Artificial Intelligence in Healthcare: A Self-Assessment Driven Approach to the Fundamentals

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Background and Purpose

- **AI in Healthcare:** Rapid rise of AI is transforming healthcare via diagnostic accuracy, data synthesis, and personalized treatments.
- **Educational Gap:** Healthcare professionals often lack comprehensive AI knowledge, creating potential for misinformation and ethical missteps.
- **CPD Imperative:** Bridging the AI-education gap through CPD is essential for safely and effectively integrating AI into clinical practice.

Healthcare's AI Wicked Problem

1. Fast-Paced AI vs. Slow Education
- AI's advancement outstrips current training of many healthcare providers.
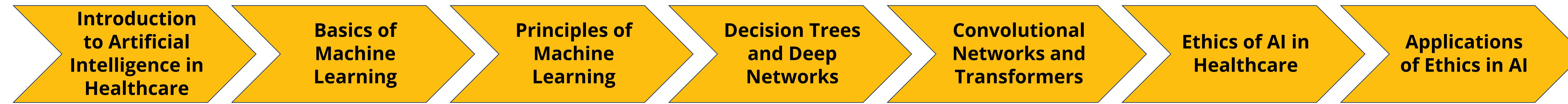- Missed opportunities during the pandemic to create robust educational initiatives.

2. Risk of Misinformation/Misuse
- Our 'reach' with AI has exceeded our 'grasp'
- Emergence of self-proclaimed AI "experts" with inadequate training.
- Potential for AI misuse leading to incorrect decisions and worse outcomes.

3. Global Imperative
- AI's benefits in healthcare (e.g., improved diagnostics, personalized care) risk being lost if providers remain undereducated.
- Either we understand how to use AI as a tool or we'll be the tools of it

Modules in Our Course

Introduction to Artificial Intelligence in Healthcare → Basics of Machine Learning → Principles of Machine Learning → Decision Trees and Deep Networks → Convolutional Networks and Transformers → Ethics of AI in Healthcare → Applications of Ethics in AI

How did Our Course do in Action?

Language of AI — Learning Objective	Pre Mean	Pre St Dev	Post Mean	Post St Dev	Diff F	Diff p-value	Diff Cohen's d
Explain the perceptions of AI in healthcare.	3.69	1.94	6.57	2.16	48.48	< .001	1.43
Summarize the current state of affairs of artificial intelligence and machine learning as it relates to healthcare applications.	3	2	6.64	1.54	116.64	< .001	1.95
Identify common applications of AI in healthcare.	3.29	2.05	5.93	2.4	33.9	< .001	1.22
Identify the strengths and limitations of AI in healthcare.	3.45	2.06	6.93	1.39	115.53	< .001	1.86
Identify elements and concepts associated with machine learning (ML) in healthcare applications.	2.36	1.6	6.21	1.66	140.72	< .001	2.38
Distinguish between common ML model types and illustrate their application in healthcare.	2	1.57	6.21	1.82	149	< .001	2.54
Discuss emerging healthcare applications of natural language processing and computer vision subfields of AI.	2.32	2.07	6.5	1.64	139	< .001	2.16

Applications of AI — Learning Objective	Pre Mean	Pre St Dev	Post Mean	Post St Dev	Diff F	Diff p-value	Diff Cohen's d
Discuss key principles in training machine learning (ML) systems.	1.98	1.91	6.29	2.15	110	< .001	2.16
Critically appraise whether an ML system is likely to perform as advertised in your practice.	1.98	1.93	5.79	1.82	108	< .001	2.00
Apply your knowledge of ML system principles for enhanced communication and collaboration with ML practitioners to advance AI in healthcare.	1.83	2.06	6.07	1.75	134	< .001	2.16
Identify the kinds of automated decisions that are well suited to a decision tree approach.	2.43	2.17	6.36	1.72	112	< .001	1.93
Explain how decision trees select data items (attributes) to use in decision making.	2.24	2.13	6	1.85	95	< .001	1.84
Explain how multiple decision trees can be combined for better performance.	2.09	2.12	6	1.73	112	< .001	1.96
Compare the intelligence of deep networks to human intelligence from a mechanistic perspective.	1.82	1.85	5.71	1.91	108	< .001	2.08
Explain the roles of gradient descent and backpropagation in deep network training.	1.33	1.67	5.14	2.26	86	< .001	2.03
Identify common strategies to reduce overfitting in deep networks.	1.35	1.71	5.14	2.56	69	< .001	1.87
Explain how convolutional networks process images and why they learn efficiently.	1.45	1.73	5	2.14	79	< .001	1.90
Explain how transformers process language and how they learn from large amounts of unlabeled data.	1.4	1.71	5.07	2.12	87	< .001	1.98

Ethics of AI — Learning Objective	Pre Mean	Pre St Dev	Post Mean	Post St Dev	Diff F	Diff p-value	Diff Cohen's d
Identify key ethical issues associated with the use of AI in healthcare.	3.07	2.23	7.21	1.7	122.3	< .001	2.00
Define key ethical concepts relevant for evaluating AI applications in healthcare.	2.64	2.28	7.07	1.58	148.4	< .001	2.13
Apply general ethical concepts to specific uses of AI in healthcare.	2.7	2.15	7.07	1.58	153	< .001	2.20
Describe the epistemic limitations of AI in healthcare.	1.93	1.9	6.57	1.72	173.4	< .001	2.52
Identify a range of ethical issues in real-world case studies.	2.76	2.2	6.5	1.95	86.2	< .001	1.76
Assess the extent to which existing ethical frameworks are adequate, given the rapid pace of AI development.	2.21	1.96	6.14	1.92	105.7	< .001	2.02
Apply the ethical concepts and frameworks from previous modules to novel problems raised by AI in healthcare.	2.05	1.77	6	2.04	104.9	< .001	2.12

Discussion and Takeaways

- Reactionary rather than proactive efforts in training is creating a situation where the reach of AI often exceeds the grasp of the healthcare system, training bodies, professionals, and their regulatory bodies
- If you try to include math, about 32% of learners will REALLY not like it
- Participants prefer to learn through clinical rather than conceptual examples
- 87% of learners reported an intention to change their practice with what they learned in the course

- The biggest motivator → Desire to use AI effectively and ethically
- Almost universal desire for more training in AI ethics
- Fear of being liable for sub-optimal use of AI
- In the aggregate, people don't know how to use AI to augment their clinical practice
- Courses like this would ensure a health professions workforce that is able to ask insightful questions, draw key inferences, and ultimately successfully augment their clinical practice with AI

Our Course

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We acknowledge our partners in the consortium who co-wrote the module content and represent academics and healthcare providers from the CSCIN, University of Waterloo, University of Guelph, Conestoga College, Grand River Hospital, Harvard University, and Queen's University.

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