



Short Communication

The Need for Developing Technology-Enabled, Safe, and Ethical Workforce for Healthcare Delivery

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ABSTRACT

Strengthening of the health system is a safety imperative, especially in a crisis as caused by the ongoing COVID-19 pandemic. While there is a need for enhancing the number and skill sets of the public health professionals, especially the frontline workers, it will be prudent to use the digital health technologies, including artificial intelligence, in enhancing the capacity of the healthcare professional education and delivery. However, it has to be ensured that an ethical and safe approach is adopted to develop and use digital health technology and, ethically appropriate training is imparted, to enhance the capacity of the human resources for health, leading to an overall health system strengthening.

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1. Background

Public health needs to be developed as an occupational health and safety service, and necessary changes in policy and implementation have to be made to keep pace with the evolving “fourth industrial revolution” (FIR), which is an advanced information and communication technology age [1].

Excessive trust in new technologies can often give rise to massive and, so far, unseen forms of workplace/occupational hazards. The recent pandemic-induced large-scale work from home office culture is jeopardizing the workers' biorhythms, even inducing some diseases, causing quicker burnouts, and enhancing task complexity. The social disconnection, due to lack of face-to-face interactions with coworkers, is becoming a risk for worker's mental health. Therefore, we need to be more ethically concerned and active to ensure a safe and healthy workplace, as well as a safe and ethical healthcare workforce, to take care of the people during the postpandemic era of the FIR.

Strengthening of the health system is an ethical and safety imperative [2], especially in a crisis as caused by the COVID-19 pandemic. That will require significant improvement of policy, education, and implementation or delivery – across all the areas.

The alignment with population and other capacity development needs should be the main criteria of decision for health workforce development, rather than transplanting such systems from other countries, however advanced they may be [3].

2. Issues with human resources for health professional education and delivery

As it has been evident for quite some time [4], there is a significant crunch in health human resources in India. As evident from the second joint statement by the public health experts from India [5], it will be prudent to scale up public health rapidly (including medical care) – both for services, as well as education and research. This has to be done both judiciously and ethically. Otherwise, the accountability may not be there and the blame for any mismanagement will be passed on and on to unrelated personnel – most often the frontline workers. One of the neglected areas of healthcare delivery professionals that need urgent attention is trained personnel specialized for digital health or health informatics [6].

This article looks at the issues related to technology, particularly artificial intelligence (AI), and health professional education in the following three ways: (1) technology/AI-enabled or automated

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health professional education (teaching–learning), (2) development of ethical, AI-enabled healthcare systems, and (3) ethical and socially acceptable use of AI-enabled healthcare delivery.

In the next three sections, we deal with these aspects. The third aspect also reinforces the importance of the first one. In other words, education and training or capacity building, for a safe and ethical healthcare workforce, will require changing the current curriculum and also the ways of teaching/learning for healthcare professional education.

3. Technology/AI-enabled or automated health professional education (teaching–learning)

For health professional education, the use of technology, especially AI, has been evolving gradually. AI is being used to provide students with adaptive and individualized educational content that can be further improved with student feedback. This approach allows the students to identify knowledge gaps and respond to them effectively, leveraging on their comfortable ways of learning methods. AI-enabled assessment of learning can make evaluation more objective, fast, cost-efficient, and individualized.

Automated virtual lessons are being implemented as eLectures for medical education for more than a decade now. While these sorts of efforts are praiseworthy, wide acceptance has not been there until the current pandemic struck [7].

Automated essay scoring systems can yield scores that consistently agree with those of human raters at a level as high, if not higher, as the level of agreement among human raters themselves. These sorts of systems offer health professional educators many benefits for scoring constructed-response tasks, such as improving the consistency of scoring, reducing the time required for scoring and reporting, minimizing the costs of scoring, and providing students with immediate feedback on constructed-response tasks [8].

A relatively new concept is that of automated item generation, which involves leveraging the expertise of content specialists, item templates, and computer algorithms to create a variety of item (question) permutations. This usually results in hundreds or thousands of new examination items based on a single item model. Automated item generation may significantly improve item writing capabilities, reduce human error, streamline efficiencies, and reduce costs for individuals in the medical and health professions [9].

Although a steep learning curve and potential stormy interactions between multidisciplinary team members could be its limitations, this is most certainly a proper way to generate well-designed automated assessments for health professional education. The other impediments to the adoption of technology and AI in medical education include the lack of understanding of the benefits of AI among health professional educators and practitioners. Furthermore, limited digitalization of the learning management systems, doubts regarding the privacy, security, quality, and accuracy concerns remain for medical education. While technological and associated advances of the FIR are reducing technological barriers, explainability is still a major issue. While patients are eager to adopt technologies, the healthcare providers are more skeptical human beings. Ethical and legal barriers reign supreme for privacy concerns [1,9].

One of the ways to overcome health human resource crunch is to use the telemedicine and teleducation facilities. It is very heartening to note that, during the ongoing pandemic, India has released the Telemedicine Practice Guidelines 2020 for modern medicine [10], AYUSH (Ayurveda, Unani, and Siddha) [11], and homeopathy [12]. While the Government of India has been actively encouraging the use of the AYUSH systems of medicine, in addition to the modern medicine, the WHO [13] has also been encouraging

that and various countries are practicing [14] and organizing conferences [15] related to these traditional/complementary or alternative medicine systems.

4. Development of ethical, AI-enabled healthcare systems

There have been various other applications of technology or digital health interventions for fighting against the ongoing COVID-19 pandemic [16]. In the present day of ubiquitous social media amplification of information, communication in a useful and harmless way is becoming very difficult [17]. However, technology, if used judiciously, can be more beneficial than harmful. Here are a couple of examples.

BlueDot is a Canadian startup on AI, which has the goal of combining public health and medical expertise with advanced data analytics. It is the world's first global early warning system to track and contextualize infectious disease risks. BlueDot has developed outbreak risk software [18], based on AI that can help in handling exposure and spread of infectious diseases such as COVID-19. BlueDot helps answer important questions regarding the report of local cases, and the severity, in various countries. They provide real-time insights to users with COVID-19's movements, strengthening the security of human health. On December 30, 2019, BlueDot alerted its private sector and government clients about a cluster of “unusual pneumonia” cases happening around a market in Wuhan, China. That was the first recognition of the novel coronavirus that is now known as SARS-Cov2, causing the COVID-19. Nine days later, the World Health Organization released its statement alerting people to the emergence of COVID-19. The BlueDot engine gathers data on more than 150 diseases and syndromes around the world searching every 15 minutes, 24 hours a day. This includes official data from organizations such as the CDC or the WHO, as well as less structured information from the social media. BlueDot's predictive ability mostly comes from nonhealthcare data such as the worldwide movements of annually four billion travelers on commercial flights; human, animal, and insect population data; climate data from satellites; and local information from journalists and healthcare workers, pouring through 100,000 online articles each day spanning 65 languages. During the early days of COVID-19, the system flagged articles in Chinese that reported 27 pneumonia cases associated with a market that had seafood and live animals in Wuhan. In addition to the alert, BlueDot correctly identified the cities that were highly connected to Wuhan using things such as global airline ticketing data to help anticipate where the infected might be traveling. The international destinations that BlueDot anticipated would have the highest volume of travelers from Wuhan were Bangkok, Hong Kong, Tokyo, Taipei, Phuket, Seoul, and Singapore. Finally, 11 of the cities at the top of their list were the first places to see COVID-19 cases [19].

The World Health Organization has created a repository of about more than 5000 peer-reviewed and curated research articles on many aspects including epidemiology, clinical features, diagnosis, treatment, social factors, and economics. IIIT Delhi researchers [20] have developed and applied the AI technique of natural language processing on this massive literature and have been able to discover the direct effects of COVID-19 and also many systematic implications such as the anticipated rise in TB and cancer mortality due to the nonavailability of drugs during the export lockdown. This helps users understand, synthesize, and take preemptive action with the available peer-reviewed evidence on COVID-19.

Apart from the two current examples shared earlier, there are various others [16] that weigh benefits and risks before rolling out the interventions. There are some underlying principles that need to be followed to ensure that all such AI-enabled healthcare delivery interventions are socially and ethically sound.

A useful document outlining some guidelines, from the Alan Turing Institute, on AI ethics and safety in the public sector, including healthcare and education, identifies the potential harms caused by AI systems. It proposes concrete, operationalizable measures to counteract them. The guide underlines that public sector organizations can anticipate and preclude these potential harms by stewarding a culture of responsible innovation and, also by, by putting in place governance processes supporting the design and implementation of ethical, fair, and safe AI systems [21].

There are many social and ethical issues related to bias and privacy concerns which affect healthcare safety. On the other hand, the potential of AI algorithms to assist with healthcare decision-making is vast as they can be trained on large data sets. AI may be used to help handle cases where a triage decision needs to be made in an intensive care unit—such as who gets access to a ventilator—which can have life and death ramifications. Unfortunately, heart diseases are often misdiagnosed in women, and colored patients are frequently undertreated for pain. These biases predate the advent of AI, but they could become more widely encoded into the fabric of the healthcare system if they are not corrected before AI becomes widespread. Furthermore, privacy concerns with respect to data collection and data accuracy are a growing problem. Vast data collection may be necessary for curtailing the spread of disease: organizations around the globe are proposing phone-based apps that track individuals' contact with those diagnosed with or recovering from the novel coronavirus. Google and Apple are partnering on an opt-in app for individuals to self-disclose their COVID-19 diagnosis. This may be justified until the pandemic ends. However, once the precedent for this type of surveillance is established, how do we remove that power from governments and other organizations [22]?

In this article [23], three recent case studies are discussed that are trying to anchor the principles in evidence-based policy analysis and implementation recommendations while facilitating meaningful international coordination on the development and use of AI. The COVID-19 pandemic has ensured that the demand for AI technologies—whether for pandemic response and recovery or numerous other uses—will go on rising. However, open dialog about how to use AI safely and ethically will help us avoid the trap of adopting technological solutions that cause more problems than they solve.

The COVID-19 pandemic is pushing many organizations to accelerate the adoption of more sophisticated AI systems. The AI systems are usually designed with a “human in the loop”, who is able to intervene when necessary. If an AI system performs well in 99% of cases, humans tend to become complacent, even in systems where the human is more empowered. They stop scrutinizing the AI systems they are supposed to be supervising. Unfortunately, when things go wrong, these humans-in-the-loop can become especially confused and struggle to regain control: a phenomenon known as “automation surprise.” [24].

5. Ethical and socially acceptable use of AI-enabled healthcare delivery

AI in health care will require leaders well versed in both biomedical and data science skills such as basic digital literacy, the fundamentals of genomics, AI, and machine learning. It has to become mainstream for all practitioners, accompanied by critical-thinking skills and the development of a continuous learning mindset. Along with improving clinical training, healthcare systems need to think about the existing workforce and provide ongoing learning, while healthcare providers need the time and incentive to continue learning. It is critical to get the basic digitization of systems and data in place before deploying AI-enabled interventions –

especially because the frustrations staff have with basic digitization could spill over to the wider introduction of AI. Moreover, as more health care is delivered using new digital technologies, public concerns about how healthcare data are used have grown. Healthcare organizations must have robust and compliant data-sharing policies that support the improvements in care that AI offers while providing the right safeguards in a cost-efficient way. Physicians believe that, given the volume of data required for AI, a poorly thought out process of anonymization could be a major cost, making diagnostic algorithms prohibitively expensive [25].

Healthcare professionals and organizations will need to overcome several challenges and tackle core structural issues, such as access to data and the readiness of algorithms for clinical practice. They also need to have basic AI literacy, including data governance principles, basic statistics, data visualization, and the impact on clinical processes. Now there is an urgent need for education and training so that appropriate technologies can be rapidly adopted, resulting in a healthier world for our patients and our communities [26].

The health professional education curriculum needs a restart to enable students to develop the skills to deal with massive data and also to communicate effectively with patients in a data-driven healthcare environment [27].

With the exponential expansion of medical knowledge, technologies such as AI are needed to enable healthcare professionals to effectively use this knowledge to deliver health care. Healthcare professionals need to be adequately trained in this new technology and know its advantages to improve cost, quality, and access to health care and its shortfalls such as transparency and liability. AI needs to be seamlessly integrated across different aspects of the curriculum [28].

AI is an area witnessing accelerated development. Governments have been paying attention to this and recognizing the implication and have been doing several activities to steer the direction and lay down a framework to allay the challenges and worries. Governments are eager to steer and control this development, rather than leave the technological advancements in the hands of private sectors or academic institutes, who may or may not work in an ethical and safe way for the benefit of the mankind. NITI Aayog, the official think tank of the Government of India [29], is coming out with a national strategy on artificial intelligence. The strategy also flags important issues such as ethics, bias, and privacy issues relating to AI and envisions government promoting research in technology to address these concerns. The focus is on sectors such as agriculture, health, and education where public investment and lead would be necessary. Digital technologies, practices, sciences, goods, and services can be enormously beneficial for human flourishing. AI can play a crucial role in capacity building of human resources for health in combating the ongoing pandemic, as well beyond that.

6. Way forward

Currently there is the necessity of new approaches for ethics with urgency for ensuring that AI can be safely and beneficially used in the COVID-19 response and beyond. AI can help in detecting, understanding, and predicting the spread of disease, which can provide early warning signs and inform effective interventions. AI may improve the medical response to the pandemic in multiple ways: supporting physicians by automating aspects of diagnosis, prioritizing healthcare resources, and improving vaccine and drug development⁴. AI also has potential applications beyond immediate response, such as combating online misinformation about COVID-19. We can leverage the current crisis to use AI for societal benefit. Nevertheless, as we are racing against time to deploy new technologies, ethical issues and risks are enhanced. There is a growing concern universally that the use of AI and data to combat

COVID-19 may compromise privacy and civil liberties by incentivizing the collection and processing of large amounts of private or personal data [30].

Therefore, a key challenge will be ensuring that AI is developed and used in a way that is transparent and compatible with the public interest, while stimulating and driving innovation in the sector. In other words, an ethical approach to develop and use digital health technology, including AI, will enhance the capacity of the human resources for health and lead to overall health system strengthening and safety. This will also require changes in healthcare professional education curriculum and methods of teaching to ensure the development and encouragement of a safe, ethical, and technologically empowered, healthcare workforce.

Conflicts of interest

The authors declare no conflict of interest.

References

- Min J, Kim Y, Lee S, Jang T-W, Kim I, Song J. The fourth industrial revolution and its impact on occupational health and safety, worker's compensation and labor conditions. *Saf Health Work* 2019;10(4):400–8.
- Vijayaprasad G, Sudarshini S. Response to Covid-19: an ethical imperative to build a resilient health system in India. *Indian J Med Ethics* 2020;2(3):89–92.
- Dussault G. Reflections on health workforce development; comment on "health professional training and capacity strengthening through international academic partnerships: the first five years of the human resources for health program in Rwanda". *Int J Health Policy Manage* 2019;8(4):245–6. <https://doi.org/10.15171/ijhpm.2018.129>.
- Nandan D, Agarwal D. Human resources for health in India: urgent need for reforms. *Indian J Community Med* 2012;37(4):205–6.
- Second joint statement of the IPHA, IAPSM and IAE – public health approach for COVID-19 pandemic control in India [serial online], [cited 2020 Jun 26]. *Indian J Public Health* 2020;64(Suppl. S2):84–6. Available from: <http://www.ijph.in/text.asp?2020/64/6/84/285636>.
- Sarbadhikari SN. Will Health Informatics gain its rightful place for ushering in Digital India? *Indian J Community Med* 2018;43(2):126–7.
- Rehatschek H, Hruska A. Fully automated virtual lessons in medical education, vol. 2013. Kazan: International Conference on Interactive Collaborative Learning (ICL); 2013. p. 3–8. <https://doi.org/10.1109/ICL.2013.6644525>.
- Gierl MJ, Latifi S, Lai H, Boulais AP, De Champlain A. Automated essay scoring and the future of educational assessment in medical education. *Med Educ* 2014;48(10):950–62. <https://doi.org/10.1111/medu.12517>.
- Royal KD, Hedgpeth M-W, Jeon T, Colford CM. Automated item generation: the future of medical education assessment? *EMJ Innov* 2018;2(1):88–93 [cited 2020 Aug 04] Available from: <https://www.emjreviews.com/innovations/article/automated-item-generation-the-future-of-medical-education-assessment/>.
- Ministry of Health and Family Welfare Government of India. Telemedicine practice guidelines; 2020 [cited 2020 Jun 26], Available from: <https://www.mohfw.gov.in/pdf/Telemedicine.pdf>.
- Central Council of Indian Medicine Government of India. Telemedicine practice guidelines for ayurveda, Siddha and Unani Practitioners. 2020 [cited 2020 Jun 26], Available from: https://www.ccimindia.org/pdf/CCIM_Telemedicine_Guidelines_08-04-2020.pdf.
- Central Council of Homoeopathy Government of India. Telemedicine practice guidelines; 2020 [cited 2020, May 01], Available from: <https://www.ayush.gov.in/docs/126.pdf>.
- World Health Organization. Benchmarks for training in Unani medicine, part of series on benchmarks for training in traditional/complementary and alternative medicine; 2010 [cited 2020 Aug 04] Available from: <https://www.who.int/medicines/areas/traditional/BenchmarksforTraininginUnaniMedicine.pdf?ua=1>.
- Lallanilla M. Ayurveda: facts about ayurvedic medicine; 2015 [cited 2020 Aug 04] Available from: <https://www.livescience.com/42153-ayurveda.html>.
- 4th international conference on natural products and medicinal plants research; 2020 [cited 2020 Aug 04] Available from: <https://naturalproducts.conferenceseries.com/events-list/siddha-and-unani-medicine>.
- Sarbadhikari S, Sarbadhikari SN. The global experience of digital health interventions in COVID-19 management. *Indian J Public Health* 2020;64:S117–24.
- Sarbadhikari S Ch. 18, the future of communication in a digital world. In: Parija SC, Adkoli BV, editors. *Effective medical communication: the A, B, C, D, E of it*. Springer. 2020, ISBN 978-981-15-3408-9; 2020. https://doi.org/10.1007/978-981-15-3409-6_18 Chapter.
- Bluedot. BlueDot's outbreak risk software safeguards lives by mitigating exposure to infectious diseases that threaten human health, security, and prosperity; 2020 [cited 2020 Jun 26], Available from: <https://bluedot.global/>.
- Bowles J. How Canadian AI start-up BlueDot spotted Coronavirus before anyone else had a clue; 2020 [cited 2020 Aug 04] Available from: <https://diginomica.com/how-canadian-ai-start-bluedot-spotted-coronavirus-anyone-else-had-clue>.
- Awasthi R, Pal R, Singh P, Nagori A, Reddy S, Gulati A, Kumaraguru P, Sethi T. CovidNLP: a web application for distilling systemic implications of COVID-19 pandemic with Natural Language processing. medRxiv. 2020. <https://doi.org/10.1101/2020.04.25.20079129> Available from [cited 2020 Jun 26], <https://www.medrxiv.org/content/10.1101/2020.04.25.20079129v1>.
- Leslie D. Understanding artificial intelligence ethics and safety: a guide for the responsible design and implementation of AI systems in the public sector. The Alan Turing Institute; 2019. <https://doi.org/10.5281/zenodo.3240529> [cited 2020 Aug 04].
- Howard A, Borenstein J. AI, robots, and ethics in the age of COVID-19; 2020 [cited 2020 Aug 04] Available from: <https://sloanreview.mit.edu/article/ai-robots-and-ethics-in-the-age-of-covid-19/>.
- Newman JC. Pandemic is showing us we need safe and ethical AI more than ever; 2020 [cited 2020 Aug 04] Available from: <https://thehill.com/opinion/technology/500637-pandemic-is-showing-us-we-need-safe-and-ethical-ai-more-than-ever>.
- Kahn J AI. Engineers should spend time training not just algorithms, but also the humans who use them; 2020 [cited 2020 Aug 04] Available from: <https://fortune.com/2020/05/05/a-i-engineers-should-spend-time-training-not-just-algorithms-but-also-the-humans-who-use-them/>.
- Eit Health and McKinsey & Company. Transforming healthcare with AI: the impact on the workforce and organizations; 2020 [cited 2020 Aug 04] Available from: https://eithealth.eu/wp-content/uploads/2020/03/EIT-Health-and-McKinsey_Transforming-Healthcare-with-AI.pdf.
- Wiljer D, Hakim Z. Developing an artificial intelligence-enabled health care practice: rewiring health care professions for better care; 2019. <https://doi.org/10.1016/j.jmir.2019.09.010> [cited 2020 Aug 04] Available from: <https://www.innohealth.com/2019/03/05/artificial-intelligence-redefining-the-role-of-the-health-professional-are-we-there-yet/>.
- Paranjape K, Schinkel M, Nannan Panday R, Car J, Nanayakkara P. Introducing artificial intelligence training in medical education. *JMIR Med Educ* 2019 Dec 3;5(2):e16048. <https://doi.org/10.2196/16048>.
- Niti Aayog Government of India. National strategy on artificial intelligence; 2018 [cited 2020 Jun 26] Available from: <https://niti.gov.in/national-strategy-artificial-intelligence>.
- Tzachor A, Whittlestone J, Sundaram L, Ó hÉigeartaigh S. Artificial intelligence in a crisis needs ethics with urgency. *Nat Mach Intell* 2020;2:365–6. <https://doi.org/10.1038/s42256-020-0195-0>.