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REPORT

Reframing artificial intelligence for global health equity and ethics

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ABSTRACT

Artificial intelligence (AI) drives rapid changes in health systems and services worldwide. However, the speed of change in health technology and research is not always followed by the same speed of change in educational, legal, societal, and ethical aspects. AI has a huge potential to decrease global health inequities. Yet, it also carries risks that might widen disparities. This report presents some of the literature findings and discussion regarding AI, health equity, and ethics. Related to this, core determinants of health equity in the AI era were discussed in light of medical ethics, and public health principles and recommendations were developed with a special focus on increased community participation, educational reforms, and alignment with global sustainability efforts. The main discussion points and recommendations were summarized in a figure and a table, created by the co-authors. Current literature suggests that implementing secure data storage, transparent quality assurance mechanisms, and continuous monitoring and evaluation of newly introduced AI tools, including their effects on public and environmental health outcomes, health equity, and ethics are needed for future policies and practices. Health professionals, researchers, policymakers, and businesses need up-to-date guidelines, regulations, and tools to enable the development and use of AI solutions to promote health equity, including principles of medical and public health ethics. Community engagement in designing, implementing, and evaluating AI solutions is crucial, especially to ensure that populations with vulnerabilities are not left behind.

Keywords: Artificial intelligence, Global health, Health equity, Ethics, Community participation

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INTRODUCTION

The ability of a machine to create judgments and insightful opinions-even when the available data is incomplete or unclear-is known as artificial intelligence[1]. Artificial intelligence (AI) can be broadly categorized into three types: functional, intellectual, and architectural. The latter two are more advanced and have a wider range of applications. Artificial Narrow Intelligence (ANI), which focuses on a single, repetitive task that may be automated by bots, is the most basic kind of AI. Artificial general intelligence, or AGI, possesses cognitive abilities comparable to those of humans. Unlike ANI, this kind of intelligence is not limited to a single, specific activity but rather concentrates on a wider range of areas1. Artificial super intelligence, a more advanced version of AI, will eventually emerge as a result of AGI and Deep Learning's capacity to give AI the propensity to seek out new information and progress on its own[1].

AI, described as the fourth industrial revolution, drives rapid changes in health systems and services worldwide. AI can bridge critical gaps in health care, including strengthening surveillance and supply chain optimization[2], supporting pandemic preparedness and response, informing the decisions of health policymakers and allocating resources within health systems[3]. According to the literature, some of the AI-based examples in practice include computer vision-assisted mammograms to improve the detection of breast cancer, models to identify respiratory decompensation in COVID-19 patients, and AI tools to predict the length of hospital stay, facilitate health resource allocation, and lower healthcare costs[4-7]. In the US, The Centers for Disease Control and Prevention (CDC) is working on new applications of AI and machine learning (ML) for public health, such as estimating trends in opioid overdose-related mortality, using natural language processing methods on foodborne outbreak data, and using large language models to improve syndromic surveillance[8].

AI can help populations have easier access to trustworthy health information in different languages and assist health professionals in making better decisions. This opportunity is significant in a world with increased human mobility, including health systems challenged by the rapid forced displacement of populations for various reasons, including conflicts, climate change, and related disasters.

With gained momentum in health research, AI can help accelerate the generation of new scientific evidence in a much shorter time with big data sets, in addition to identifying patterns of health disparities and taking appropriate measures to avoid future inequities. On the other hand, the speed of change in health technology and research is usually not followed by the speed of change in educational, legal, societal, and ethical aspects. AI has a huge potential to decrease global health inequities. Yet, it also carries significant risks that might widen disparities[9], especially in low- and middle-income countries and for populations with vulnerabilities including children, women, young people, the elderly, persons with disabilities, minorities, stigmatized populations, people living in poverty, and those affected by the digital divide. While AI has the potential to improve health systems, a scoping review by Murphy et al.[10], suggests that its introduction should be approached with cautious optimism.

METHOD

This report was prepared based on some of the key peer-reviewed and grey literature including key guidelines of the World Health Organization, CDC and USAID, in addition to the authors' framing of important factors to consider regarding achieving global health equity in the age of AI. The method used in this paper was exempt from ethics committee approval.

RESULTS

AI Building Blocks in Global Health include information processing, computer vision, speech

recognition, natural language processing, machine learning, planning and exploring agents, image generation, speech generation, automatic handling of objects, autonomous movement and navigation informed by AI[11]. AI use cases in healthcare are very diverse including surveillance, prediction, and population risk management in public health, capacity planning and health personnel management, quality assurance and training in health systems, as well as clinical diagnosis and treatment support including AI facilitated patient monitoring and surgeries[11].

AI has a huge potential to achieve better public health outcomes with fewer resources and time, however, AI also has the risk of having adverse effects on global health equity if some of the key determinants of health and equity are not considered by policymakers, donors, businesses, health professionals, researchers, and other stakeholders. In their editorial paper, Farhud and Zokaei[12] defined AI as a double-edged sword, emphasizing that besides ethical dilemmas and concerns about privacy, data protection, informed consent, and social gaps, lack of empathy and sympathy are significant challenges that we face while using current AI. Figure 1 summarizes core determinants of health equity in the age of AI.

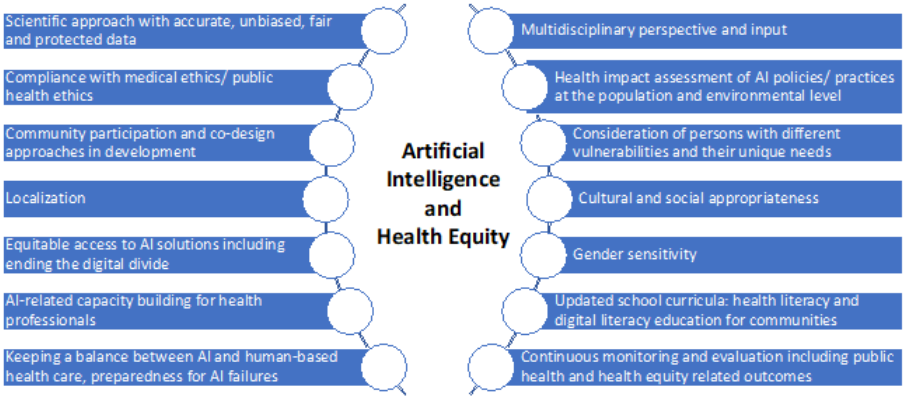


Figure 1. Core determinants of health equity in the age of AI (Karadag and Keskinbora, 2024)

As shown in Figure 1, AI solutions in global health need to be based on scientific rigor with accurate, unbiased, fair, and protected data and developed with a multidisciplinary approach, including but not limited to experts from public health, bioethics, social science, and communication science disciplines. Multidisciplinarity in development, implementation, and evaluation of AI solutions is crucial to ensure that solutions integrate perspectives of different scientific disciplines and that they respond to the real needs of health systems and communities.

Localization of solutions is also important, meaning AI solutions developed elsewhere need to be adapted to the local settings or developed locally, based on the local needs and context of countries.

From the sustainability perspective, health impact assessments might be beneficial and necessary before developing large-scale AI-based health policies, practices, and products at the community level. Depending on the health issue and context, compliance with medical and/or public health ethics during the development and implementation of AI tools is also crucial. To evaluate the viability and possible effects of AI-related policies, programs, or services targeted at fostering ethics and equity, advanced research studies using frameworks such

as the Ethics, Equity Feasibility, Acceptability Framework, developed by Ismail et al.[13] can be very beneficial.

These studies will assist in identifying obstacles, assessing available resources, and formulating effective solutions to address health disparities and ethical issues, as well as the feasibility and acceptability of innovations[13].

Since choices about the distribution of resources, the order of importance of interventions, and methods of execution can have a big impact on people's lives and communities, the incorporation of ethical principles is crucial in these initiatives. Real and lasting progress in global health equity requires that these choices are made with ethical values like justice, fairness, and regard for human dignity in mind.

As shown in Figure 1, the level of equity in access to AI technologies is another important dimension that requires careful assessment before introducing these new technologies in different countries or regions. AI might harm global health equity if the solutions are only available in high-resource settings, if they are not localized in different country contexts and/or adapted to the needs of different communities.

In lower-resourced settings, certain AI technologies may not be available and this resulting privilege bias may create an access barrier for disadvantaged communities. Historical exploitation and unethical practices also negatively impact certain patients' perceptions of new methods of health care. These patients may not trust new technologies and avoid seeking health care, thus increasing the health disparities that the models aim to tackle[14,15]. Essentially, a comprehensive strategy that puts the rights and well-being of people and communities first, encourages communication and cooperation amongst stakeholders, and respects the values of justice, fairness, and human dignity is needed to enable equitable access to AI technologies.

Health records contains highly personal and sensitive data. When AI is used to analyze this data, patients' privacy must be protected. In this context, techniques such as data anonymization and encryption need to be used more effectively to ensure trust between service providers and users. Clear consent mechanisms for patients on how their data is used should be developed. AI systems' decision-making processes are sometimes seen as a "black box" because it can be difficult to understand how these processes work. Transparency is especially important for building trust between service users and healthcare professionals.

According to the World Health Organization (WHO) (2021), patients and communities require assurance that their rights and interests will not be subordinated to the powerful commercial interests of technology companies or the interests of governments in surveillance and social control[4]. AI technologies should also be intelligible or understandable to developers, medical professionals, users, and regulators, which can be achieved by improving the transparency of new technologies and making these technologies explainable[4].

Unintended biases in algorithms, limited quality or accuracy of local training data, and inadequate privacy protocols can lead to inaccuracies and inequities in AI-based analysis of health-related data. In theory, bias can enter at any point during the AI lifecycle which moves from model development to validation and implementation, followed by maintenance and updates in the post-implementation period[5,10]. In current scientific literature, there are examples of bias regarding racial, ethnic, gender, and geographic disparities in clinical or public health problem selection, where research questions usually target health problems in majority populations due to unequal funding availability and/or interest in the problem by industry, academia, donors, and peer reviewers. In AI-based systems, we may also see bias in data collection, variable selection, algorithm development, and post-deployment steps.[5,16]

In this respect, ensuring that algorithms are accurate, objective, unbiased, and fair; in addition to protecting data and privacy for both health service users and providers is extremely important. Hence, an assessment of the potential impact of AI solutions on various aspects such as privacy, security, and bias is needed. Ensuring the cultural and social appropriateness of AI tools and AI-based systems, as well as having a gender-sensitive approach in all steps are also vital[3,10].

Recently, several research groups have published frameworks to reduce bias in healthcare-related AI and to improve research ethics. Among them, Abramoff et al. (2023) proposed an expanded Total Product Lifecycle framework for healthcare AI/ML, describing the sources and impacts of undesirable bias, and how these can be analyzed, and mitigated[17]. To prevent future bias and disparities in research, scientific journal editors could also require reporting of population demographics and diversity[18]. Shaw et al.[19] also described recommendations for governance leaders to enhance the ethical governance of AI in global health research.

We suggest that future assessments of new health technology should take into account the unique social, cultural, and economic circumstances of the target country or region to guarantee that the technology meets local standards, values, and requirements. To address issues of prejudice, discrimination, and improper use of AI technologies, procedures for accountability, transparency, and governance should be put in place. According to Birhane[20] and Johnson et al.[18], algorithmic systems never emerge in a social, historical, or political vacuum, so by merging intentional ethical principles and a health equity lens with data science, AI could learn to identify and address health inequities[13,20].

Overreliance on AI and ignoring in-person interactions, implementing AI solutions without adequate capacity-building of health professionals, and failing to empower communities with health literacy and digital literacy programs can lead to ineffective AI interventions as well as employment problems for health professionals, with waste of valuable human and financial resources.

As we navigate the AI era, education systems from preschool to higher education and beyond, need urgent adaptation to equip students across all levels with the knowledge and skills necessary to thrive in a rapidly evolving innovation landscape. This adaptation is particularly critical in fields such as medicine, nursing, public health, and other health sciences, where AI technologies have the potential to revolutionize health research and care. Curricula in these disciplines should include education about AI, machine learning, data science, and related technologies to ensure that students understand their capabilities, limitations, and ethical and public health implications. This includes teaching students how to critically evaluate AI algorithms, interpret AI-driven insights, and effectively integrate AI tools into clinical/public health practice and research, with a health equity perspective.

Furthermore, interdisciplinary collaboration between computer science, social sciences, communication sciences, and health sciences including public health and ethics, can stimulate creativity and advance the creation of AI-powered solutions to complicated health problems. Educational institutions may better equip aspiring health professionals to use AI technologies responsibly and ethically by including AI education in their curricula with a multidisciplinary perspective.

In summary, updating health sciences curricula to reflect the demands and opportunities of the AI era is essential for preparing the next generations to excel in their respective fields and contribute meaningfully to the health of populations and the environment, in a world affected by environmental pollution and climate change. According to WHO, AI should be consistent with global efforts to achieve sustainable development goals. Sustainability also requires

governments and companies to address anticipated disruptions in the workplace, including potential job losses due to the use of automated systems[4]. Governments and education institutions should also develop and update AI curricula in national education systems with ethical principles and plan regular and updated public communication and appropriate risk communication strategies regarding the use of AI in healthcare systems and beyond. Some of our education-related recommendations are as follows:

1. Incorporate ethics, health, and human rights across the school curriculum: This could involve discussing ethical and human rights considerations related to AI in health, science, mathematics, social studies, and literature classes among others.

2. Dedicated courses on AI ethics: These courses can cover topics such as bias and fairness in AI algorithms, privacy concerns, accountability, transparency, and societal, public health, and environmental health impacts of AI technologies.

3. Case studies and practical applications: Education programs can use real-world case studies and practical exercises to illustrate ethical dilemmas, public health problems, and decision-making processes related to AI, where students are encouraged to analyze these cases, debate different perspectives, and develop solutions grounded in ethical and public health principles.

4. Invite experts and stakeholders as guest speakers: Education institutions can invite AI professionals, ethicists, public health professionals, legislators, and impacted communities-to share their knowledge and experiences with students.

5. Promote ethical design and development: Education programs can instruct students on techniques of ethical design and encourage critical thinking and reflection, so that they may create AI systems that put inclusivity, accountability, transparency, and justice first.

6. Enable educators and practitioners to stay up-to-date on the most recent advancements in AI ethics, sustainability issues, and best practices by providing them with opportunities for professional development and continuing education programs.

In our rapidly changing world, we need more effort to promote inclusivity and equity in access to AI technologies, particularly for poor, disadvantaged, or marginalized communities that may be disproportionately affected by the digital divide. This could include initiatives to improve digital literacy, provide training and support for the application of AI technologies, and ensure affordability and accessibility of internet and digital tools.

When it comes to health systems, keeping a balance between AI and human-based health care will be crucial[3], since AI may not always be the most appropriate tool to respond to certain individual and public health needs. Also, AI solutions may not always be available or accessible, for instance in case of certain disaster or humanitarian situations. While AI has a great potential to strengthen preparedness and response for many types of health emergencies including disease outbreaks, and natural and human-made disasters, there might be severe crisis times when technology and the Internet are not available and health systems rely solely on health human resources. Climate change is one of the biggest threats to a stable environment for human beings and future scenarios should also consider unstable health systems with a severe energy crisis. In this respect, health systems and organizations at the national and international levels must always be ready to respond to health emergencies in traditional ways, based on an appropriately trained and adequate number of health professionals.

Another problem that can be encountered with full AI-utilizing or AI-adaptable systems for health care is AI failures. For prevention, backup AI systems that can be activated in case of primary system failures should be installed. Regular maintenance and updates should be

scheduled to keep the systems in optimal condition. In addition, Monitoring and Early Warning Systems should be developed to detect anomalies and alert human operators. Nevertheless, human operators should always be kept in the duty cycle of health service provision to supervise and intervene when necessary. This measure provides an additional layer of oversight and decision-making capability. Health professionals, researchers, policymakers, and private sector entrepreneurs need comprehensive guidelines, regulatory frameworks, training resources, and tools to ensure AI solutions are developed responsibly and are used in ways that promote health equity, including issues concerning medical and public health ethics[9,10]. Non-maleficence, beneficence, respect for patient autonomy, and justice are the core ethical concepts that underpin medical practice and patient care[21]. Table 1 summarizes key points to consider and implement in the AI era to promote health equity within the framework of medical ethics principles and public health (Keskinbora, 2019).

Table 1. Evaluation of AI within the framework of medical ethics principles and public health

Principles of medical ethics	**Description**	**Fundamental assessment in the context of ethics and public health**
Non-maleficence	Avoiding the harm, minimizing the risks	Consider risks and conduct risk analysis/health impact assessment of new AI policies, practices, and products at the population and environmental level.
Beneficence	Promoting well-being	Evaluate and choose the best solutions that promote the physical, mental, and social well-being of populations and the well-being of the planet.
Respect for autonomy	Right to exercise informed choices	Consider the priorities and values of individuals and populations, including the underserved, stigmatized, and marginalized, promote their active engagement in AI solutions, and keep people at the center of all decision-making.
Justice	Treating people with equal respect and consideration	Ensure health equity by fair distribution of and access to beneficial health tech, including opportunities for digital literacy and health literacy education for all.

(Adapted from Keskinbora KH. Medical ethics considerations on artificial intelligence. J Clin Neurosci 2019;64:277-282.)

At the global level, the WHO should have a leading and guiding role for countries with up-to-date statements, publications, and technical support regarding the integration of AI into the health systems in such a rapidly changing innovation ecosystem. WHO's Guidance on Ethics and Governance of AI for Health (2021) and further publications and statements are highly important to consider for all stakeholders, including the private sector[4]. According to WHO, we need a collective effort to design and implement ethically defensible laws and policies and ethically designed AI technologies. There are potentially serious negative consequences if ethical principles and human rights obligations are not prioritized by those who fund, design, regulate, or use AI technologies for health[4].

For inclusive policies and practices, community participation in developing, implementing, and evaluating AI solutions is also crucial, especially to ensure populations with vulnerabilities are not forgotten. Recently, co-design approaches have been emphasized more widely when it comes to the development of health policies and interventions at the community level, with a special focus on the inclusion of more vulnerable, disadvantaged, or underserved population groups in decision-making processes. Interactions between the AI models, clinicians, public health professionals, patients, communities, and health policy makers are extremely important[14].

CONCLUSION

The global health community has a significant role in protecting populations with different vulnerabilities and advocating for health rights and equity to achieve the goal of leaving no one behind. implementing secure data storage, transparent quality assurance mechanisms, and continuous monitoring and evaluation of newly introduced AI tools, including their effects on public and environmental health outcomes, health equity, and ethics are needed to for future policies and practices. In this respect, translational research approaches need more attention and funding at the national and international research landscapes. For surveillance and other health data collection systems, having segregated data on age, gender, socioeconomic status, legal status, chronic condition, and disability, as well as other determinants of health will be pivotal in ensuring inclusiveness in big data and in understanding which AI solution works and which needs improvement to achieve health and health equity for all, including more sustainable health systems in the long term.

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