complexities of arriving at search criteria that capture all avenues available to graduates of the DHDA program. There is minimal concrete data available for these emerging disciplines. Sources that track job posting activity are often limited to what postings occur online and many jobs are promoted through other means. LMIC's data is limited to jobs that have an associated National Occupancy Classification ("NOC") code. For emerging roles and professions, NOC codes will not have been established yet. Regardless of the considerable 'noise' in the data, it does suggest possibilities and potential employers that could be explored.

Interviews with key stakeholders revealed a range of perspectives on the need for this type of professional. Stakeholders confirmed they would preferentially hire candidates with the skills that the DHDA Program offers. It is important to note the program is a vanguard. In the absence

of concrete data, stakeholders have urged us to develop use cases based on the experiences of graduates in the early years of the Program.

Job posting data were extracted from Burning Glass, using three main query terms: artificial intelligence, digital health and machine learning (in the health context). This analysis revealed that:

- Similar to the opinion offered by previous key stakeholders and informants, there were digital health and data related jobs in both the public and private sectors, although the specific skills needed in workers in the two sectors might differ.
- Traditional healthcare organizations such as hospitals might not be the primary employers (at least in the short term) of program graduates, due largely to more constrained budgets in these public sector institutions. The exception may be roles in clinical informatics although these roles may require experience with clinical informatics programs.
- Organizations related to health authorities and the management of health care systems were prioritizing jobs requiring digital health and data management knowledge.
- Jobs related to digital health were often coupled to project/program manager roles.
- Jobs posted by universities for machine learning (in health) roles are often associated with research efforts, and this type of role has not yet filtered into the private sector.

THE APPLICANTS:

As noted above, the program was intended to attract a diverse group of learners from two primary domains: i) those with a digital or data background but with little experience in health care, and ii) those from health care with little experience in digital or data.

An analysis of the backgrounds and credentials of those applying to the program revealed that the DHDA program was indeed attractive to a diverse set of learners. The results suggest that the program was more effective in attracting those with health care backgrounds than those from the digital world, although some applicants came with a background in both.

The plurality of students who applied to the program had a Bachelor of Science degree, with the next most frequent pool consisting of those with a college Advanced Diploma. Several applicants held Masters degrees (of Science or Public Health), one came with a Bachelors of Commerce, one held a PhD and one was a medical doctor.

Over the course of the study period, three cohorts were admitted to the DHDA program. September enrolment numbers were:

Year	Enrolment
2021	28
2022	39
2023	18

An extensive survey of the 2021 initial cohort was conducted to assess the student's motivation for applying to the program, their decision to accept it, and other concerns or issues they had about the program they were starting. Twenty-four of the 28 students in the program (an 86% participation rate) completed the survey.

Of these 24 students, 15 had a background in health care, only 1 came from the digital world exclusively, 6 of the students had backgrounds in both digital/data and health care, and 2 entered the program with little to no experience in either the health care or digital/data worlds.

For those students who came from a particular domain, they self-reported that their knowledge in the area was moderate, and that was for all areas covered in the program. For example, students coming from health care indicated that their knowledge and appreciation of health care was low, although their understanding and appreciation of digital/data issues was rated even lower.

Of all of the areas of the curriculum, students indicated that their most anticipated courses were those in data science and AI, although it is also these same courses about which they expressed the greatest apprehension.

Almost all of the students indicated that they were interested in pursuing the final-semester practicum, although as described in the next session, not all of these students ultimately decided to pursue this experience.

When asked about their career aspirations, and how their selection of the DHDA program fit into their plans, the most-often expressed views were for aspirations for careers in health care administration and industry. In general, research was not identified as prominently in future career plans except for those who came with a background in digital/data. Those with healthcare backgrounds only did not identify research as a career goal.

The open-ended comments by students in the program are illustrative of their motivation to enter the program and the field of digital health/data analytics in general. Those who came to the program from a health care background only offered comments such as:

- *In a nutshell what I'm hoping for is individualized healthcare. The easier it is to process data and analyze it, the better the outcome will be for individuals, instead of relying on population data.*
- *I believe I will be prepared to support the organization with Digital Health Tools and Data Analytics Techniques for any projects that come their way.*
- *I believe graduates would be able to better implement digital aspects to healthcare and to help lead projects with the knowledge we have gained from the DHDA program.*
- *I believe that the program will produce comprehensive graduates that have the skills of either healthcare or tech, then learning the knowledge and skills of the other to make to result in a well-rounded health expert.*
- *It is my belief, and hope, that graduates of the DHDA program will be the professionals who are empowered to bring positive change to the healthcare system. I think that streamlining health information and delivery will be required of us as we adapt to the demands of modern populations and modern issues. Though I haven't yet been an employee of the healthcare system, I imagine the pandemic alone must have been a major catalyst for change in how we think about delivering health services. Looking forward, I think graduates should focus on positioning our healthcare system for future global changes such as widening economic inequality, climate emergency, and mass migration.*
- *I hope to get a better understanding and adaptability to the more technology forward healthcare system that is fast approaching.*
- *Efficient, novel, and innovative ideas and technological solutions to issues in healthcare in order to provide better care for patients, caregivers, practitioners, and stakeholders.*
- *Tools, guidance, support to more efficiently retrieve important information used in the treatment, prevention and conducting of a wide variety of health care services.*
- *I believe a graduate of the DHDA Program will be able to offer better healthcare quality and accessibility by bridging the gap between technology and healthcare.*

- *Innovations to improve Canadian Healthcare. Help create an improved model of healthcare delivery in Canada, that can inspire other healthcare systems to move in a similar direction.*
- *A graduate of the DHDA would lead innovative changes in healthcare - merging technology and health. 2. A graduate would bridge the gap and speak the language of healthcare and AI 3. A graduate would lead health tech projects improving patient outcomes. Although I am apprehensive about the AI course but it is the area that interests me the most! I see myself as a graduate of DHDA using AI tools to inform healthcare in various areas e.g. genomics and imaging. I see myself owning a health-tech start-up company that will provide healthcare solutions using AI-technologies. I look forward to completing this program!*
- *They will be able to fill in the gap between technology and health administration that exists with focus on AI and other aspects.*
- *Create a new infrastructure for the future of healthcare.*
- *Move healthcare more towards technology. Help see identify issues faster.*

Students entering the program with backgrounds in both data/digital and health care offered the following comments:

- *Efficient diagnostic tool, assisted better robotic surgeries, forecasting the trends in various health ailments such as cancer, diabetes, infections etc.*
- *A desire to work as data scientists in various private and government sectors.*
- *Students were seeking a unique offering of clinical healthcare experience based with a new knowledge of data and machine learning, an understanding of current and future issues, and a unique understanding of how to implement data or use machine language or artificial intelligence in health care to increase efficiency, reduce mortality or improve patient outcomes. Students offered a variety of such suggestions.*
- *The program offers the possibility to create and implement lasting digital solutions to current problems in healthcare delivery.*

Comments from remaining students include:

- *A clear roadmap/strategy and comprehensive set of skills for successfully implementing and delivering digital health solutions.*

- *Wide range of data analytics and new visions to improve, better tools for decision making and many more.*
- *A more digitalized healthcare system to provide more accessibility for the public.*

Overall, what the student data reveal is that students understood the purpose and intent of the program, and for a variety of reasons, were keen to pursue the program in order to get jobs that would allow them to apply the knowledge and skills obtained to improve health care.

THE CURRICULUM:

As noted above, the program was designed to be six semesters (2 years) in length with an off-ramp for students at the end of semester 4. The specific courses and course content was shaped by the PAC and other experts in the field.

It was understood that the program might recruit individuals with different backgrounds. Specifically, student already digital and data-literate but who had little knowledge about health care, and health care professionals who knew a lot about health care but little about digital and data analytic issues. Thus, a primary goal of the initial coursework was to level the playing field to educate students comfortable in both worlds. Much of this coursework would be online. The implication of this was that the actual experiential and hands on components of the program would be delivered late in the program through special project courses and a lengthy practicum (see below). In addition, the program was always intended to be practical and useful, and the expectation was that students would be valued and valuable contributors advancing digital and data issues in their chosen areas of health care. Therefore, some of the courses focused on implementation science and design thinking, essentially how to initiate, promote and sustain change.

The courses in the program and a brief description of the courses follows:

Brief course descriptions follow:

Semester 1

The Healthcare Ecosystem: Behind the Scenes

Digital health professionals operate within a complex, multi-faceted and ever evolving health ecosystem, that encompasses everything from the clinic to the legislature. Every decision can have immense impact. We will take you behind the scenes of healthcare and you will expand your knowledge of how healthcare works, exploring several models with a keen focus on how Canada's healthcare system provides care and supports digitally enabled systems in comparison to other systems. You will learn the fundamental vocabulary and concepts that are foundational to understanding the national and international healthcare landscape.

Key topics include:

- Structure and governance of Canada's healthcare system: local, provincial, and national
- Comparative healthcare systems
- Population health, including social determinants of health
- Indigenous healthcare
- Public and private organizations
- Health economics: funding sources, key performance indicators, and digital tools

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Digital Health I: Empowering People

Digital Health I explores the role of e-health and digital health within the healthcare system. You will examine the critical importance of digital health and its emerging and dominant role in building a healthier world for all. According to HIMSS, digital health *connects and empowers people to manage health and wellness (HIMSS 2020)* and through this course, you will understand the key concepts and the practical and pragmatic knowledge and experience required to work within digital healthcare ecosystems. You will acquire key knowledge, skills and attitudes critical for implementing and optimizing flexible and interoperable digital tools, technologies and services that empower patients, providers and the community to manage health and build a healthier world for all.

Key topics include:

- Definitions and frameworks for digital health
- Health Information Systems
- Interoperability and Collaborative Tools
- Patient Safety and Digital Health
- Mobile Health and Applications
- Transformative capabilities of Digital Health
- TeleHealth and Virtual Care at the *Webside*
- Consumer and Public Digital Health
- Human Factors

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Data Science and Analytics I

Digital health professionals require high quality, timely, relevant, clean data to support effective clinical decision making and diagnostics. You will learn the fundamentals of effective data collection, data definitions, data cleaning, and management, using current technologies and data standard practices. The course will explore a variety of structured and unstructured data types, including both clinical and patient-provided that are required to improve health and personalize health care. You will also become familiar with the basics of databases, managing data and building modern and safe data storage systems. The course will introduce concepts related to big data, machine learning, and predictive analytics. You will be able to put into practice essential concepts of data collection, management and processing including visualization, as well as effective data communication tools and techniques to support a data driven and data enabled healthcare environment.

Key topics include:

- Introduction to data science and data analytics
- Introduction to types of data: big, small and patient generated
- Data Collection methods, tools and processes
- Operational systems: Relational and non-relational databases
- Standards used in defining data in the healthcare environment
- Data Management best practices and real-life examples
- Cloud computing and data science
- Data Use: Visualization Tools and Practices
- Data governance

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Semester 2

Digital Health II: Building Systems

Digital Health relies on dynamic, robust and adaptive systems to provide high quality care. You will build on the key fundamental knowledge from Digital Health I, examining the social, ethical,

financial, and systems issues that shape the experience of digital health. Using contemporary case studies to highlight the potentials, perils, and pitfalls of digital health transformation, you will explore issues related to population health, privacy, cybersecurity, and governance. You will also examine issues related using digital health to address social and ethical issues, such as equity, diversity and access to care for all. You will also examine issues related to building responsive and adaptive digital health systems that connect communities together for integrated and coordinated care. In addition, students will hear from a diverse selection of experts in health policy, research, administration, industry, and evaluation, and will be exposed to potential areas for future study, work placement, and capstone projects. Key topics and case studies include:

- Big Data and Population Health
- Privacy, Cybersecurity and Governance
- Inclusion, Diversity, Equity and Accessibility in Digital Health
- Canada Health Infoway and eHealth Ontario: One Record to Rule Them All?
- COVID-19 and the Digital Transformation
- Community Care and the Digital Divide
- Transforming Quality and Safety with Digital Image Peer Review
- The Robot Will See You Shortly: Surgery at a Distance
- AI in the NICU
- Telementoring to Teach the World

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Artificial Intelligence and Machine Learning I

AI and Machine learning are rapidly changing every aspect and dimension of the health system and, in fact, some say, will change healthcare as we know it. You will explore the power and limits of artificial intelligence and will provide practical skills and experience with AI applications that are currently enhancing healthcare. Building from concepts around clinical decision making and decision support, you will work with a wide range AI applications from robots to Chatbots to machine learning techniques and data-driven tools that predict and change health and wellness. You will understand the evolution of AI and explore concepts and models required for learning how to apply AI. The course will also consider the social and economic implications of

AI looking critically at bias, ethics, as well as the impact on diverse communities and the accessibility of healthcare for even the most vulnerable populations.

Key topics include:

- Mathematical foundations 1 & 2
- Data analysis
- Learning methods
- Computational models and training
- Machine and deep learning
- AI and personalized medicine and the EHR
- AI bias, legislation and ethics
- Putting AI into Practice and the future

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Data Science and Analytics II

You will continue to build and advance your knowledge around data analytics and data science by learning new concepts and working on a data science project. Through labs and practical projects working with relevant data and scenarios, you will rapidly advance your ability to put your knowledge of data analytics and science into practice. You will explore how data is used in clinical and healthcare operational decision making, data modelling and basic concepts of coding that will being to harness the immense amount of data produced along the health care journey. In particular, we will look at the impact of large data sets on fighting real problems such as health equities and the spread of pandemics such as COVID-19. You will work on practical case studies on how a data science project is structured, including how to frame a data science question within the content of clinical environment, sourcing available data, and applying mechanisms of translating a data science inquiry into a project. You will also acquire the knowledge how data science fits within the existing software development cycle and considerations how to productize an idea/project.

Key topics include:

- Data Science Projects: Inquiry, Framing and Data Science Solution
- Management of data: Data warehousing
- Data Analysis: Purpose and Techniques around Data mining

- Data Sources and Use: Risks and Limitations
- Coding, modelling techniques and key vendor platforms
- High level overview of a data science project cycle and role of data science

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Semester 3

Fundamentals of Implementation Science

Change and helping people change is incredibly difficult and this is particularity true in healthcare where it often takes and decade or more for good science and practice to reach our patients and our communities. Fortunately, there is a discipline to help us: implementation science. You will learn the fundamentals of implementation beginning with clearly identifying the problem, putting together a clear plan based on the best available evidence, managing the change with appropriate tool and processes, and working with key stakeholders to make that change a reality. Making the change is hard, but maintaining and sustaining change is even more challenging. You will acquire the skills to ensure that change is measured and sustained over a long period of time to ensure the best care is in practice.

Key topics include:

- Understanding Critical and Wicked Problems
- Engaging Stakeholders and Building Effective Relationships
- Using Evidence to Inform Practice
- Assessing the Environment
- Managing Projects Effectively
- Delivering on Time and on Budget

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Design Thinking and Quality Improvement

Designing change and continually improving that change on a human scale in healthcare is complex. There are practical and pragmatic approaches to achieving this change that work. You will learn to find solutions that are desired by your stakeholders, viable within the context that

you are working in and feasible with the resources at hand. You will learn to deploy quickly, change continuously and evolve practice rapidly. You will learn key concepts, tools and processes related to design thinking, human factors and quality improvement, including human centred design and lean methodologies.

Key topics include:

- Engaging and Involving Stakeholders in Framing the Problem
- Inspiring through Clear Vision
- Co-Creation and Co-Design with End Users
- Human Factors and User-Centred Design
- Generating Impactful Ideas
- Rapid Prototyping for Progress
- PDSA and Rapid testing cycles
- Improving with Data
- Sharing Success for Continuous Change

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Artificial Intelligence and Machine Learning II

You will learn advanced topics in artificial intelligence and machine learning, including successes and failures when implemented in clinical environments. You will learn how data, images and sounds are processed, along with their practical applications. Further, you gain an appreciation for the risks of AI and machine learning, such as if medical decision making is based solely on data that can be rife with inherent bias, or using data in a manner that does not adapt to new examples. Personalized medicine will be heavily reliant on data and good clinical judgment, but also on systems that are free of false data and that provide a transparent view on machine learning predictions. Students will learn the ethical considerations, risks, and major platforms in use by working on a data science and/or machine learning project.

Key topics include:

- Supervised and unsupervised learning
- Deep Learning – how it is and what it is used for
- Text data, natural language processing and languages models (GPT-3 et al)

- Computer vision and image processing (segmentation et al)
- Audio processing (e.g., cough detection, sleep quality assessment, fall/motion alerts)
- Risks & Limitations (overfitting, bias, transparency)
- Examples from MI or partners (surgical, wound, radiology, etc.)
- Ethics, privacy and “explainability”
- Personalized medicine
- Integration and usage of data from patient devices (smartwatches et al)

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Semester 4

Advanced Topics in Implementation Science

Making the change in a complex system like healthcare is hard, but maintaining and sustaining change is even more challenging. Building on the critical skills and knowledge you have acquired through Implementation Science, you will acquire the skills to ensure that change is measured and sustained over a long period of time to ensure the best care is realized in practice.

Key topics include:

- Building Change and Programs to Last
- Understanding the Logic and Theory of Change
- Developing Key Performance Indicators
- Assessing and Evaluating Change
- Communicating the Impact of Change
- Disseminating New Knowledge

This course will be delivered online using a combination of lectures, independent readings, and seminars.

Applied Project

You will develop a project that will showcase the advanced knowledge and skills that you have acquired during the program. Your project will form an invaluable piece of your professional portfolio that you can use to demonstrate to potential employers in the field that you are ready

to be part of a high performing digital health team. You will focus on one of the primary program streams of artificial intelligence, machine learning, robotics, or data science. You will apply your skills in design thinking and implementation science to maximize potential impact to the healthcare system, while ensuring feasibility and facilitating robust evaluation. Sample projects include:

- Development of a dashboard to track patient and staff vaccination rates
- Integration of data from various health information databases to support clinical decision making
- Development of an evaluation strategy for a new technology, process, or policy
- Application of machine learning to predict patterns in community disease spread
- Development of an AI chat bot to support essential service triage

You will receive mentorship and feedback from experts in your chosen subject area.

Semester 5

Practicum I

You will be placed within a healthcare organization that has an active machine learning, artificial intelligence, robotics, or data science project. You will apply the knowledge, skills, and judgement that you have acquired through the program to date to embed yourself within a team of digital health professionals. This first of two practicums will be an opportunity for you to not only demonstrate what you have learned, but also to get feedback from industry professionals on how you can improve and eventually become employed in your chosen field.

If you are already employed at an organization that has a digital health project that you could contribute to, you may choose to complete your practicum at your workplace. We will work with your organization to ensure that you receive the challenge and feedback that you need to advance your skills.

This practicum will be taken full-time, 35 hours per week over 15 weeks.

Special Topics in Professional Development

During your practicum you will connect on a weekly basis with your Michener faculty and the rest of your class cohort who are in placements to reflect on your progress, set goals for the rest of the placement, and discuss topics relevant to professional growth in the field of AI, machine learning, data science and robotics. You will participate in a professional learning community

that will help you constructively integrate the feedback you receive from your practicum leaders, as well as giving you an opportunity to refine your skills in teamwork and communication.

Finally, guest lectures from industry professionals will give you valuable insights into the emerging trends and workplace dynamics of your chosen field. Guest lectures will be tailored as much as possible to the development needs of your cohort.

Sample guest lecture topics include:

- Workplace culture and the "hidden" skills of career success
- Professional communication and relationship management
- Leadership and followership
- Conflict management
- Emerging trends in AI, machine learning, data science and robotics
- Equity, diversity and inclusion in the workplace

Semester 6

Practicum II

For your second practicum you will have the choice of either continuing with your first placement and becoming more central to the team's projects, or switching focus and beginning a new placement. Regardless of your path, this practicum will be an opportunity to further develop your skills and demonstrate your readiness for employment in your chosen stream. You will continue to receive feedback from leaders on your placement team as you work together to refine your professional development goals.

As with the first practicum, if you are already employed at an organization that has a digital health project that you could contribute to, you may choose to complete your practicum at your workplace.

This practicum will be taken full-time, 35 hours per week over 15 weeks.

Special Topics in Professional Development (cont.)

During your practicum you will connect on a weekly basis with your Michener faculty and the rest of your class cohort who are in placements to reflect on your progress, set goals for the rest of the placement, and discuss topics relevant to professional growth in the field of AI, machine learning, data science and robotics. You will participate in a professional learning community

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Sample guest lecture topics include:

- Workplace culture and the "hidden" skills of career success
- Professional communication and relationship management
- Leadership and followership
- Conflict management
- Emerging trends in AI, machine learning, data science and robotics
- Equity, diversity and inclusion in the workplace

This course will be delivered online using a seminar format.

THE PRACTICUUM:

There was much discussion about the advisability of including a practicum in the program. Ultimately, since a guiding principle of the program was to keep it job-oriented, it was decided to have the final two semesters of the program as a practicum, that could be two separate placements or one extended one. The practicum was always intended to be full-time. It was understood that there would be considerable effort, and considerable resource requirement, to recruit practicum placements and to monitor the educational experience it provided to students. In spite of their early expressions of enthusiasm for a practicum opportunity, we were unsure how many students would ultimately choose this opportunity after the first four coursework semesters. So, an exit ramp was designed allowing students to graduate from the DHDA program after four semesters and leave with a Graduate Certificate.

In any program (whether it is called a practicum, internship or co-op) with a significant and extended experiential component, a major effort is to recruit appropriate and relevant placements.

The marketing strategy to recruit practicum placements is described in **Appendix 1.**

The majority, but not all, of students in the DHDA program opted to remain in the full program and participate in a practicum. Specifically, in 2023, 58% (11/19) students took the practicum, 65% of students in 2024 (20/31) and we currently estimate that as many as 87% (14/16) of current students will take the practicum in 2025.

The practicum placements for the first cohort of students is shown below:

The Michener Institute of Education at UHN

DIGITAL HEALTH AND DATA ANALYTIC PROGRAM
General 2022 Placement Information

2022 Placements

Canadian Association of Medical Radiation Technologists
Canadian Artificial Intelligence and Data in Radiotherapy Alliance (CADRA) Project Development

University Health Network - Joint Department of Medical Imaging
JDMI AI Centre AI/ML analyst in clinical research

University Health Network - Quality & Safety
Consolidation of Serious Safety Event (SSE) data sources

Centre for Addiction and Mental Health
Modelling obsessive-compulsive disorder (OCD) patient trajectories

Centre for Addiction and Mental Health
Predictive model for adherence to treatment for obsessive-compulsive disorder (OCD) patients

Unity Health – St Michael's Hospital
Implementing analytical tools for project management

Swift Medical
Natural language ontologies for clinical data capture and predictive analytics

University Health Network – Emergency Department
Emergency Department triage workflow analysis

Luxsonic
Identifying key performance indicators (KPI) for medical imaging analysis effectiveness

Ontario Health
Indigenous Data Governance Matters process

University Health Network – Laboratory Medicine Program
Development and validation of a deep learning-based tool for testicular tumours

Baycrest Health Sciences
Toronto Dementia Project (Student customized placement)

Other companies and institutions that have sponsored practicum placements in subsequent cohorts include:

- North York General Hospital Governance
- UHN Process Analysis
- Canadian Association of Provincial Cancer Agencies Emergency Preparedness
- Canadian Association of Provincial Cancer Agencies Quality Radiotherapy
- KMH Cardiology Analytics
- Nova Scotia Health Radiation Oncology
- Canadian Artificial Intelligence and Data in Radiotherapy Alliance
- Ontario Health Ontario Renal Network
- Ontario Health Trillium Gift of Life

Student evaluations of Practicum

Students were surveyed at the end of their practicum to evaluate their perception of the placement and its value. Key observations are reported below.

Table 1. DHDA students' level of agreement with the end of practicum placement survey questions in 2023:

DHDA End of Practicum Placement Survey Questions	Level of Agreement				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Q1. The program prepared me for my practicum.	14%	14%	43%	29%	0%
Q3. The host site adequately equipped me to take on the project.	14%	14%	29%	29%	14%
Q4. I felt welcomed and accepted as a part of the team.	0%	0%	0%	57%	43%

Q5. I received appropriate assistance (both from Michener and the host site) to address any questions or concerns I had about my placement.	14%	0%	29%	57%	0%
Q6. I was able to access the resources necessary to do the work that was expected of me (e.g. inter/intranet, clinical/business systems, access to data).	14%	0%	29%	29%	29%
Q7. I was given opportunities to apply the learned theory/knowledge from school to practical situations.	17%	0%	0%	67%	17%
Q8. I was given the opportunity to network with team members/build a network of connections relevant to a future career as a digital health professional.	14%	14%	0%	29%	43%
Q10. I would recommend this placement site to a fellow student.	29%	0%	14%	29%	29%
Q11. I would recommend my supervisor(s) for future student placements.	0%	0%	0%	43%	57%
Q12. I felt comfortable speaking up if I observed unethical or poor practice in terms of digital health and data analytics.	14%	0%	0%	43%	43%
Q13. The terms of the Student/Supervisor Agreement were respected.	14%	0%	14%	43%	29%
Q14. The learning experience in the program overall has inspired me to pursue employment in the DHDA field.	14%	14%	14%	29%	29%

Partner Evaluation of Practicum

Similarly, partners who supervised practicum placements, were asked of their perceptions of the experience. As a first step, we evaluated what practicum supervisors were looking for as they interviewed students interested in their placement. Their responses are below.

When interviewing potential candidates, what skills and abilities were you looking for in a practicum student? Please select all that apply from the list below.

SKILL	N	%
Subject specific skills	4	80%
Creativity	3	60%
Adaptability	4	80%
Working independently	4	80%
Working in a team	3	60%
Ability to use technology/software	4	80%
Emotional intelligence	1	20%
Ability/willingness to take initiative	3	60%
Critical thinking	3	60%
Problem solving	2	40%
Other:	Detail-oriented analysis skills	

Most importantly, supervisors were asked about their perceived value of the practicum, for both the student and supervisor/workplace. The table below shows supervisors who responded either Agree (A) or Strongly Agree (SA) to the statements shown below.

Please rate your level of agreement with the following statements:

	SA + A	Neutral
The Michener practicum student's abilities improved over the course of the placement.	5	0
The Michener practicum student was adequately prepared for the practicum project.	4	1
Hosting a Michener practicum student benefited my team/ organization.	5	0
My team/ organization encountered no challenges as a result of hosting a Michener practicum student.	5	0

Perhaps the most essential question asked of supervisors was whether they would consider hiring the Michener DHDA practicum student they had. Their comments were:

- *"Yes, if we had the funds available…"*
- *"Yes, the student's interests aligned well with the goals of our group and their enthusiasm was a benefit to the team."*
- *"We did!"*
- *"Maybe, but I think the students should be given the opportunities to learn about machine learning during their coursework as well."*

When asked if they would hire a DHDA graduate in the future, comments were:

- *"Yes, great program."*
- *"Yes, since they would have gained broad exposure to the procedures/issues with data in health setting."*
- *"Yes, if they meet our needs."*
- *"In general, I think the phenotype of graduate fills and empty niche of healthcare/data competency. I could see opportunities for roles for these students."*
- *"Yes."*

Overall, the evaluation suggests that supervisors were pleased with the quality of the students and perceived that they had added value to the workplace and, on the basis of the experiences they had with them, would hire students from the program.

EMPLOYMENT OF GRADUATES.

Similar to any other program that is job-oriented and that recruits students who are career-focused, some students left the program during its course because they had received, and accepted, job offers. So, in all of the cohorts in the program so far, approximately 5 or so students leave before graduation because they took jobs. (There is also expected attrition – see comments below under "General Observations and Lessons Learned".)

In addition, because the program was advertised as a part-time program, most of the students were either working or took jobs during the course of the program. As a result, many students simply stayed with their current employer after graduation, although some of these indicated that the program allowed them to expand their role in their current employment.

The jobs held or obtained by DHDA students include:

- Ergonomic Consultant, The Modifier Co.
- Interviewer, Statistics Canada
- Data Analyst, True North Imaging
- Technical Support Analyst, Surrey Place
- Medical Laboratory Technologist, William Osler Health System
- Product Manager, Data Science & Advanced Analytics, Unity Health
- Clinical Informatics Specialist, BC Provincial Public Health System
- Clinical Operations Manager, Research, Baycrest Academy for Research & Education
- Research & Project Coordinator, University of Toronto
- Partnerships Manager, Pontosense
- Quality Improvement Specialist, Humber River Hospital
- Data Analyst, Lanark Leeds and Grenville Addictions & Mental Health
- Dual Fraud Analyst, Royal Bank of Canada
- Digital Marketing Associate, LiftOff by CCAWR
- Senior Strategist, Bob's Your Uncle
- Registered Nurse, Credit Valley Hospital
- Data Analyst, Freelance
- Bioinformatics Analyst, UHN
- Operations Support, Region of Peel
- Clinical Data Analyst, William Osler Health System
- Embryology Research Technician, CREATE Fertility

GENERAL OBSERVATIONS AND LESSONS LEARNED:

The DHDA Program captures a health care need.

The work on the program so far, the continuing interactions with informed experts, and the feedback from students and practicum supervisors, reinforces the real need for more digital- and data-literate individuals in health care. In that sense, the motivation and enthusiasm for creating the program remains. The experience to date, and this research project, help shape

how to deliver an education that serves these needs in the most efficient and effective way, including how the program could be designed to keep it financially sustainable.

Again, the program was designed to be practical and job oriented. In that sense, the most encouraging and reinforcing assessments were those like the one captured in the quote below from a graduate of the DHDA program who said:

"I entered the DHDA program as a frontline clinician with a keen interest in technology. I have gained applicable and valuable knowledge that has already led me to advance in my current career."

The funds provided in the FSC grant were helpful in allowing for a comprehensive assessment of the program, its values and outcomes. The overall sense from the evaluation project is that the program does indeed address a need for more digital- and data-literate individuals in healthcare. As one hopes for from an evaluation, it revealed both the positives and the negatives in the program design, observations that will be useful as we modify the program in the future to make it even more effective.

The attrition rate from the DHDA program was higher than is typical for Michener programs.

Given that this is a new program, we were unsure how it would be received by students. One measure of the program's successful design is the number of students who start, but do not complete, the program – i.e. the attrition rate. Because of our initial uncertainty about the attrition rate, it was designed quite deliberately to offer students an exit from the program after four semesters, rather than requiring a full six-semester commitment. Given this design, and explicit opportunity for an early exit, one might not count students leaving after four semesters as typical attrition. As noted above, also, some students left the program early because they had secured employment, in some cases during the didactic portion of the program, in other cases during the practicum. Again, because the program was designed to lead to employment, these may not also be considered attrition failures.

That said, the attrition from the program was generally higher than what we experience in other Michener programs. The most frequent reasons given by students for leaving the program early, i.e. before the full six semesters were:

- They were in full-time jobs during the program and the practicum required a full-time commitment (in contrast to the earlier didactic segment of the program which could be pursued part time).

- They felt that the didactic portion of the program had already given them the knowledge and skills they were looking for to move into new positions either in their current organizations or in some new place of employment.
- They had accepted a new job after the completion of the first four semesters.
- Financial hardships because the students in the program were not OSAP-eligible.

Students are dissatisfied with some elements of the program.

Student evaluations and feedback reveal areas of student dis-satisfaction that need attention. Some of this negative feedback is reasonably predictable, characteristic of complaints some students have in any program. More significant student feedback were expressions that the coursework was too heavy, especially the clinical placements, particularly for a program advertised as part-time. This student feedback in some cases led to some "lightening" of the coursework mid-stream.

There were also expressions of dissatisfaction that some of the practicum placements were paid, and others were not. Aside from the equity issues this raises, students had a clear preference for paid placements and were particularly dis-satisfied if a placement of particular interest to them was not in the "paid" category.

One complaint, one anticipated in early discussion by the program designers, was the uncertainty about what graduates of the program would be called. In health care, people's roles are often easily labelled – e.g., they are a nurse or respiratory therapist – with identified and understood job titles. It was unclear what title the graduates of this program could claim (e.g. are they "digital specialists"?) and there was a sense that this would disadvantage students in their pursuit of jobs. The issue of "job titles" in the fields of digital health and data analytics is not unique to this program. But, particularly in times when certain health care roles, like doctors and nurses, receive so much attention, and when the dollars for technology and innovation in the health care system is so constrained, people are concerned that the absence of clearly acknowledged job titles disadvantages those seeking employment in health care. What is clear is that individuals with the skill sets resulting from the DHDA program do not fit easily into the National Occupation Classification (NOC) codes used by governments and others in labour markets studies and assessments. This general problem extends to many areas of the applied (or allied) health professions where the NOC codes do not accurately capture the jobs or professions in today's health care system.

The practicum, while pedagogically valuable for some, challenges the financial sustainability of the program.

We under-estimated the human and financial resources required to mount the practicum portion of the curriculum. There is a minimum of one full-time person needed to secure the required number of placements, match students to sites, monitor and evaluate the value of the placement etc. Frankly, the practicum component challenges the financial viability of the overall program. These observations, coupled with student feedback about the practicum itself (including that some students got what they wanted out of the program without doing the practicum) has led us to consider other options shorter in duration and less resource intensive to give students the knowledge and skills required, by drawing on coursework in other Michener programs and programs offering micro-credentials.

Revisions to current program.

In light of the information obtained as a result of this evaluation research project funded by Future Skills, particularly the concerns of the challenges presented by the practicum component (see above), we amended the program to a four-semester graduate certificate program by removing the final two semesters of practicum. It was felt that the redesign better supported the needs of the students that were entering the program, most of whom were working full time but looking for digital health knowledge and skills to support their careers. We also know that many students were offered jobs at the end of semester four (i.e. pre-practicum) or sometime during the first practicum semester prompting them to leave the program. Elimination of an optional exit in the program also made the program more sustainable.

FINAL COMMENTS:

We were motivated to create the DHDA program because of the acknowledged need for more digital- and data -literate individuals in the healthcare sector. Everything we learned as a result of this project reinforces this continuing need.

We thank the Future Skills Centre for their support of this project. It has provided valuable insights and information that have led already to program improvements and adjustments.

Respectfully submitted,

Harvey P. Weingarten, Ph.D.
Principal Investigator
Principal, Michener Institute of Education at UHN

APPENDIX 1

Digital Health and Data Analytics Program

The Ask

- The Michener Institute for Education at UHN is seeking partners who can provide practical placements for its graduates from its Digital Health and Data Analytics program.
- Digital Health and Data Analytics - The Michener Institute

Michener Institute UHN DIGITAL HEALTH & DATA ANALYTICS

Digital Health and Data Analytics Program

Program Overview

- The DHDA Program is a 2-year part time program
- offered to university graduates, primarily with health care or IT backgrounds
- preparing "***Digital Health Specialists***":

Year 1			Year 2		
1 (Fall)	2 (Winter)	3 (Summer)	4 (Fall)	5 (Winter)	6 (Summer)
Healthcare Ecosystem: Behind the Scenes	Artificial Intelligence & Machine Learning I	Artificial Intelligence & Machine Learning II	Applied Project	Practicum I	Practicum II
Digital Health I: Empowering People	Digital Health II: Building Systems	Fundamentals of Implementation Science	Advanced Topics in Implementation Science	Special Topics in Professional Development	Special Topics in Professional Development
Data Science & Analytics I	Data Science & Analytics II	Design Thinking & Quality Improvement			

Michener Institute UHN DIGITAL HEALTH & DATA ANALYTICS

Digital Health and Data Analytics Program

These Digital Health Specialists will be ideally positioned to:

- Support development of digital health care pathways, healthcare design/delivery as well as provide care in highly digitized virtual environments
- Develop/enable data driven and integrated healthcare strategies into hyper-connected, boundary-less care models utilizing quality data and evidence base practices
- Foster the use of digital solutions that promote equity, diversity, inclusion, including the most vulnerable and underserved in the community
- Work in a variety of healthcare settings (public or private) to bridge the technology and clinical gap and enable seamless healthcare digital product development
- Plan, design and carry out hands-on data science and machine learning initiatives in the healthcare team or with industry partners

Michener Institute UHN DIGITAL HEALTH & DATA ANALYTICS

Seeking Placements

- Students are to be placed within a healthcare focused organization/agency/program that has an active digital health, machine learning, artificial intelligence, robotics, or data science project. They will apply the knowledge, skills, and judgement acquired through the program to date to embed themselves within a team of digital health professionals.

- We are seeking partners in the following sectors:
  - Health care organizations
  - Government agencies
  - Industry
  - Research institutes/labs
  - Start ups

Michener UHN DIGITAL HEALTH & DATA ANALYTICS

Seeking Placements

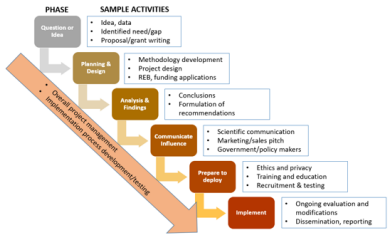
The Specifics

- Each student must complete two 4-month placements (January to April, May to August, 2023) OR one 8-month placement (January to August 2023)
- Each practicum will be a full-time, 35 hours per week to be completed over 15 weeks
- Funding desired but not essential

Michener UHN DIGITAL HEALTH & DATA ANALYTICS

Seeking Placements

- These practica will be an opportunity for students to not only demonstrate and hone what they have learned, but also to get feedback from experienced professionals on how they can improve and eventually become employed in their chosen field
- Practicum experiences will be focused on specific phases of the innovation/implementation journey



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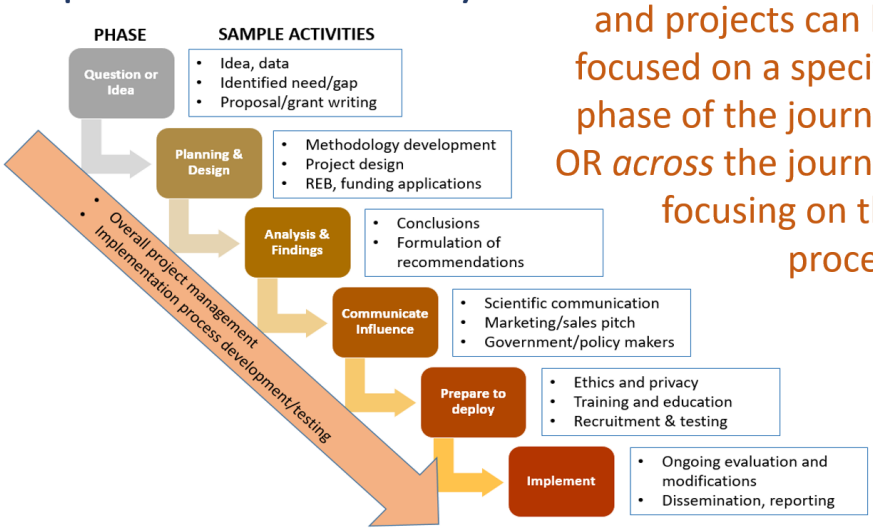
Implementation Pathway



Learner experiences and projects can be focused on a specific phase of the journey OR *across* the journey focusing on the process

Michener Institute | UHN | DIGITAL HEALTH & DATA ANALYTICS

Seeking Placements

Responsibilities of partners:

- Sign overarching affiliation agreement with Michener
- Annually inform Michener of available placements
- Describe each experience and project proposed for the learner and the roles and responsibilities of the learner during the experience (see next slide)
- Assign a supervisor for the learner – meet weekly, evaluate professional performance monthly, summarize student achievements at end of semester (overall time commitment – 1 hour/week)
- Identify level of funding (if applicable)

Michener INSTITUTE UHN DIGITAL HEALTH & DATA ANALYTICS

Seeking Placements

Project Information

Project Title: (this will be posted on The Michener website)
Funding Assigned:
Project Description: Including background, aim(s), methods and significance of the project. You can use the workflow diagram on page 2 to help identify phase(s) where the experience and project is placed. (Maximum 400 words) Suggested headings: • Background/Rationale • Aims/Goals • Methods • Significance

DRAFT

Michener INSTITUTE UHN DIGITAL HEALTH & DATA ANALYTICS

Seeking Placements

Example:

The goal of the project is to develop an AI-based tool to determine required services for patients facing lengthy wait times for initial assessment with a neurologist. The Toronto Dementia Research Alliance (TDRA) has developed a patient database that will be used to build our model/system.

Currently there are over 1000 consented patients enrolled in the TDRA database and new patients continue to be added weekly. Our vision is to build an expert system that will be able to triage patients at the time of referral to determine which key services are needed and can be accessed without physician or nurse intervention (ie. OT for home safety assessments, social work for urgent long-term care placement, etc.) to help expedite early access to healthcare services, enhance individual clinical care, and eliminate the need for certain in-person evaluations.

We will use data mining techniques to identify critical variables in this database and a ML algorithm to build our predictive model.

Michener Institute UHN DIGITAL HEALTH & DATA ANALYTICS