BRIDGING THE GAP AND HARNESSING ARTIFICIAL INTELLIGENCE FOR RURAL HEALTHCARE EQUITY IN DEVELOPING COUNTRIES: A LEGAL PERSPECTIVE

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Abstract

The goal of artificial intelligence (AI) is to replicate human intelligence by fusing computer science with large datasets. AI subsets are being used in practically every area of surgery and medicine. By thoroughly describing the progress made so far, the current laws, the drawbacks in AI applications, the current state of AI integration, enduring difficulties, and creative solutions to overcome them, this review aims to highlight the importance of AI in healthcare settings in developing nations and draw attention to the need for a robust legislation. The doctrinal approach was adopted to discover healthcare inequities in developing countries, medical AI in rural countries healthcare, envisioning AI-driven healthcare in rural developing regions: a transformative framework, AI Governance and Regulatory Considerations in Healthcare, challenges and limitations, and the ways in which these challenges could be overcome with a view to fostering AI adoption in developing country healthcare systems. However, AI's growing role in diagnosis, prognosis prediction, and patient management, as well as hospital management and community healthcare, has improved the efficiency of the healthcare system as a whole, thereby giving room for the urgent need for a robust legislative framework for its governance. This is particularly true in developing nations with high patient loads and resource-constrained areas where patient care is frequently compromised as a result of inadequate provisions of the law to safeguard patients' rights and provide remedies in cases of medical malpractice. The complete use of AI in healthcare is, however, hampered by a number of obstacles, such as low acceptance rates, a lack of standardised norms, expensive equipment installation and maintenance, inefficient transportation, connectivity problems, and a dearth of adequate legislative framework. AI has a bright future in healthcare despite these obstacles. In poor countries, while it is recommended that healthcare practitioners have the necessary skills and knowledge to apply AI technology in healthcare, most importantly is also the need for developing countries to enact laws specifically made for its regulation.

Keywords: Healthcare system, Artificial Intelligence, Development, Healthcare Inequalities.

1.0. Introduction

In the quickly evolving field of computer science known as artificial intelligence (AI), computers are used to mimic human intellect in tasks like learning, memory, analysis, and even creativity[2]. Artificial Intelligence has been around for a while. In his 1950 paper 'Computing Machinery and Intelligence,' Alan Turing presented the concepts of machine learning, genetic algorithms, reinforcement learning, and the Turing test, which served as the foundation for his initial conceptualisation of artificial intelligence. In 1956, at a meeting held at Dartmouth College, AI was formally brought into existence[3].

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[2] Krittanawong C, Zhang H, Wang Z, Aydar M, Liang M, Li J, Meng Z, Li G, and Tang W, 'Artificial Intelligence in Precision Cardiovascular Medicine'. *Journal of the American College of Cardiology,* [2017] 69(23), 2657-2664. doi: 10.1016/j.jacc.2017.03.571

[3] Hamet P, Tremblay J, 'Artificial Intelligence in Medicine'. *Metabolism,* [2017] 69, 36–40.

AI was initially used in the healthcare industry as a medical diagnostic decision support (MDDS) system. Miller examined the development of MDDS systems between 1954 and 1993[4]. Warner et al. created a groundbreaking MDDS method in 1961 that could be applied to the detection of congenital cardiac conditions[5]. De Dombal et al. from the University of Leeds in the United Kingdom created one of the earliest MDDS systems that were utilised in practice for clinical diagnosis and simulation exercises in 1969[6]. Shortliffe created the MYCIN expert system in the early 1970s, which was used to determine which organisms were responsible for infectious infections and to recommend the use of antibiotics[7]. Numerous MDDS systems, including those for internal medicine, forensics, veterinary medicine, pathology, radiology, psychiatry, and other fields, had been developed by the 1990s[8]. Artificial Intelligence (AI) is revolutionising the healthcare industry in recent years due to the rapid development of computers, the internet, advanced statistics, machine learning, and neural networks, as well as the rise in wearable and handheld networked devices like smartphones and watches. Medical AI technology will be crucial to electronic health records (EHRs), diagnosis, treatment protocol development, patient monitoring and care, personalised medicine, robotic surgery, and health system management, however, AI robot used for medical practice won't be able to fully replace clinical work anytime soon[9].

In this article, we will first briefly discuss the potential of medical AI technology, followed by a study of healthcare disparities and quality in developing countries. Next, we look at how medical AI technologies like computer-assisted diagnosis and mobile clinical decision support systems (mCDSS) affect healthcare outcomes in developing countries' rural areas. Finally, we suggest a multilevel medical AI service network targeted at enhancing the accessibility and quality of rural healthcare services in developing nations, as well as promoting the development of medical AI technologies appropriate for rural application.

2.0. Rural Healthcare Inequities in Developing Countries

Particularly in emerging nations, achieving health fairness and raising the standard of healthcare for disadvantaged groups are crucial societal missions. A few governmental organisations, groups, and educational institutions have taken notice of this problem and are looking for answers[10]. Developing nations are those whose annual gross national income per capita is less than $11,905. Areas classified as rural have a population density of no more than 150 persons per square kilometre[11]. Rural populations in underdeveloped nations typically have lower life expectancies and worse health than their urban counterparts. One of the most significant socioeconomic determinants is poverty. Poor health status is directly caused by limited access to quality healthcare. The poor quality of healthcare in rural areas of developing nations is caused by a number of factors, including low public health spending, low health insurance coverage, a limited benefit package, a lack of facilities and medical professionals, inadequate training for healthcare workers, transportation issues, and more[12].

[4] Miller RA, 'Medical Diagnostic Decision Support Systems—Past, Present, and Future: A Threaded Bibliography and Brief Commentary'. *J Am Med Inform Assoc.* [1994] 1, 8–27.

[5] Warner HR, Toronto AF, Veasey LG, Stephenson SR, 'A Mathematical Approach to Medical Diagnosis. Application to Congenital Heart Disease'. *JAMA*, [1961] 177, 177–183.

[6] Horrocks JC, McCann AP, Staniland JR, Leaper DJ, Wilson DH, Computer-Aided Diagnosis: Description of an Adaptable System, and Operational Experience with 2,034 Cases.' *Br Med J.,* [1972] 2, 5–9.

[7] Shortliffe EH, *Computer-Based Medical Consultations: MYCIN. Artificial Intelligence Series* (New York: Elsevier Computer Science Library, 1976).

[8] de Dombal FT, Hartley JR, Sleeman DH, 'A Computer-Assisted System for Learning Clinical Diagnosis.' *Lancet.*, [1969] 1, 145–148.

[9] Miller DD, Brown EW, 'Artificial Intelligence in Medical Practice: The Question to the Answer?' *Am J Med.,* [2018] 131, 129-133.

[10] World Health Organization, Increasing Access to Health Workers in Remote and Rural Areas through Improved Retention: Global Policy Recommendations (2010). Available at www.who.int/hrh/retention/guidelines/en accessed 12 October 2024.

[11] Strasser R, Kam SM, Regalado SM, 'Rural Health Care Access and Policy in Developing Countries'. *Annu Rev Public Health,* [2016] 37, 395-412.

[12] Liu X, Tang S, Yu B, Phuong NK, Zhang Y, Tang C, Li J, Zhang T, Fan M, and Du X, 'Can Rural Health Insurance Improve Equity in Health Care Utilization? A Comparison between China and Vietnam.' *International Journal for Equity in Health*, [2012] 11(1), 10.

The lack of qualified healthcare professionals in rural areas is more acute in emerging nations than in industrialised ones. The reasons for this include a higher percentage of rural populations in these countries, relatively low wages, poor living and working conditions, excessive workloads, a lack of opportunities for professional development and continuing education, a lack of students from rural backgrounds, and a shortage of health workers nationwide[13]. In 2016, 68% of people in developing nations lived in rural areas (3.4 billion people), and this number is expected to rise and peak in the 2020s. The proportion of people living in rural areas in developed nations, however, was just 19% in 2016[14]. Asia and Africa are home to around 90% of the world's rural population, with China and India housing half of them (45%) with 857 million and 635 million inhabitants, respectively. The two countries with the greatest rural populations in Africa are Ethiopia (78 million) and Nigeria (95 million). In terms of India's doctor-to-population ratio, there were 1.71 doctors for every 1000 people in urban areas and 0.45 for every 1000 people in rural areas[15]. In China, the number of physicians per 1000 people was 1.33 in rural areas and 3.00 in metropolitan areas[16]. Africa has the worst scenario. In Ethiopia, the urban and rural doctor densities were 0.07 and 0.02 per 1000 people, respectively, whereas in Nigeria, they were 0.14 and 0.01 per 1000 people, respectively[17].

It is challenging to recruit and maintain top-notch healthcare professionals in rural areas because of the unfavourable working conditions. Many developing nations introduce shortened medical education programs or allow nurses to handle specific duties of medical practitioners in order to make up for the medical practitioner's shortage. For instance, China has a large number of junior medical colleges and secondary medical vocational schools where middle or high school graduates receive three years of medical education in order to become doctors. About 52% of doctors (2.9 million) in China in 2014 held less than a bachelor's degree, and the majority of them worked in rural areas. The acute need for health workers in rural areas can be sufficiently met by this; however these doctors lack the necessary medical knowledge and expertise[18].

Rural doctors lack the assistance of other healthcare professionals, such as specialists, chemists, and lab technicians, even if they possess the necessary training and expertise. They typically have to offer a greater range of services in these circumstances. Medical services will be of worse quality as a result of this professional isolation and differing scope of practice[19]. Today, the field of medicine is expanding quickly. The obstacles to ongoing education and professional development prevent rural physicians' expertise from being updated and enhanced[20].

As a result, rural parts of emerging nations have poor healthcare quality. The maternal mortality ratio, or MMR, is commonly recognised as a broad measure of the standard of healthcare in a community. The International Labour Organisation reports that the global MMR in rural regions is 29 deaths per 10,000 live births, while in urban areas it is 11 deaths. The MMR in Asia and the Pacific was 18 deaths

[13] *Ibid* (n 10).

[14] International Labour Office, Global Evidence on Inequities in Rural Health Protection: New Data on Rural Deficits in Health Coverage for 174 Countries (2015). Available at www.social protection.org/gimi/gess/RessourcePDF.action?ressource.ressourceId = 51297 accessed 12 October 2024.

[15] World Health Organization. The Health Workforce in India. 2016. Available at www.who.int/hrh/resources/16058health_workforce_India.pdf accessed 12 October 2024.

[16] Zhou K, Zhang X, Ding Y, Zhang Y, Wang D, Lu Z, Xu L, Wang W, Guo X, Chen L, Chen C, Ou J, Yan F, Li J, Gong Y, and Hu C, 'Inequality Trends of Health Workforce in Different Stages of Medical System Reform (1985–2011) in China.' *Human Resources for Health,* [2015] 13(1), 94.

[17] The World Bank. The Labor Market for Health Workers in Africa (2013). Available at https://openknowledge.worldbank.org/bitstream/handle/10986/13824/82557.pdf?sequence=5 accessed 10 October 2024.

[18] Zhu J, Li W, Chen L, 'Doctors in China: Improving Quality through Modernisation of Residency Education'. *Lancet.*, [2016] 388, 1922–1929.

[19] *Ibid* (n 10).

[20] Wilson NW, Couper ID, De Vries E, Reid S, Fish T, and Marais BJ, 'A Critical Review of Interventions to Redress the Inequitable Distribution of Healthcare Professionals to Rural and Remote Areas.' *Rural and Remote Health,* [2009] 9(2), 1060.

per 10,000 live births in rural regions and 8 deaths per 10,000 live births in urban areas. The MMR was as high as 55 deaths per 10,000 live births in rural Africa, but it was only 29 in urban settings. On the other hand, there is no difference between urban and rural locations, and the MMR is extremely low in developed areas. For instance, the MMR in North America was two deaths for every 10,000 live births in both urban and rural areas[21].

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3.0. Medical AI in Rural Countries Healthcare

As was previously said, there are often few qualified doctors in rural areas of developing nations, therefore nurses or other paramedical health professionals must handle a high volume of patients. But the majority of issues were straightforward, recurring, and manageable with a few necessary, safe medications. Medical AI technology was first referred to as computer-assisted medical technology. The Early Detection and Prevention System (EDPS), a computer-assisted diagnostic tool, was created in India in 1998 for use in remote clinics without a doctor. For nurses or other seasoned paramedical staff, the system offered advice and suggestions. According to a study by Bangalore, India's Kempegowda Institute of Medical Science, 933 patients had an overall consistency rate of 94% between the EDPS and doctors. According to a different study, patients responded favourably to the computer system because they thought it was more accurate and had more in-depth interactions with them than other medical professionals they had seen. Additionally, the village health nurses expressed interest in implementing this system in their practice[23].

Any mobile electronic device—including smartphones, computers, iPads, and wearable technology—that offers medical advice to healthcare professionals in order to enhance the standard of care is referred to as mCDSS. Adepoju et al. conducted a thorough analysis of mCDSS utilisation in sub-Saharan African rural areas. A few studies have demonstrated positive impacts, such as a notable improvement in healthcare outcomes and a decrease in the overprescription of antibiotics, despite the lack of evidence that the mCDSS may raise the general standard of healthcare in sub-Saharan Africa. Additionally, they discovered that health professionals thought the mCDSS may boost their productivity, competence, and self-confidence at work, and that the systems could enhance patient-provider relationships by fostering greater trust and confidence[24]. Olajubu et al. came to the conclusion that if this system were fully developed and properly implemented, it would help expand access to healthcare from urban regions to rural ones, which would lower the number of casualties in developing nations' vulnerable areas, particularly in Sub-Saharan Africa[25].

Medical AI technology has recently been used to improve healthcare in rural China. An 11-pound portable all-in-one diagnostic unit that can do 11 tests, such as electrocardiographs, blood pressure checks, and regular blood and urine analysis, has been utilised in village healthcare settings, according to a South China Morning Post news story. Developed by a national rural healthcare program-supported internet healthcare startup, this device can automatically upload medical information and outcomes to an online data analysis system and produce a diagnosis that village health personnel may evaluate and refer to. A number of major Chinese technology companies are

[21] International Labour Office, Global Evidence on Inequities in Rural Health Protection: New Data on Rural Deficits in Health Coverage for 174 Countries (2015). Available at www.social-protection.org/gimi/gess/RessourcePDF.action?ressource.ressourceId=51297 accessed 9 October 2024.

[22] *Ibid*

[23] Friedman EA, 'Computer-Assisted Medical Diagnosis for Rural Sub-Saharan Africa.' *IEEE Technol Soc.,* [2009] 23, 18-28.

[24] Adepoju IO, Albersen BJ, De Brouwere V, van Roosmalen J, Zweekhorst MBM, Businge JB, Okonofua FE, Arulogun OS, Odujinrin OT, Adejumo OA, Adeyemi AB, Dijkstra PO, and van der Kwaak A, 'mHealth for Clinical Decision-Making in Sub-Saharan Africa: A Scoping Review.' *JMIR mHealth and uHealth,* [2017] 5(3), e38.

[25] Olajubu EA, Odukoya OH, and Akinboro SA, 'LWAs Computational Platform for E-Consultation using Mobile Devices: Cases from Developing Nations'. *Technol Health Care,* [2014] 22, 561–571.

also investing in AI-powered smart clinics for rural areas. One such example is Chabot, which can interact with patients, offer medical advice, and train healthcare professionals online[26].

Many AI-driven solutions have been created for specific diseases in rural areas, in addition to the use of AI technology in primary health settings. To screen for upper gastrointestinal tumours, for instance, a cheap, swallowable endoscopic capsule with AI analytical technology can be utilised, replacing pricy or challenging conventional screening tools. Since most incidences of stomach cancer occur in rural parts of underdeveloped nations, this device is especially well-suited for these places[27]. Additionally, acute leukaemia is a malignant condition, and the effectiveness of treatment depends on determining the type or subtype of leukaemia. However, most hospitals in developing nations lack access to advanced treatments, which are very costly. Based on the morphological characteristics of bone marrow pictures, Escalante et al. demonstrated a very successful AI technique for classifying acute leukaemia. In developing nations, this technique might offer an alternative to pricey diagnostic techniques[28]. Furthermore, because there aren't enough qualified neurologists in poor nations, a significant percentage of instances with peripheral neuropathies go undetected because of their complexity. According to Kunhimangalam et al., a new AI clinical decision support system could offer medical advice on peripheral neuropathies' diagnosis and course of therapy. The accuracy of this technique was 93.3% when compared to the opinions of experts. In the absence of professionals, this method offers a solution for patients with peripheral neuropathies living in remote areas[29]. Additionally, a new automated AI diagnostic method based on a mobile device was published by Oliveira et al. It can identify malaria by analysing peripheral blood samples stained with Giemsa and light microscopy images. On average, the system's accuracy was 91%[30]. According to the aforementioned instances, low-cost diagnostic instruments that substitute more costly or challenging traditional screening equipment that is unavailable in rural areas can help solve accessibility hurdles in developing nations' rural areas.

In this way, medical AI technology can not only lower medical expenses and increase the effectiveness of physicians, but it can also be trained to be used by nurses and paramedical health workers to make up for a shortage of physicians. But only having a few medical AI tools, like a portable all-in-one diagnostic station or a mCDSS, is insufficient. An effective medical AI system needs a number of supports, including infrastructure (such as internet and electricity), ongoing training, supervision, funding, technical advancements, and supportive public health policies, in order to raise the general standard of healthcare services in rural areas of developing nations[31]. As a result, we provide in this article a thorough multilayer medical AI service network designed to raise the standard and accessibility of healthcare services in developing nations' rural areas.

Envisioning AI-Driven Healthcare in Rural Developing Regions: A Transformative Framework

There is the need for a multilevel medical AI service network, and given the circumstances in rural locations, the medical AI system ought to be created especially for them. In order to accomplish this, we will now outline the multilevel medical AI service network.

[26] South China Morning Post. A look at how China is using technology to improve rural access to quality health care. 2018. Available at www.scmp.com/tech/article/2135880/look-how-china-using-technologyimprove-rural-access-quality-health-care accessed 9 October 2024.

[27] Caprara R, Obstein KL, Scozzarro G, Dinelli M, D'Errico G, Mangone M, Baldi A, De Luca V, Ciandrini A, Morini A, Ricciardi W, and Boccia S, 'A Platform for Gastric Cancer Screening in Low- and Middle-Income Countries'. *IEEE Transactions on Biomedical Engineering*, [2015] 62(5), 1324-1332.

[28] Escalante HJ, Montes-y-Gómez M, González JA, Forestier G, Grisel O, Macé P, Jourdan L, Sebag M, Dorado J, García RB, and Alayón S, Acute Leukemia Classification by Ensemble Particle Swarm Model Selection'. *Artificial Intelligence in Medicine* [2012] 55(3), 163-175.

[29] Kunhimangalam R, Ovallath S, Joseph PK, 'A Clinical Decision Support System with an Integrated EMR for Diagnosis of Peripheral Neuropathy.' *J Med Syst.*, [2014] 38, 38.

[30] Oliveira AD, Prats C, Espasa M, López-Rubio A, Reyes M, Fernández-Montoy C, Martínez-Pérez JE, and Cobo J, 'The Malaria System MicroApp: A New, Mobile Device-Based Tool for Malaria Diagnosis'. *JMIR Research Protocols*, [2017] 6(4), e70.

[31] *Ibid* (n 23).

(1) **Frontline Medical AI System at the Basic Level:** The most basic rural healthcare facilities, such village or private clinics, will make use of this approach. The following characteristics are necessary for this system due to the following factors: poor general economic conditions, inconvenient transportation, a lack of or unstable communication and electric power facilities, limited training of medical staff, and relatively simple ailments:
   (a) A clinical decision support system that is both practical and affordable, with a primary focus on common diseases. Only referrals can be made for severe or complex illnesses;
   (b) affordability; no more than $500 to $1000 should be spent;
   (c) a sturdy, compact design that makes it simple to pull or carry and can be fitted with watertight, sand, shock, and moisture protection;
   (d) connection; outfitted with a range of networking techniques (such as cable, wireless, and telephone lines) for information transfer and system enhancements;
   (e) outfitted with a hand-cranked generator or a rechargeable battery; and
   (f) an intuitive operating interface that needs little training[32]. Generally speaking, a laptop plus a portable diagnostic device make up this system's primary setup[33]. Simple medical diagnosis, including blood, urine, ECG, and other standard tests, can be made with the diagnostic tools. An AI medical package that includes EHRs, diagnosis analysis, and advising systems is installed on the laptop.

(2) **Regional Medical AI Support Centres at the Middle Level:** These could be installed in state or provincial hospitals as well as local hospitals. These are primarily responsible for teaching primary health professionals, collecting and reporting epidemiological data from primary EHRs, and maintaining, repairing, and upgrading frontline medical AI systems. In order to treat patients with severe and complex ailments, these facilities may also be outfitted with specialised medical AI systems.

(3) **National Medical AI Development Centre, at the Highest Level:** Its responsibilities include promoting international collaboration and coordinating the advancement, promotion, and modernisation of medical AI systems across the country. Multiparty collaboration is required to guarantee the success of this multilevel medical AI service network. Government agencies are in charge of funding and managing the system; charities and nonprofits can assist in raising money; medical research institutes and universities can design suitable medical AI systems; medical equipment manufacturers will be in charge of producing the systems; and, lastly, local health agencies and medical organisations will be in charge of promoting the system. Maintaining this system's updates and keeping up with the most recent advancements in medicine requires constant cooperation.

AI Governance and Regulatory Considerations in Healthcare

A number of laws, principles and guidelines have been developed for the application of "ethical" AI in the area of healthcare[34]. The application of AI is also subject to other standards, guidelines, and frameworks, such as regulatory requirements, bioethics laws and policies, human rights commitments, and data protection regulations. Meanwhile, the WHO Expert Group reached a consensus on a set of guiding principles which serve as the foundation for the regulation for the use and application of AI[35]. They are discussed as follows:

Artificial Intelligence and Human Rights

The Universal Declaration of Human Rights, the International Covenant on Economic, Social, and Cultural Rights (including General Comment No. 14, which defines the right to health), the

[32] *Ibid* (n 18).
[33] *Ibid* (n 34).
[34] A Jobin, M Ienca and E Vayena, 'The Global Landscape of AI Ethics Guidelines'. *Nat Mach Intell.* [2019] 1: 389-99.
[35] Ethics and governance of artificial intelligence for health: WHO guidance. Geneva: World Health Organization; 2021.

International Covenant on Civil and Political Rights, and regional human rights conventions like the African Charter on Human and People's Rights, the American Convention on Human Rights, and the European Convention on Human Rights all reflect efforts to list human rights and to strengthen their observance through explicit legal mechanisms. Not every developing country has ratified important human rights documents; some have signed but not ratified charters or have voiced concerns about specific clauses. However, generally speaking, national laws like constitutions or human rights laws uphold the human rights enumerated in international instruments, which set a standard for the defence and advancement of human dignity globally.

While machine learning systems have the potential to improve human rights, they also run the risk of undermining fundamental human rights norms. Regarding the relationship between AI and human rights realisation, the Office of the High Commissioner for Human Rights has released a number of opinions. According to the Office's March 2020 guidance, AI and big data can enhance the human right to health when "new technologies are designed in an accountable manner." These technologies could guarantee that some vulnerable populations receive effective, customised care, including robotics, assistive devices, and built-in environmental applications[36]. The Office further stated that such technology could dehumanise care, damage older people's autonomy and independence, and pose major threats to patient privacy, all of which violate the right to health[37]. In a speech to the Human Rights Council in February 2021, the United Nations Secretary-General raised a number of human rights concerns about the growing collection and use of data on the COVID-19 pandemic and urged governments to "place human rights at the centre of regulatory frameworks and legislation on the development and use of digital technologies"[38]. Human rights organisations have interpreted and, where appropriate, altered existing human rights laws and standards for AI evaluation, and they are being reviewed in light of the problems and opportunities presented by AI in medical law. The Toronto Declaration[39] addresses the impact of AI on human rights and places it within the universally binding, actionable framework of human rights laws and standards; it establishes mechanisms for public and private sector accountability, protects people from discrimination, and promotes equity, diversity, and inclusion, all while ensuring equality and effective redress and remedy.

In 2018, the Council of Europe's Committee of Ministers published proposed recommendations to Member States about the impact of algorithmic systems on human rights[40]. The Council of Europe is looking into the feasibility and potential components of a legal framework for the development, design, and application of digital technologies in accordance with its human rights, democracy, and rule of law criteria. Most developing countries' legal frameworks for human rights, bioethics, and privacy apply to numerous areas of artificial intelligence for health. These include the Oviedo Convention on Human Rights and Biomedicine, which addresses ethical principles of individual human rights and responsibilities[41]; the Convention for the Protection of Individuals with Regard to

[36]Question of the Realization of Economic, Social and Cultural Rights in all Countries: The Role of New Technologies for the Realization of Economic, Social and Cultural Rights: Report of the Secretary General. Geneva: Office of the High Commissioner for Human Rights; 2020. Available at:
https://www.ohchr.org/EN/HRBodies/HRC/RegularSessions/Session43/Documents/A_HRC_43_29.pdf accessed 16 December 2024.

[37]*Ibid*.

[38]Secretary-General Guterres calls for a global reset to recover better, guided by human rights. Geneva: United Nations Human Rights Council; 2021. Available at: https://www.ohchr.org/EN/HRBodies/HRC/Pages/NewsDetail.aspx?NewsID=26769&LangID=E accessed 13 December 2024.

[39]The Toronto Declaration. Protecting the right to equality and non-discrimination in machine learning systems. Amnesty International and Access Now; 2018. Available at: https://www.torontodeclaration.org/declaration-text/english/ accessed 12 December 2024.

[40]Addressing the impact of algorithms on human rights. Strasbourg: Council of Europe' 2019. Available at: https://rm.coe.int/draft-recommendation-of-the-committee-of-ministers-to-states-on-the-hu/168095eecf accessed 16 December 2024.

[41]Convention for the Protection of Human Rights and Dignity of the Human Being with Regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine. Strasbourg: Council of Europe; 1997. Available at: https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId=090000168007cf98 accessed 16 December 2024.

Automatic Processing of Personal Data[42]; the Consultative Committee of Convention 108+[43] guidelines on the protection of individuals with regard to the processing of personal data in a world of big data; and Article 8 of the European Convention on Human Rights, which states that everyone has the right to respect for their private and family life, home, and correspondence[44].

Even with strong human rights standards, however, organisations and institutions in developing countries understand that new legislation and jurisprudence are needed to address the relationship between AI and human rights, as well as a better description of how human rights standards and protections connect to and apply to the use of AI in developing countries healthcare. The Council of Europe has prepared new legal recommendations. To ascertain the viability and possible components of a legal framework for the development and use of AI in accordance with the Council of Europe's standards on human rights, democracy, and the rule of law, the Council formed the Ad-hoc Committee on Artificial Intelligence in 2019–2020 to carry out extensive multi-stakeholder consultations. Furthermore, in 2019, the Council of Europe issued Guidelines on Artificial Intelligence and Data Protection[45], which are likewise based on the protection of human dignity, human rights, and basic freedoms.

Data Protection Laws and Policies

Data protection laws are "rights-based approaches" that establish norms for regulating data processing while also protecting individuals' rights and imposing obligations on data controllers and processors. Data protection regulations are now increasingly recognising that patients have the right not to be subject to choices based entirely on automated processes. Over 100 countries have passed data protection laws. The General Data Protection Regulation (GDPR) of the European Union (EU) is a well-known collection of data protection rules; in the United States, the Health Insurance Portability and Accountability Act of 1996 govern privacy and health data security.

Some regulations and guidelines are especially intended to govern the use of personal data for AI. For example, the Ibero-American Data Protection Network, which includes 22 data protection authorities in Portugal and Spain, Mexico, and other Central and South American and Caribbean countries, has issued General Recommendations for the Processing of Personal Data in Artificial Intelligence[46] as well as specific guidelines for compliance with the principles and rights that govern the protection of personal data in AI in medical situations[47].

Existing Laws and Policies Related to Health Data

Health data collection, processing, analysis, transfer, and usage are governed by a variety of laws and rules. The African Union's convention on cybersecurity and personal data protection (2014)[48] mandates that personal data involving genetic information and health research be processed only with the consent of the national data protection authority through the Personal Data Protection Guidelines

[42]Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data. Strasbourg: Council of Europe; 1981. Available at: https://rm.coe.int/1680078b37 accessed 12 December 2024.
[43]*Ibid*
[44]European Convention on Human Rights. Strasbourg: Council of Europe; 2010. Available at: https://www.echr.coe.Int/documents/convention_eng.pdf accessed 12 December 2024.
[45]Guidelines on artificial intelligence and data protection. Strasbourg: Council of Europe; 2019. Available at: https://rm.coe.int/guidelines-on-artificial-intelligence-and-data-protection/168091f9d8 accessed 13 December 2024.
[46] General recommendations for the processing of personal data in artificial intelligence. Brussels: Red IberoAmerica de Proteccion de Datos, European Union; 2019. Available at: https://www.redipd.org/sites/default/files/2020-02/guide-general-recommendations-processing-personal-data-ai.pdf accessed 16 December 2024.
[47] Specific guidelines for compliance with the principles and rights that govern the protection of personal data in artificial intelligence projects. Brussels: Red IberoAmerica de Proteccion de Datos, European Union; 2019. Available at: https://www.redipd.org/sites/default/files/2020-02/guide-specificguidelines-ai-projects.pdf accessed 16 December 2024.
[48] African Union Convention on Cyber Security and Personal Data Protection. Addis Ababa: African Union; 2014. Available at: https://au.int/en/treaties/african-union-convention-cyber-security-and-personal-dataprotection accessed 16 December 2024.

for Africa[49], and the Council of Europe's Committee of Ministers recommended to Member States in 2019[50] that health-related data be protected. In general, the African continent's digital transformation strategy[51] encourages African Union Member States to "have adequate regulation; particularly around data governance and digital platforms, to ensure that trust is preserved in the digitalisation". In February 2021, the African Academy of Sciences and the African Union Development Agency issued recommendations for data and biospecimen governance in Africa, promoting a participant-centered approach to research involving human participants while enabling ethical research practices on the continent and providing governance guidelines[52].
Data transit between countries is governed by laws outlined in trade agreements, intellectual property (IP) standards for data ownership, and the role of competition law and policy in data accumulation and control.

Challenges and Limitations of AI Adoption in Healthcare Systems of Developing Countries

Integrating AI into modern healthcare holds enormous promise, but it also introduces substantial obstacles, such as data privacy and security. These difficulties are particularly acute in underdeveloped countries. While using healthcare data to improve patient well-being has potential, it is critical to carefully manage this data to avoid harm to individuals and society[53]. AI frequently encounters the "frame problem," in which applications exhibit mistakes when employed outside their intended context due to certain fundamental algorithms[54]. Furthermore, human biases during AI model implementation can cause dataset changes based on gender, socioeconomic status, environmental factors, and ethnicity[55]. It is critical to recognise that information documented for a single demographic may not directly apply to minority populations, particularly those in rural locations, thereby leading to misdiagnoses and affecting patient care[56]. Furthermore, certain AI models may lack thorough clinical validation, making their effectiveness and reliability in real-world healthcare settings uncertain[57]. There are also no standardised norms or laws for the development and implementation of AI in healthcare. This can cause variances in quality and safety across different AI applications and populations, with underdeveloped countries being the most vulnerable to quality breaches.

AI systems may accidentally encourage needless testing or treatment based on algorithmic recommendations, increasing healthcare expenditures and perhaps harming patients. This could have a negative impact on poor countries' already overcrowded healthcare systems. Interpretable AI models are critical for medical decision support because they assist doctors and patients understand how and why AI systems make specific suggestions. However, interpretability alone is insufficient to guarantee the quality and safety of AI in healthcare. AI models must also be continuously evaluated

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and verified in real-world healthcare settings, where they may face a variety of problems and uncertainties. Studies have found issues such as improving data quality, training contextual AI models, and implementing strong privacy and ethical rules[58]. Regularly monitoring any performance concerns, such as errors, biases, or inconsistencies, and assuring the continued reliability and accuracy of AI systems is difficult, particularly in remote locations[59].

Clinicians in underdeveloped countries must comprehend how the proposed algorithms would improve patient care in their daily routines. Unfortunately, the majority of practitioners in developing nations lack experience, limiting the efficient application of AI. Furthermore, rural clinics frequently employ nurses and paramedics with limited training. However, current medical AI systems largely assist skilled doctors. As a result, there is an urgent need for a user-friendly operating system designed specifically for rural health workers, as well as educating rural health workers to properly use AI[60].

Even when AI-based healthcare is readily available in developing nations, its implementation is hampered by electricity and internet limits, both of which are significant obstacles in low- to middle-income countries. Furthermore, the installation and maintenance expenses of AI systems are substantial, therefore many AI advancements have yet to reach low-income countries due to a lack of financial infrastructure. For example, adopting a new robotic surgical platform might cost more than $1 million, with an additional 3,000-5,000 USD per surgical procedure[61]. Limited healthcare funds in developing countries frequently restrict them from purchasing many AI technologies needed by the rapid population[62].

Overcoming Challenges and Fostering AI Adoption in Developing Country Healthcare Systems

Strategic and coordinated initiatives can close the implementation gap in AI, especially in developing countries. Aderibigbe, Ohenhen, Nwaobia, Gidiagba, and Ani[63] highlight important tactics to deal with obstacles and encourage the widespread use of AI technologies. To them, filling in medical skill gaps is critical. Priority should be given to initiatives for education and capacity building in AI-related disciplines. This entails developing a culture of lifelong learning, offering professional training programs, and integrating AI courses into academic curricula. Knowledge transfer can be facilitated by collaborations between government agencies, business, and educational institutions.

At the other hand, to guarantee moral behaviour and inclusivity, complete AI policies must be developed. Frameworks that handle issues of bias, openness, and privacy should be established by governments. Diverse viewpoints are taken into account when stakeholders are included in the policy-making process, such as civil society, AI developers, and under-represented groups.
Furthermore, to keep up with developments, it is essential to support AI research and innovation. Innovation can be stimulated by establishing research centres, encouraging industry-academia ties, and awarding funds for projects centred on artificial intelligence. Localised research initiatives

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[62] *Ibid*
[63]Adebayo Olusegun Aderibigbe, Peter Efosa Ohenhen, Nwabueze Kelvin Nwaobia, Joachim Osheyor Gidiagba, and Emmanuel Chigozie Ani, 'Artificial Intelligence in Developing Countries: Bridging the Gap Between Potential and Implementation', *Computer Science & IT Research Journal*, [2023] 4(3), 185-199. DOI: 10.51594/csitrj.v4i3.629

guarantee that AI solutions are customised to meet the unique requirements and difficulties faced by developing nations. For AI to be implemented successfully, cooperation between the public and private sectors is essential.

Partnerships between the public and commercial sectors can make it easier to share data, resources, and expertise. By offering incentives to companies who invest in AI projects, governments may promote an environment that supports and encourages innovation.
Establishing credibility and encouraging community involvement are crucial elements of a successful AI deployment. There should be campaigns to increase public knowledge of the advantages and dangers of artificial intelligence. Local needs are met and cultural sensitivity is ensured by involving the community in decision-making processes.

International cooperation is essential since AI concerns are global in scope. Partnerships with international organisations, research institutes, and IT corporations can be advantageous for developing nations. Sharing best practices, collaborating on research initiatives, and exchanging knowledge all help close the AI divide. Targeted investment and assistance for AI-driven firms and entrepreneurs are necessary to advance inclusive growth. Incubators, mentorship programs, and easily accessible funding sources can enable regional innovators to create solutions that tackle particular problems in their regions.
Finally, stakeholders can cooperate to close the gap in AI implementation by utilising these tactics. In order to guarantee that the advantages of these advancements reach all facets of society in developing nations, the objective is to establish an atmosphere in which AI technologies support inclusive development.

Conclusion

Both the accessibility and quality of healthcare in rural areas of developing countries could be enhanced by medical AI technology. We suggest a multilayer medical AI service network to achieve this objective, comprising a national medical AI development centre (the top level), regional medical AI support centres (the middle levels), and a frontline medical AI system (the first level). To develop, promote, maintain, and improve the system, we advise governments, nonprofits, charities, university research institutions, and firms that provide medical equipment and artificial intelligence to work together continually. Additionally, the management of this initiative could be assigned to a permanent agency inside the government health sector. In order to enhance healthcare for patients in developing countries, we expect that this evaluation will serve as a reference for national government health departments, international organisations (such as the World Health Organisation and the International Labour Organisation), and other relevant organisations.