SUMMARY REPORT

Kingston Health Sciences Centre - Queen's University Innovation Workshop

Digital Health, Machine Learning and Artificial Intelligence in Health

Elizabeth Eisenhauer MD[1], Ben Kwan MD[2], Akshay Rajaram MD[3], Amber Simpson PhD[4], Claudio Soares MD PhD[5], Martin ten Hove MD[6], Sonal Varma MD[7], Fabio Ynoe de Moraes MD[8]

1. Innovation Lead, Kingston Health Sciences Centre
2. Department of Radiology, Queen's University
3. Department of Family Medicine, Queen's University
4. School of Computing, Queen's University
5. Department of Psychiatry, Queen's University
6. Department of Ophthalmology, Queen's University
7. Department of Pathiology, Queen's University
8. Department of Oncology, Queen's University

Contents

Introduction and Background

On February 3, 2020, Kingston Health Sciences Centre (KHSC) and Queen's University held an Innovation Workshop on ***Digital Health, Machine Learning and Artificial Intelligence in Healthcare.*** This was the first of three planned workshops examining priority themes coming from the new Innovation Portfolio developed by Kingston Health Sciences Centre (KHSC). The portfolio themes (Table 1) were developed through a process of examining local strengths in research and innovation, interviews across Ontario and internationally, and review and discussion by leaders within KHSC and the Queen's Faculty of Health Sciences. Workshops are being undertaken with financial support from KHSC, University Hospital Kingston Foundation (UKHF), and the Faculty of Health Sciences at Queen's (FHS).

Table 1 – Innovation Themes of KHSC Portfolio

Theme:	Workshop
Digital Health, Machine Learning, Artificial Intelligence	**February 3, 2020**
21st Century Interventional Medicine - Minimally Invasive Surgery	To be scheduled
New Frontiers in Integrated Care - Timely Access to Specialty Care	To be scheduled
Next Generation Tertiary Care	
Novel Business Models and Procurement	

The overarching goals of the KHSC Innovation portfolio are to:

- Improve health outcomes
- Improve the value of health interventions
- Improve patient experience and access to evidence-based care
- Implement and spread new programs, services, technologies suited to our population and region

In order to develop each theme further, workshops are being held to identify relevant ongoing and emerging projects (both research and translational) as well as to agree on a transparent pathway to set institution wide-priorities.

In addition, *specific* goals for the workshop on Digital Health, Machine Learning (ML) and Artificial Intelligence (AI) held February 3, 2020 were to address some of the following key questions and plan for moving ahead in a coherent manner, identify how priorities might be set, and identify key leaders and wise champions to advise KHSC and Queen's leaders:

- How ML/AI can help solve problems we are facing in our tertiary centre and region?
- Which are problems most suitable/important for ML/AI & Analytics solutions?
- What types of ML/AI products or services will vendors wish to sell?
- What sorts of early and advanced ML/AI projects are ongoing locally?
- How as tertiary HSC we should be part of not only research but evaluation?

The workshop program (Appendix I) was divided into series of sessions to address these goals and the 85 attendees represented a wide range of attendees from the fields of healthcare, system leadership, trainees, computing scientists, business experts and education.

This report summarizes some of the key messages from each session as well as the summary and next steps. All presentation slides may be downloaded from Kingstonhsc.ca.

Session 1 – Setting the stage

Dr. Amber Simpson, a Queen's Professor in Queen's School of Computing and Artificial Intelligence researcher started the workshop with an overview of the potential for machine learning and artificial intelligence in health care. Large data sets, analytic capability, ability to store images and cross link numerous aspects of individual patient information have created the opportunity to develop AI algorithms to improve diagnostic and prognostic aspects of health care. Cancer, radiology, and surgery were cited as areas of medicine of where AI might have substantial impact. However, she emphasized we are not there yet: there is, as yet, limited application of any AI based tool in clinical medicine. She highlighted the fact that within Ontario and Canada we have tremendous opportunity to contribute to this emerging field – having a single payer system offers real advantages over the US type of profit-driven competitive system. Furthermore, in our local setting here at Queen's in Kingston we have assets to deploy in research in this area. These include large health databases through highly collaborative research groups (e.g., Canadian Primary Care Sentinel Surveillance Network, Canadian Cancer Trials Group, Institute for Clinical Evaluative Sciences and KHSC) as well as expertise, training, and leadership of the Queen's School of Computing and the Centre for Advanced Computing. In the future, while AI and computers will not replace physicians and

other medical personnel, it seems likely that those who do not learn about how to use the tools they offer, will be replaced.

Dr. Muhammad Mamdani, Vice President, Data Science and Advanced Analytics, Unity Health Toronto and Odette Chair in Advanced Analytics and is a Professor at the University of Toronto, spoke next. He addressed the important question of assessing the *value of* novel AI products in healthcare bring before they are widely adopted. He reviewed the concept of value as being one that requires assessing the benefits and harms of new technologies from the perspective of patients, clinicians and payers (economic and utilization data) with "high value" technologies being those that provide the greatest benefit with limited use of resources. He also emphasized that AI may apply not only to clinical activities (e.g., diagnosis, prognostication, etc.), but also to non-clinical operations such as optimizing patient flow and staffing and decreasing wait times. Such applications require investment in advanced data analytics capabilities within the health system and the prioritization of potential projects using a framework that assesses value as described above. He gave a few examples from Unity Health where they have created the most advanced hospital-based applied analytics program in Canada. Projects have included forecasting Emergency Department volumes for optimal staffing, predicting ICU patient transfers, and optimizing nursing team staffing have all been undertaken with improvements in wait times, quality of care, patient outcomes and cost savings.

Dr. Jay Shaw, Research Director, Artificial Intelligence, Ethics & Health, University of Toronto Joint Centre for Bioethics was the final speaker of the session and discussed considerations of ethics and equity in deploying AI in healthcare. This important presentation began by noting that both *Ethics* ("well-founded standards of right and wrong that prescribe what humans ought to do, usually in terms of rights, obligations, benefits to society, fairness, or specific virtues") and *Equity* (" primarily concerns aspects of *justice*: The moral dimensions of the distribution of benefits + burdens, advantages + disadvantages") are important to consider as healthcare moves towards digital tools and applications of AI. He discussed a number of issues including:

1) Technology is becoming more pervasive, but not all communities have equal access to connected digital devices,
2) Not all problems are best solved by technology, but ethically designed innovation can play an important role,
3) Policy and Procurement for digital health technologies should focus on meeting the needs of providers and the public, and
4) The fundamentals of a digitized health system need attention before digital health can meet its potential.

As both tools and systems are designed, the issues above and the concepts of ethics and equitable access for patients and practitioners need to be embedded in the process.

Session 2 – Imaging-based ML/AI

The major goals for this session were to understand where each of the four imaging-based specialty areas presented is currently and will be heading in the next few years with respect to digital tools and AI applications. As well, it was hoped we could identify what is ready for implementation and evaluation at the present time and what KHSC would need to do to get ready for such implementation.

Dr. Amber Simpson, Queen's University Professor of in the School of Computing, was the first speaker who discussed the development of AI tools for **radiology**. Dr. Simpson reported on the tremendous growth in the number of publications and research related to AI in this field (from medical to political science), the opportunities that may come from using AI for imaging segmentation and outcome prediction, and highlighted the importance of sharing the large data sets that are needed to develop, then validate, AI algorithms of practical utility *("Sharing data may not solve everything but hoarding data has solved nothing")*. Finally, she emphasized some of the AI-radiology specific challenges which included data privacy, data management, and lack of interoperability in imaging data. Opportunities at Queen's and KHSC in this arena are related to the collaborations already being put in place between the Department of Radiology and School of Computing as well as the power/data in research and infrastructure groups such as the Canadian Cancer Trials Group and the Queen's Centre for Advanced Computing.

Dr. Alejandro Berlin, clinician-scientist and radiation oncologist at the University of Toronto, spoke next on the importance of AI to **radiation oncology** sciences. He described the importance of developing a standardized vocabulary to this area of research (ontology – *"naming something gives you power over it"*). He went on to highlight the importance of and great potential for AI-enabled automation in radiation oncology and reviewed automation processes, the AI planning framework, and its potential clinical impact. In Radiation Oncology, AI based methods have the potential improve the quality and speed of treatment planning and liberate time for clinicians to do more direct patient care. He concluded that robust AI methods are necessary but to bring them to clinical practice will require international collaborations to evaluate AI based plans and eventually randomized clinical trials to assess their performance.

Dr. Rob Campbell, Professor of Ophthalmology at Queen's University, gave an overview of the use of AI-image analysis in **ophthalmology**. He reviewed the global burden of eye disease burden and the wide range of AI applications in field (scribe natural language processing, robotic surgery, clinical decision making, research analytics). He highlighted how deep learning algorithms equipped with stand-alone fundus cameras have already revolutionized diabetic retinopathy and glaucoma detection and monitoring. He concluded his talk by reviewing the role Queen's and KHSC will have continuing to conduct research in AI in digital Eyecare.

Dr. Sonal Varma, an Assistant Professor in Pathology at Queen's, was the final speaker in this session. She acknowledged that, unlike the other specialties discussed earlier in the session, where images undergoing analysis (e.g., retina, radiological images) are acquired directly in digital format, pathology images are digitized following fixation, staining and cutting of specimens. Her discussion focussed primarily on **digital tools and applications used in pathology.** Telepathology has emerged as a major player in Pathology with applications in primary diagnosis, expert consultation and generating new business by enabling in-sourcing of cases from around the world. Currently, Quebec has an extensive telepathology network across Canada. In the US, many big pathology departments such Memorial Sloan Kettering, New York and Ohio State University are close to being fully digital pathology labs. Additionally, private labs including LifeLabs in Canada use digital pathology for certain subspecialties in pathology. Digitized imaging is the foundation for applying AI based algorithms for screening and diagnostic assessments in pathology. Currently, fully automated processes for diagnosis are experimental, albeit with great promise. The main application for these algorithms will be in screening for cases that are relatively straightforward diagnostically and are high volume (e.g., colonic polyps in GI pathology). Overall, digital pathology is the reality and new way of doing pathology with integration of AI in certain aspects showing great promise.

Session 3 - Tools for Monitoring Acute and Chronic Disease

As for the preceding session, the major goals for this session were to understand how each of the fields discussed were exploring the use of digital tools and analytics in chronic and acute disease monitoring. As well, we hoped we could identify what is ready for implementation and evaluation at the present time and what KHSC would need to do to get ready for such implementation.

Dr. Claudio Soares, Professor and Head of the Department of Psychiatry at Queen's, was the first speaker. Dr. Soares focused on **mobile health technologies (mHealth) in mental health** and how these technologies could contribute to patient engagement, symptom

management, treatment adherence, and real-time monitoring of wellness, resilience and relapse prevention. He introduced the concept of "digital phenotyping" and discussed the extent to which context-sensing data and other information gathered through smartphones (GPS tracker, accelerometer, location entropy) could have an important role in quantifying prodromal symptoms prior to relapse in depression and measuring patient behavior in the context of interventions. Ultimately, innovation and research on mHealth may help reduce the burden (personal, societal) associated with depression.

Dr. Michael Fitzpatrick, Chief of Staff at KHSC and a respirologist in the Department of Medicine at Queen's spoke next. His focus was on Chronic Obstructive Lung Disease (COPD), a life-limiting condition which is very common in our region and one which has considerable impact on health resources including emergency department (ED) visits and hospital admissions. This background set the stage for why digital tools and analytics would be of value in tracking patients at home to identify and anticipate when an exacerbation was unfolding - and allow early intervention. He described the case for using innovative procurement for new technology to do this – particularly in our region where there is a small population over a large geographic area and a high proportion of elderly patients. A technology that could support the transition of care to the home and reduce readmissions would be ideal – for example a tool that could monitor patient symptoms and vital signs, produce an action plan for AECOPD and could be accessed by a nurse specialist on a tablet. KHSC has acquired such technology and is now rolling it out.

Dr. David Maslove, a Clinician Scientist in the Departments of Medicine and Critical Care Medicine at Queen's, was the final speaker. He described research ongoing locally in which big data from the patients in the **Intensive Care Unit** (ICU) are used to identify patterns to predict individual outcomes. He highlighted that the ICU environment collects a multitude of datapoints every day and is one of the most technologically advanced areas in medicine in terms of patient monitoring – the ICU is a thus a "proving ground" for precision medicine. He noted a challenge that "regular" big data is not necessarily the same as "medical" big data. The research at Queen's and KHSC is working to combine genomics, waveforms data and electronic medical record (EMR) data. The progress at this time has included storing data from every heartbeat from every patient in HDF5-based data standard using a fast query system which has generated approximately 30TB of high frequency data. He also highlighted that to progress this work locally, there are still critical gaps: data scientists, computing resources, appropriate EMR data, and support from IT/decision support and clinical engineering.

Session 4 – Primary Care and Population Health

In this session, presentations focused on applications of digital health and AI being used to improve care locally, nationally, and internationally. Additionally, presenters underscored the importance of high-quality data in supporting and sustaining such initiatives.

Mr. Troy Jones, Chief Operating Office of KHSC, described the initiative to replace the current Health Information System (HIS) with a new one which would be common to all hospitals within the region. The potential of a region-wide HIS includes opportunities for improved care coordination from primary care through long-term care, improved quality of care with standard documentation, better patient outcomes, potentially reduced costs and improved data availability and support for academic research. He provided an example of the potential benefits of readily accessed health information from Dr. Srivastava's research group at Queen's/KHSC. He has used a combination of KHSC health service use and CIHI data to develop an alternate level care risk prediction algorithm to identify patients that would benefit from earlier discharge planning. In the future, a unified health information system could automate data collection and allow for embedding of such algorithms within existing care pathways across the region.

Dr. David Barber, an Assistant Professor in the Department of Family Medicine, described how the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) led by Queen's is already applying machine learning and natural language processing to data from over two million patients, 1260 clinicians, and 17 electronic medical records to enhance the management of chronic diseases across the country. These same advanced analytical techniques could be used to reduce the burden of certain administrative tasks associated with burnout (e.g., automated charting) and provide intelligent decision support at the point of care.

Dr. Karen Yeates, a nephrologist and Professor of Medicine at Queen's, described how AI is being used to reduce mortality and morbidity of cervical cancer in low resource settings. In Tanzania, use of a mobile health solution, SEVIA (Smartphone-Enhanced Visual Assessment), by community health providers, has led to over 10,000 women receiving cervical cancer screening and generated more than 100,000 labelled images. These images have now formed the basis for deep learning algorithms capable of analyzing images autonomously, further decentralizing and democratizing care.

Session 5 - Artificial Intelligence and Medical Education

Dr. Alison Paprica, an Executive Advisor and Affiliate Scientist at ICES from the University of Toronto and member of the Royal College of Physicians and Surgeons Task Force on AI and Emerging Technologies, chaired this panel session which delved into several important questions related to the impact of healthcare related AI on education. Panel members included the following Queen's faculty and students***:*** **Dr. Damon Dagnone**, CBME Faculty Lead for PGME; **Dr. Tony Sanfilippo,** Associate Dean, UGME at Queen's; **Dr. Akshay Rajaram**, PGY1 in Family Medicine, and **Ms. Regina Leung**, a 3rd year medical student. Following a brief introduction, the audience was posed a series of questions related to AI in Education and these were expanded upon further by discussion of panel members. As seen in the pooled results (Appendix II), the audience expressed diverse opinions. Key questions included:

1. **What is an essential prerequisite to using AI in medicine and medical education?**
   63% chose: "The first step has to be identifying a problem /opportunity that genuinely needs AI vs. starting with an AI tool and looking for places to use it."
2. **How can we prepare clinicians for the future state?**
   42% chose "Figure out how to correctly define a problem and select appropriate data for training – assemble teams with clinicians with computer scientists, data scientists, software engineers and others."
3. **What can you do to improve your AI-related skills and knowledge right now?**
   41% chose: "Start solving data problems in teams – lots of online resources, learn a bit of coding like Python."
4. **How should we use AI in medical education to improve teaching and assessment?**
   46% chose: "There are multiple ways we should do this."

As noted above – audience answers to these questions were variable – and reflective of the diverse backgrounds present at the workshop. Dr. Paprica left the workshop attendees with a list of resources on the broad topic of AI and education which are appended to this report (Appendix III).

Workshop Summary and Next Steps

Dr. David Pichora, CEO of Kingston Health Sciences Centre, provided a of the workshop as well as some initial thoughts of next steps. In terms of key messages, the following were noted as recurring points regarding Digital Health, Machine Learning and Artificial Intelligence:

1. **Multidisciplinary teams** are critical. We need colleagues in computing, biology, medicine, surgery, decision support, hospital administration, and patients as we define and tackle important questions using these approaches.
2. **Value or (potential value)** is important to consider when weighing investments in potential AI/ML projects aimed at healthcare problems – value to the patients, system and providers.
3. **Research (discovery) vs innovation (implementation based on research evidence).** The two overlap – but whether research gets implemented will depend on whether it will have an **impact on things that matter (and at what cost).**
4. **AI will not replace healthcare providers,** but its "intelligent" deployment will undoubtedly become part of aspects of care for providers, patients and of our hospital and clinic operations. Therefore, education and training are important.
5. There are many of people at KHSC/Queen's and our region interested in this field, thus **great potential** for research, implementation and evaluation

A number of next steps in terms of further development of this theme within the innovation portfolio were proposed:

1. KHSC and Queen's should create a joint **Digital Health/AI Team** to help guide development of priorities and projects. It is not clear whether this will be a single team or perhaps split between ***Digital Health*** (use of mHealth, eVisits) and ***Machine Learning/AI*** (analytics, tool development and evaluation). Furthermore, there may be some discussion needed about whether the team should be divided according to whether it examines projects that are more on the "research" side of care or in "implementation/evaluation." Priority setting for projects to be undertaken at KHSC/Queen's will be key and some of the points raised by Dr. Mamdani resonated – projects that will either improve patient outcomes, reduce hospital costs or resource utilization or both will be of highest priority for investment.
2. **Organization wide reflection and survey.** There seems to be a need to identify issues and problems within KHSC for which advanced analytics could offer *solutions.* Some of these may be related to hospital operations/scheduling (as per examples form Dr. Mamdani's presentation). Others may be problems related to prognostication or treatment decision making. A survey might illuminate the biggest needs and bring forward ideas towards their solution.
3. **Earmark funding** (potentially in collaboration with FHS/South Eastern Academic Medical Organization) to support priority projects. The Digital Health/AI team could identify priority areas and projects for funding and thus having a budget for the next year to invest in high priority projects will be important.
4. A high-level **report** of workshop will be created and distributed which will provide support to the above actions

Kingston Health Sciences Centre - Queen's University

Innovation Workshop

PROGRAM

Kingston Health Sciences Centre
Centre des sciences de la santé de Kingston
Hôpital Hotel Dieu Hospital
KGH Hôpital Général de Kingston General Hospital

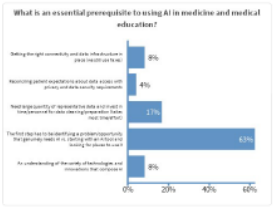
Queen's University

TIME	TOPIC	PRESENTER
0800	**SESSION 1 – Setting the stage for the day - KEYNOTE lectures** Chair: Dr. Elizabeth Eisenhauer, Innovation Lead, Kingston Health Sciences Centre	
0800	Welcome and goals for the workshop	***Dr. Elizabeth Eisenhauer***
0805	The Potential of Artificial Intelligence in Health Care	***Dr. Amber Simpson*** Queen's School of Computing and Dept of Biomedical and Molecular Sciences
0835	The Value Equation for Assessment of Novel ML and AI Products	***Dr. Muhammad Mamdani*** Vice President Data Science and Advanced Analytics, Unity Health, Toronto ON
0905	Considerations of Ethics and Equity in deploying AI in healthcare	***Dr. Jay Shaw*** Institute for Health System Solutions & Virtual Care, Women's College Research Institute, Toronto ON
0940	***HEALTH BREAK***	
1000	**SESSION 2 – <u>Imaging</u> based ML/AI for diagnosis, treatment planning, prognosis** Chair – Dr. Fabio Ynoe de Moraes, Dept. of Oncology - *Where each field is currently and is going.* - *Identifying what is <u>ready for implementation/evaluation</u> (if any).* - *What KHSC/we would need to do <u>to get ready</u>*	
1000	Radiology	***Dr. Amber Simpson*** Queen's School of Computing and Dept of Biomedical and Molecular Sciences
1015	Radiation Oncology & the prospective applications of AI methods in the real world: new lessons, new challenges	***Dr. Alejandro Berlin*** Princess Margaret Cancer Centre University of Toronto
1030	Ophthalmology	***Dr. Robert Campbell*** Dept. of Ophthalmology
1045	Pathology	***Dr. Sonal Varma*** Dept. of Pathology and Molecular Medicine
1100	**Rapid Fire Local Projects (3 min/3 slides)**	
	Democratization of Prostate Cancer Diagnosis: 3.0 T to 1.5 T	***Mr. Andrew Grebenisan*** School of Computing
	Image-Guided Interventions 2.0: Precision and Personalization Through AI	***Mr. Alireza Sedghi*** School of Computing
	Stage against the machine: Chemical detection of Prostate Cancer	***Ms. Jenny Wang*** Dept. of Pathology and Molecular Medicine
110	***PANEL DISCUSSION***	
1135	**SESSION 3 – Tools for <u>Monitoring Acute and Chronic Disease</u>**	

	Chair: Dr. Ben Kwan, Dept. of Radiology - *Where each field is currently and is going.* - *Identifying what is ready for implementation/evaluation (if any). What KHSC/we would need to do to get ready*	
1135	Mental Health	***Dr. Claudio Soares*** Dept. of Psychiatry
1150	Chronic Lung Disease	***Dr. Michael Fitzpatrick*** Dept. of Medicine; KHSC Chief of Staff
1205	Critical care	***Dr. David Maslove*** Depts. of Medicine and Critical Care Medicine
1220	**Rapid Fire Local Projects (3 min/3 slides):**	
	Jump starting a deep learning based rhythm detection tool for analyzing high-frequency telemetry data in the KHSC ICU	***Mr. Alex Hamilton*** Dept. of Critical Care Medicine
	Machine learning approaches to develop prediction models for bronchopulmonary dysplasia or death in preterm neonates <33 weeks GA	***Dr. Faiza Khurshid*** Dept. of Pediatrics
	Psychiatry moving to the 21st century!	***Dr. Nazanin Alavi Tabari*** Dept. of Psychiatry
	Artificial Intelligence Based Texture Analysis of the Retina	***Dr. Damien Pike*** Dept. of Ophthalmology
1235	***PANEL DISCUSSION***	
1300	***LUNCH***	
1345	**SESSION 4 – Primary Care and Population Health** Chair: Dr. Akshay Rajaram, Dept. of Family Medicine	
1345	The potential of AI in primary Health Care: how Big Data (e.g. CPCSSN) could transform primary care	***Dr. David Barber*** Dept. of Family Medicine
1410	How AI can facilitate remote care of populations – the cervical screening example	***Dr. Karen Yeates*** Dept. of Medicine
1435	The new Health Information System at KHSC and its potential for impact	***Mr. Troy Jones***, Chief Operating Officer Kingston Health Sciences Centre
1455	***PANEL DISCUSSION***	
1510	***HEALTH BREAK***	
1530	**SESSION 5 –Artificial Intelligence and Medical Education** Chair: Dr. Alison Paprica, University of Toronto	
1530	Panel and Audience Discussion	***Dr. Akshay Rajaram*** (PGY1 Family Medicine), ***Ms. Regina Leung*** (Queen's Med student) ***Dr. Tony Sanfilippo*** (Ass. Dean UG Medicine) ***Dr. Damon Dagnone*** (CBME lead)
1630	**CLOSING REMARKS –** **Dr. David Pichora,** President & CEO, Kingston Health Sciences Centre	
1700	**Close of Workshop**	

Appendix II

What is an essential prerequisite to using AI in medicine and medical education?

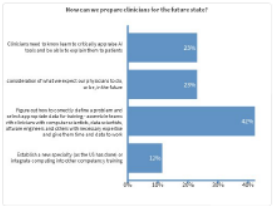


Response options	Count	Percentage
Getting the right connectivity and data infrastructure in place (we still use faxes)	2	8%
Reconciling patient expectations about data access with privacy and data security requirements	1	4%
Need large quantity of representative data and invest in time/personnel for data cleaning/preparation (takes most time/effort)	4	17%
The first step has to be identifying a problem/opportunity that genuinely needs AI vs. starting with an AI tool and looking for places to use it	**15**	**63%**
An understanding of the variety of technologies and innovations that compose AI	2	8%

86% Engagement

24 Responses

How can we prepare clinicians for the future state?

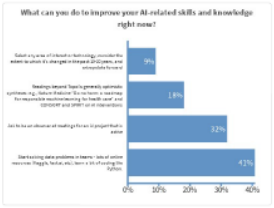


Response options	Count	Percentage
Clinicians need to know learn to critically appraise AI tools and be able to explain them to patients	6	23%
A consideration of what we expect our physicians to do, or be, in the future	6	23%
Figure out how to correctly define a problem and select appropriate data for training - assemble teams with clinicians with computer scientists, data scientists, software engineers and others with necessary expertise and give them time and data to work	**11**	**42%**
Establish a new specialty (as the US has done) or integrate computing into other competency training	3	12%

93% Engagement

26 Responses

What can you do to improve your AI-related skills and knowledge right now?

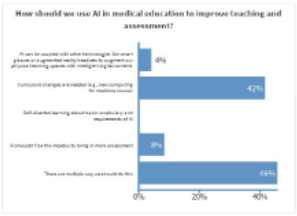


Response options	Count	Percentage
Select any area of interest or technology, consider the extent to which it's changed in the past 10-20 years, and extrapolate forward	2	9%
Readings beyond Topol's generally optimistic syntheses: e.g., Nature Medicine "Do no harm: a roadmap for responsible machine learning for health care" and CONSORT and SPIRIT on AI interventions	4	18%
Ask to be an observer at meetings for an AI project that is active	7	32%
Start solving data problems in teams - lots of online resources (Kaggle, fast.ai, etc), learn a bit of coding like Python.	**9**	**41%**

79% Engagement

22 Responses

How should we use AI in medical education to improve teaching and assessment?



Response options	Count	Percentage
AI can be coupled with other technologies like smart glasses or augmented reality headsets to augment our physical learning spaces with intelligent digital content.	1	4%
Curriculum changes are needed (e.g., new computing for medicine course)	10	42%
Self-directed learning about basic vocabulary and requirements of AI	0	0%
AI shouldn't be the impetus to bring in more assessment	2	8%
There are multiple way we should do this	**11**	**46%**

86% Engagement

24 Responses

Appendix III

- Kaggle - online data competitions with public datasets and published solutions. Have tutorials/courses as well
- Fast.ai - free online hands-on course - 7 weeks to completion
- https://www.udemy.com/course/machinelearning/
- Attend in-person datathons
- Explore large open-source datasets like MIMIC-III
- Beam AL, Kohane IS. Big data and machine learning in health care. Jama. 2018 Apr 3;319(13):1317-8.
- Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nature medicine. 2019 Jan;25(1)
- https://aeon.co/ideas/how-much-can-we-afford-to-forget-if-we-train-machines-to-remember?utm_source=pocket&utm_medium=email&utm_campaign=pockethits
- University of Toronto Computing Course: http://c4m.cdf.toronto.edu/
- The Topol Review - https://topol.hee.nhs.uk
- Rajkomar A, Dean J, Kohane I. Machine learning in medicine. New England Journal of Medicine. 2019 Apr 4;380(14):1347-58.
- Wiens J, Saria S, Sendak M, Ghassemi M, Liu VX, Doshi-Velez F, Jung K, Heller K, Kale D, Saeed M, Ossorio PN. Do no harm: a roadmap for responsible machine learning for health care. Nature medicine. 2019 Sep;25(9):1337-40.
- Liu X, Faes L, Calvert MJ, Denniston AK. Extension of the CONSORT and SPIRIT statements. The Lancet. 2019 Oct 5;394(10205):1225.
- Royal College of Physicians and Surgeons Task Force on AI and Emerging Technologies, Chaired by Dean Reznick: http://www.royalcollege.ca/rcsite/health-policy/initiatives/ai-task-force-e
- And stay tuned for:
    - Vector-SickKids Health AI Deployment Symposium Report, Goldenberg et al
    - Vector-Trillium ML4H Unconference Report – What healthcare problems should ML be trying to solve, Ghassemi et al
    - CIFAR AI4H Task Force Report – Co-chaired by Naylor and Evans