**Globalizing artificial intelligence for improving clinical practice**

Md Mahbub Hossain, Rachit Sharma, Abida Sultana, Samia Tasnim, Farah Faizah

***Abstract:***

*Application of artificial intelligence (AI) technologies is facilitating clinical care in many developed countries. These technologies offer benefits including reduced cost and improved clinical outcomes. However, critical challenges exist in continuously evolving AI systems necessitating regulatory approaches for optimal development of AI in clinical care. Recent guidelines and frameworks have outlined several directions for using AI in developed nations whereas developing countries continue to experience digital divide. These nations have fewer resources to address multifaceted burden of diseases. Using AI can potentially improve clinical care in these resource-constrained contexts. Future strategic and regulatory approaches should adopt a global vision to use AI in clinical settings around the world by building capacities and strengthening collaborations.*

**Keywords:** Artificial intelligence; telemedicine; global health; clinical care

Artificial intelligence (AI) technologies are facilitating modern healthcare organizations to leverage the power of big data in clinical practice [1]. In most cases, AI-based systems improve clinical decision-making using multiple layers of information and pre-specified algorithms [2]. In addition, recent AI technologies like machine learning can learn from existing data and perform predictive operations resulting in robust performance in clinical settings [1,2]. Studies have shown high accuracy of AI-based systems in clinical practice across different specialties. Earlier advancements in AI focused on providing diagnostic support by matching pre-stored images of radiological [3] or histological specimens [4]. More recent studies have shown how AI-driven decision-making systems can improve medical and surgical activities with better precision in delivering health services [1,5].

Such innovations are likely to serve the healthcare industry by minimizing humanistic errors, savings costs, and maximizing informed decision-making [2]. However, there are ongoing debates on replacing health workforce with technological interfaces and affecting the humane aspect of providing healthcare [6]. Moreover, the safety and efficacy of AI technologies are not empirically evaluated in the case of most of the clinical conditions [1]. These issues suggest a more careful analysis of different ethical aspects before adopting AI in clinical practice. In this discourse, many countries have started developing their guidelines and regulatory frameworks for using AI in clinical practice. For example, *High-Level Expert Group on AI* of the European Commission has presented "Ethics guidelines for trustworthy AI," which proposed that the development of AI should be lawful, ethical, and robust [7]. Another framework developed by the National Institute for Health and Care Excellence in the UK focuses on economic impacts and clinical effectiveness of digital health technologies, including AI [8]. Moreover, AI-based systems are continuously evolving, for which it is essential to maintain the balance between technological advancements and safety of using the same for clinical operations. A recent regulatory framework by the US Food and Drug Administration (FDA) acknowledges this issue and argues future modifications of AI-bases technologies should emphasize on safe and effective use among the users [9]. While such guidelines are essential for optimal development and implementation of AI-based clinical systems, most of these guidelines have local or regional scopes rather than a global vision. In the era of continued globalization, it is critical to recognize the pre-existing digital divide among global nations, how it can aggravate by newer technologies like AI, and how future advancements should address these challenges.

Digital health technologies are increasingly being used to strengthen health systems in many low- and middle-income countries. However, very few of those technologies are applied in clinical settings among these countries. Two systematic reviews of mHealth interventions in India and China have shown slow and limited advancements in using digital technologies for population health [10,11]. In such resource-constrained contexts, AI-based clinical systems are likely to arrive late and incur high price to the users or health systems to adopt the same. In addition, developing nations do not have adequate resources to pursue advanced research and development in the field of AI and other advanced technologies. Therefore, a digital divide continues to exist between the developed and developing nations.

Furthermore, clinical practice guidelines are diverse across contexts and populations. In this scenario, new guidelines for AI in different countries may add more complexities in clinical practice globally. Interestingly, such crises can be prevented through AI technologies can be used to reduce the complexities and improve the clinical practice given an integration of AI in clinical settings under uniform guidelines all over the world. In this process, the AI-based systems will be exposed to diverse and big data essential for training and testing, yielding better precision in clinical decision-making in different contexts. Moreover, the use of AI in integrating genomic, epigenetic, and behavioral data can better inform personalized diagnosis and treatment across populations [2]. Furthermore, AI can be used to analyze and integrate the economic, political, and technological considerations in clinical practice, which can help in achieving sustainability in global health systems [1,5].

To unleash these opportunities, a global vision for developing and using AI in clinical practice is essential. It can be achieved by fostering collaboration between scholars and institutions across the globe with a focus to the developing countries which have a more significant proportion of the global burden of diseases. Without advancing medical education in the era of digital health, clinical practitioners may not achieve the competencies to serve within a technologically advanced healthcare ecosystem. Therefore, capacity building should be focused both for the development and use of AI-driven clinical systems around the world. Global stakeholders can address this challenge by promoting digital health education, developing capacities in AI-based clinical research, informing widespread adoption of AI across health systems, and utilization of AI in clinical practice. Recent initiatives by the World Health Organization (WHO) and the International Telecommunication Union (ITU) for benchmarking AI in healthcare offer promises to improve the AI-driven processes and outcomes [12]. As the guidelines and benchmarking procedures are currently under development, adopting globalized approaches within these efforts may set better directions to the future technological advancements in healthcare. Such collegial vision can facilitate overcoming the existing digital health challenges and prevent future disparities in AI-based clinical practice.

***Funding:*** *No funding was received at any stage of preparing this letter.*

***Conflicts of interest:*** *We declare no conflict of interest.*

**References**

1. Jiang F, Jiang Y, Zhi H, Dong Y, Li H, Ma S, et al. Artificial intelligence in healthcare: past, present and future. Stroke Vasc Neurol [Internet]. 2017 Dec [cited 2019 Aug 6];2(4):230–43. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29507784

2. Shahid N, Rappon T, Berta W. Applications of artificial neural networks in health care organizational decision-making: A scoping review. PLoS One [Internet]. 2019 [cited 2019 Aug 6];14(2):e0212356. Available from: http://www.ncbi.nlm.nih.gov/pubmed/30779785

3. Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJWL. Artificial intelligence in radiology. Nat Rev Cancer [Internet]. 2018 [cited 2019 Aug 6];18(8):500–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29777175

4. Djuric U, Zadeh G, Aldape K, Diamandis P. Precision histology: how deep learning is poised to revitalize histomorphology for personalized cancer care. npj Precis Oncol [Internet]. 2017 Dec 19 [cited 2019 Aug 6];1(1):22. Available from: http://www.nature.com/articles/s41698-017-0022-1

5. Lynn LA. Artificial intelligence systems for complex decision-making in acute care medicine: a review. Patient Saf Surg [Internet]. 2019 Dec 1 [cited 2019 Aug 6];13(1):6. Available from: https://pssjournal.biomedcentral.com/articles/10.1186/s13037-019-0188-2

6. Meskó B, Hetényi G, Győrffy Z. Will artificial intelligence solve the human resource crisis in healthcare? BMC Health Serv Res [Internet]. 2018 Dec 13 [cited 2019 Aug 6];18(1):545. Available from: https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-018-3359-4

7. European Commission. Ethics guidelines for trustworthy AI | Digital Single Market [Internet]. 2019 [cited 2019 Aug 6]. Available from: https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai

8. National Institute for Health and Care Excellence. Evidence Standards Framework for Digital Health Technologies Contents [Internet]. 2019 [cited 2019 Aug 6]. Available from: https://www.nice.org.uk/Media/Default/About/what-we-do/our-programmes/evidence-standards-framework/digital-evidence-standards-framework.pdf

9. Food and Drug Administration. Proposed Regulatory Framework for Modifications to Artificial Intelligence/Machine Learning (AI/ML)-Based Software as a Medical Device (SaMD)-Discussion Paper and Request for Feedback [Internet]. 2019 [cited 2019 Aug 6]. Available from: https://www.fda.gov/downloads/medicaldevices/deviceregulationandguidance/guidancedocuments/ucm514737.pdf.

10. Bassi A, John O, Praveen D, Maulik PK, Panda R, Jha V. Current Status and Future Directions of mHealth Interventions for Health System Strengthening in India: Systematic Review. JMIR mHealth uHealth [Internet]. 2018 Oct 26 [cited 2019 Jul 30];6(10):e11440. Available from: http://mhealth.jmir.org/2018/10/e11440/

11. Tian M, Zhang J, Luo R, Chen S, Petrovic D, Redfern J, et al. mHealth Interventions for Health System Strengthening in China: A Systematic Review. JMIR mHealth uHealth [Internet]. 2017 Mar 16 [cited 2019 Aug 6];5(3):e32. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28302597

12. International Telecommunication Union (ITU). ITU-WHO Workshop on Artificial intelligence for health [Internet]. 2018. [cited 2019 Aug 6]. Available from: https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180925/Pages/default.aspx