

ARTIFICIAL INTELLIGENCE, DATA PROTECTION, AND HEALTHCARE: AREAS OF CONVERGENCE AND DIVERGENCE

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ABSTRACT

The convergence of Artificial Intelligence (AI) and healthcare has revolutionized the medical landscape, offering unprecedented opportunities for improved diagnosis, treatment, and patient care. However, this symbiosis also raises critical concerns about data protection, privacy, and security. As AI systems increasingly rely on vast amounts of personal health data, the need for robust ethical and regulatory frameworks has become paramount. This paper navigates the complex intersections between AI, data protection, and healthcare, illuminating areas of convergence and divergence. Through a nuanced examination of the benefits and challenges of AI in healthcare, this paper will reveal the imperative for harmonizing technological innovation with human rights and dignity.

1.0. INTRODUCTION

The healthcare sector is witnessing a transformative moment and as Artificial Intelligence (AI) reshapes the contours of medical practice, research, and policy, we are faced with a critical question: *how do we harness the power of AI to improve patient care while also protecting the*

privacy and dignity of those patients? AI's potential to enhance patient outcomes, streamline clinical workflows, and unlock novel therapeutic approaches has captivated the imagination of healthcare professionals, researchers, and policymakers alike. Yet, this enthusiasm must be tempered by a sober recognition of the ethical and regulatory complexities that accompany the integration of AI in healthcare. The exponential growth of personal health data, coupled with AI's insatiable appetite for information, has created a perfect storm of concerns around data protection, privacy, and security.

This paper explores the intricate relationships between AI, data protection, and healthcare, seeking to disentangle the areas of convergence and divergence. By bringing to the fore the ethical, legal, and social implications of AI in healthcare, this paper aims to contribute to the ongoing discourse on responsible innovation, human rights, and the future of healthcare. This paper's inquiry is grounded in a deep respect for the human experience, acknowledging that the pursuit of technological progress must always be tempered by a commitment to human dignity, autonomy, and well-being.

1.1. UNDERSTANDING KEY TERMS

1.1.1. ARTIFICIAL INTELLIGENCE is a broad field of computer science that focuses on creating intelligent systems that can mimic human intelligence. These intelligent AI systems are designed to analyse data, learn from it, and make decisions or predictions based on that information. AI algorithms can be trained to recognize patterns, solve complex problems, and improve their performance over time.

Artificial intelligence is not one technology, but rather a collection of them. Most of these technologies have immediate relevance to the healthcare field, but the specific processes and tasks they support vary widely.¹ *Bird and Bird*² define artificial intelligence as software or programs able to perform operations similar to the human activity of learning and decision-making through the use of technologies based on processes of machine learning, deep learning, and neural networks. Consequently, AI includes bots (i.e. Robots), extends beyond that and encompasses a wide range of technologies, including *Machine Learning (ML)*³, *Natural Language Processing (NLP)*⁴, *Computer Vision*,⁵ and more with the aim to simulate human-like intelligence and perform tasks that traditionally require human cognition.

¹ Davenport, T., & Kalakota, R. (2019). The potential for artificial intelligence in healthcare. *Future healthcare journal*, 6(2), 94–98. <https://doi.org/10.7861/futurehosp.6-2-94>

² Bird & Bird LLP. *I Sistemi di Intelligenza Artificiale per la Diagnosi Medica*. London: Bird & Bird LLP (2022).

³ ML basically teaches a machine how to learn automatically from the given training data and improves its performance from the learned experiences.

⁴ NLP basically enables computers to comprehend human communication, in terms of speech and texts. It's a subfield of machine learning technology. NLP-trained computers can interpret, manipulate, and understand human language based on data from multiple communication sources, such as emails, text message, video, audio, social media feeds, etc.

⁵ Computer vision simply teaches computers to understand the visual worlds, using digital images, deep learning models to react to the objects it identifies and classifies. It is actually an automated system of interpreting visual data, instructing computers to comprehend the data on a pixel-by-pixel basis. The way computer vision automates tasks is the same as what human visual systems do. To say otherwise, it interprets visual data in the same manner as people do.

1.1.2. DATA PROTECTION: While there is no clear-cut definition of this term, data protection is the process of safeguarding important, sensitive information from corruption, compromise or loss. It refers to the practices, policies, and procedures aimed at safeguarding personal data from unauthorized access, use, disclosure, modification, or destruction. It involves the implementation of technical and organizational measures to ensure the confidentiality, integrity, and availability of personal data.

1.1.3. HEALTHCARE refers to the efforts made to maintain, restore, or promote someone's physical, mental, or emotional well-being, especially when performed by trained and licensed professionals. Healthcare is the improvement of health via the prevention, diagnosis, treatment, amelioration or cure of disease, illness, injury, and other physical and mental impairments in people. Health care is delivered by health professionals and allied health fields. Medicine, dentistry, pharmacy, midwifery, nursing, optometry, audiology, psychology, occupational therapy, physical therapy, athletic training, and other health professions all constitute health care. The term includes work done in providing primary care, secondary care, and tertiary care, as well as in public health.⁶

1.1.4. CONVERGENCE refers to the process of coming together or merging of two or more distinct entities, concepts, or systems, resulting in a unified or integrated whole. It is the process by which distinct fields, technologies, or disciplines come together to form a unified framework, often resulting in synergistic advancements and innovations. The *Collins English Dictionary* defines convergence as the process by which different ideas, groups, or societies stop being different and become more similar. In the context of this paper, convergence specifically denotes the integration and alignment of AI technologies with data protection principles to achieve improved healthcare outcomes.

1.1.5. DIVERGENCE refers to the process by which fields, technologies, or areas of study develop in different directions, leading to distinct paths, methodologies, or outcomes. This separation can result from differences in objectives, principles, regulatory frameworks, etc., and may highlight areas of conflict, incompatibility, or unique development trajectories.

1.1.6. In the context of Artificial Intelligence (AI), data protection, and healthcare, divergence signifies the points at which these fields encounter challenges or contradictions that prevent seamless integration.

2.0. LEGAL FRAMEWORK REGULATING HEALTHCARE, DATA PROTECTION AND THE USE OF ARTIFICIAL INTELLIGENCE (AI)

2.1. INTERNATIONAL AND REGIONAL INSTRUMENTS

- a) *Universal Declaration of Human Rights (UDHR)*⁷: Provides a foundation for protecting human rights, which can be applicable to AI use, especially concerning privacy, freedom of expression, and protection against discrimination.

⁶ Wikipedia: https://en.wikipedia.org/wiki/Health_care Accessed on May 23, 2025

⁷ Universal Declaration of Human Rights (adopted 10 December 1948 UNGA Res 217 A(III) (UDHR)

- b) *Council of Europe's Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (Convention 108)*⁸: A treaty which protects the right to privacy of individuals; addresses privacy concerns taking account of the increasing flow across frontiers of personal data undergoing automated processing.
- c) *European Union's General Data Protection Regulation (GDPR)*⁹: The strongest privacy and security law in the world¹⁰. The GDPR aims to protect the fundamental rights and freedoms of individuals, particularly their right to privacy, therefore, it imposes regulations on the collection, use, storage, processing and transfer of personal data, including via AI systems, within the EU.
- d) *International Telecommunication Union (ITU)*: Works on international standards related to information and communication technologies, which may indirectly influence AI regulation.
- e) *OECD Principles on Artificial Intelligence*: Provides non-binding guidelines on AI development, addressing transparency, accountability, and other ethical considerations. These guidelines are applicable in 38 member countries.
- f) *Montreal Declaration for Responsible AI*: An initiative by the Global Partnership on Artificial Intelligence (GPAI) to promote the responsible development and use of AI. The Montréal Declaration is a collective work that aims to put AI development at the service of the well-being of all people, and to guide social change by developing recommendations with strong democratic legitimacy. It is based on a declaration of ethical principles built around 7 core values: *well-being, autonomy, justice, privacy, knowledge, democracy and responsibility*.
- g) *African Union Convention on Cyber Security and Personal Data Protection*¹¹, a legal framework which makes provisions for addressing AI-related issues, especially concerning cybercrime and data protection and cyber security in Africa.
- h) *ECOWAS Supplementary Act on Personal Data Protection*¹² is believed to be the first regional instrument promoting the protection of the data privacy rights of citizens of ECOWAS Member States. It requires member states to establish national legal frameworks for the protection of privacy of data relating to the collection, processing, transmission, storage, and use of personal data.
- i) *African Charter on Human and Peoples' Rights (ACHPR)*¹³. A regional human rights instrument that outlines the rights and freedoms of individuals and peoples

⁸ CETS 108, 1985

⁹ Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016. It was adopted in 2016 and entered into application on 25 May 2018.

¹⁰ <https://gdpr.eu/what-is-gdpr/> Accessed on January 12, 2025

¹¹ Treaty 0048 also known as the *Malabo Convention*, and adopted on June 27, 2014

¹² ECOWAS Supplementary Act A/SA.1/01/10

¹³ Adopted in 1981

in Africa. Though it does not explicitly address emerging technologies such as AI, it covers a broad range of human rights issues that may intersect with the use of AI.

- j) *Organisation for Economic Co-operation and Development (OECD) Guidelines on the Protection of Privacy and Transborder Flows of Personal Data (2013)*: The guidelines aim to strike a balance between protecting individual privacy and promoting the free flow of information. Its aim is to reflect privacy standards and facilitate the free flow of information for law enforcement activities. The guidelines are founded on eight basic principles that can be adopted in national privacy legislation. The principles include *collection limitation, data quality, purpose specification, use limitation, security safeguards, openness, individual participation, and accountability*.
- k) *European Union Artificial Intelligence Act*: though it is yet to have the force of law, The EU AI Act is set to be the most comprehensive AI regulatory framework globally, applying across various sectors, including healthcare. Through the Act, High-risk AI systems, including those used in healthcare, are subject to the strictest regulatory requirements. The Act's primary objective is to ensure AI systems are developed and used in a manner that is safe, transparent and respects fundamental rights.

Etc.

2.2. NIGERIAN INSTRUMENTS

- a) *The Nigerian Constitution, 1999 (as amended)*: The *Grundnorm* and supreme law of the country. It provides the legal foundation for the government and protects the fundamental rights of citizens. While it does not explicitly address artificial intelligence, its provisions pertaining to the privacy, freedom of expression, and other fundamental rights of Nigerian citizens become relevant when it comes to regulating (the use of) artificial intelligence.
- b) *Data Protection Act 2023*. This Act provides guidelines on the lawful collection, processing and storage of personal information, ensuring privacy and security.
- c) *National Information Technology Development Act 2007*. An Act which encourages the planning, research, development, standardisation, application, coordination, monitoring, evaluation and regulation of Information Technology (IT) practices, activities and systems in Nigeria
- d) *National Health Act¹⁴*: This Act provides a framework for the regulation, development, and management of the health system in Nigeria. It emphasises equitable access to healthcare services and sets standards for healthcare delivery.

¹⁴ CAP N167, Laws of the Federation, 2014

3.0. ARTIFICIAL INTELLIGENCE IN HEALTHCARE

AI lends itself to healthcare delivery very well. In fact, in the recent years there has been an exponential increase in the use of AI in clinical environments.¹⁵

“AI is already playing a role in diagnosis and clinical care, drug development, disease surveillance, outbreak response, and health systems management ... The future of healthcare is digital, and we must do what we can to promote universal access to these innovations and prevent them from becoming another driver for inequity.”¹⁶

The health sector has been very receptive to the benefits of artificial intelligence and the latter is increasingly being explored to advance health care in several aspects. The wide acceptance of AI in healthcare relates to the complexities of modern medicine, which involves acquisition and analysis of the copious amount of information or data and the limitation of clinicians to address these needs with just human intelligence. Medical AI applications with their advanced computing ability are helpful in overcoming this limitation and are using several techniques to assist clinicians in medical care.

Notably, many health-related AI systems already exist or are being developed to meet a variety of stakeholders’ needs in healthcare and therapeutic development. AI is revolutionising and strengthening modern healthcare through technologies that can predict, grasp, learn, and act. The emergence of artificial intelligence (AI) in healthcare has been groundbreaking, reshaping diagnosis and treatment recommendations, patient engagement or monitoring and adherence, as well as administrative activities. These AI technologies are already also employed in robots-assisted surgeries and other medical procedures, all of that, in furtherance of *Digital Health*. In the context of the World Health Organization’s (WHO) *Global Strategy on Digital Health 2020-2025*,¹⁷ digital health is understood to mean *“the field of knowledge and practice associated with the development and use of digital technologies to improve health”*. This definition encompasses eHealth and is in line with that used by the WHO Director-General in the *report on mHealth* noted by the Executive Board which stated that *“Today the term ‘digital health’ is often used as a broad umbrella term encompassing eHealth as well as developing areas such as the use of advanced computing sciences (in the fields of “big data”, genomics and artificial intelligence, for example)”*.¹⁸

¹⁵ Ramesh AN, Kambhampati C, Monson JRT, Drew PJ. Artificial intelligence in medicine. *Annals of the Royal College of Surgeons of England*. 2004;86(5):334-338; Diprose W, Buist N. Artificial intelligence in medicine: Humans need not apply? *The New Zealand Medical Journal*. 2016;129(1434):73-76; Mishra S, Takke A, Auti S, Suryavanshi S, Oza M. Role of artificial intelligence in health care. *BioChemistry: An Indian Journal*. 2017;11(5):1-14 All cited in Reddy, S. (2018). Use of Artificial Intelligence in Healthcare Delivery. InTech. doi: 10.5772/intechopen.74714

¹⁶ Tedros Adhanom Ghebreyesus, WHO Director-General at the AI for Good Summit

¹⁷ *Global strategy on digital health 2020-2025*. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO.

¹⁸ Document EB142/20 on mHealth, noted by the Executive Board at its 142nd session (see document EB142/2017/REC/2, summary records of thirteenth meeting, section 2).

*Bajwa et al*¹⁹ posit that the application of technology and artificial intelligence (AI) in healthcare has the potential to address some of the many supply-and-demand challenges. The increasing availability of multi-modal data (genomics, economic, demographic, clinical and phenotypic) coupled with technology innovations in mobile, internet of things (IoT)²⁰, computing power and data security herald a moment of convergence between healthcare and technology to fundamentally transform models of healthcare delivery through AI-augmented healthcare systems.

AI's strength lies in its capacity to identify patterns and relationships from vast multifaceted and complex datasets. For instance, AI systems have the ability to convert a patient's whole medical record into a single number that indicates a probable diagnosis. Moreover, AI systems are also dynamic and autonomous, learning and adapting as more data become available.

3.1. EMERGING USES OF, AND GROWING RELIANCE ON AI IN HEALTHCARE

The adoption of artificial intelligence (AI) in healthcare is growing while radically changing the face of healthcare delivery. AI is being employed in a myriad of settings including hospitals, clinical laboratories, and research facilities. AI is being used for all the four classical medical tasks: diagnosis, prognosis, treatment and therapy but mostly in the area of medical diagnosis.²¹ A key component of AI is the Internet of Things (IoT) and apart from it being used across the globe for many purposes including prediction of natural disasters, water scarcity monitoring and intelligent transport systems, the concept is actively being used in healthcare to design smart homes in order to assist senior citizens to accomplish their daily living activities while preserving their privacy and to remotely monitor their health conditions and medicine intake. This AI component alone advances telemedicine. An IoT powered by AI and set up to address the healthcare need of senior and incapacitated patients is called as *Ambient Assisted Living (AAL)*²² and as its main aim is to extend the independent living of elderly individuals in their homes, automation, security, control and communication are key aspects of AAL modular architecture. The system also includes sensors, actuators and cameras to collect different types of data about the individual and home. The constituent system sets up a smart home environment where activities and the health condition of the resident are not only tracked but also predicted.²³

Additionally, there are many other AI techniques that have been successfully used in other areas of medicine. Examples include the *Genetic algorithm techniques* which have been used to predict outcomes in acutely ill and cancer patients, and to also analyse mammograms. There are

¹⁹ Bajwa J, Munir U, Nori A and Williams B, 'Artificial Intelligence in Healthcare: Transforming the Practice of Medicine' (2021) 8(2) *Future Healthcare Journal* e188 <https://doi.org/10.7861/fhj.2021-0095> accessed on May 22, 2025

²⁰ A system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

²¹ Szolovitz P. Artificial intelligence in medical diagnosis. *Annals of Internal Medicine*. 1988;108(1):80; Farrugia A, Al-Jumeily D, Al-Jumaily M, Hussain A, Lamb D. Medical diagnosis: Are artificial intelligence systems able to diagnose the underlying causes of specific headaches? In: *Proceedings of 2013 6th International Conference on Developments in eSystems Engineering (DeSE)*; 2013. pp. 376-382

²² Costa R, Carneiro D, Novais P, Lima L, Machado J, Marques A, Neves J. Ambient assisted living. *Applied Soft Computing*. 2008;51:86-94

²³ Amiribesheli M, Benmansour A, Bouchachia A. A review of smart homes in healthcare. *Journal of Ambient Intelligence and Humanized Computing*. 2015;6(4):495-517

also the Magnetic resonance imaging (*MRI images and fuzzy logic techniques*) have been used in diagnosing various cancers, characterise ultrasound and (Computed Tomography) CT scan images and predict survival in cancer patients and administer medication and anaesthetics.²⁴

AI is revolutionising healthcare delivery by improving accuracy, accessibility, personalised medicine and efficiency in various areas. **Here are some other recent and key breakthroughs in the application of AI in healthcare:**

3.1.1. Data management and Automation of administrative processes: Artificial Intelligence in healthcare is changing many of the administrative aspects of medical care. AI can automate mundane or repetitive tasks such as data entry, diet recording, claims processing and appointment scheduling, thereby reducing administrative burden and patients and freeing up time and resources for healthcare workers and healthcare providers to focus on patient care. Furthermore, AI also has the potential to reduce human error by providing a faster way to review health records, medical imaging, claims processing and test results. This gives healthcare professionals more autonomy over their workflow process, and facilitates improved service delivery.²⁵

Quality healthcare thrives on data and health information. However, highly valuable information can sometimes get lost among the forest of trillions of data points. Additionally, the inability to connect important data points slows the development of new drugs, preventative medicine and proper diagnosis and because of the problems that come with handling massive volumes of data; AI breaks down data silos and connects in minutes, information that used to take years to process. This can reduce the time and costs of healthcare administrative processes, contributing to more efficient daily operations and patient experiences.

3.1.2. Disease Prevention, Diagnosis, Treatment and Health Promotion: AI technologies, including support vector machines, classification trees, and artificial neural networks have been essential in facilitating the clinical diagnosis of several acute and chronic illnesses.²⁶ With AI, vast health datasets can be rapidly analysed and leveraged on to identify patterns and trends, leading to precise diagnosis and timely interventions, aiding disease prevention and personalised treatment plans. The application of AI and AI-powered predictive models facilitates interpretation of results with high accuracy and speed.²⁷

²⁴ Diprose W, Buist N. Artificial intelligence in medicine: Humans need not apply? *The New Zealand Medical Journal*. 2016;129(1434):73-76

²⁵ Steve B., "AI in Healthcare"Foresee Medical. Retrieved from <https://www.foreseemed.com/artificial-intelligence-in-healthcare> accessed June 20, 2025

²⁶ Umamathy, V. R., Rajinikanth, S. B., Raj, R. D. S., Yadav, S., Munavarah, S. A., Anandapandian, P. A., Mary, A. V., Padmavathy, K., & Akshay, R. (2023). Perspective of artificial intelligence in disease diagnosis: A review of current and future endeavours in the medical field. *Cureus Journal of Medical Science*, 15(9), e45684. <https://doi.org/10.7759/cureus.45684>. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10590060/> on June 28, 2025.

²⁷ Mishra, S., Takke, A., Auti, S., Suryavanshi, S., & Oza, M. (2017). Role of artificial intelligence in health care. *BioChemistry: An Indian Journal*, 11(5), 1-14.

Daley²⁸ reports that every year, roughly 400,000 hospitalised patients suffer preventable harm,²⁹ with 100,000 deaths. Some common types of medical errors include surgical errors, diagnostic errors, medication errors, equipment failures, patient falls, hospital-acquired infections, and communication failures. Incomplete medical histories and large caseloads can also lead to deadly human errors. Immune to those variables, AI systems can predict and diagnose disease at a faster rate than most medical professionals. Notably, these systems have demonstrated efficacy in diagnosing conditions such as acute appendicitis³⁰ and Alzheimer's disease.³¹ The ability of *integrative AI* to detect cancerous cells is greatly enhanced by using many algorithms as opposed to a single algorithm, leading to improved diagnostic accuracy.³² The development of several AI approaches helps to forecast the recurrence of breast cancer.³³ Also, instead of doctors, at-home (wearable and other devices) AI systems might possibly monitor patients with insulin irregularities and swallowing issues.³⁴

In light of the foregoing, the use of AI systems to improve the diagnostic process is one of the exciting healthcare advancements. However, the influence of AI on medical diagnostics is anticipated to expand significantly as healthcare systems and professionals adopt digital technology and AI algorithms continue to advance.

3.1.3. Robot-Assisted OR Robotic Surgery: Robotic surgery is an approach healthcare providers use for minimally invasive procedures. It allows doctors to perform many types of complex procedures with more precision, flexibility and control than is possible with traditional procedures. The technology consists of robotic arms that hold tiny surgical instruments attached to them; a high-definition (HD) camera that provides enhanced, magnified, 3D views of the surgical area; as well as a surgical console where a surgeon controls the instruments and the camera's every move.

Telepresence robots enable doctors to check in with patients remotely; rehabilitation robots aid patients in performing certain movements post-surgery; surgical robots are used by surgeons to assist with various surgeries and operations; and companion robots reduce anxiety and depression among older adults. Healthcare organisations even rely on robots to transport medical

²⁸ Daley S, AI IN HEALTHCARE: Uses, Examples and Benefits. From faster diagnoses to robot-assisted surgeries, the adoption of AI in healthcare is advancing medical treatment and patient experiences. <https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare> Accessed June 28, 2025

²⁹ Rodziewicz, T. L., Houseman, B., Vaqar, S., & Hipskind, J. E. (2024). Medical Error Reduction and Prevention. In *StatPearls*. StatPearls Publishing.

³⁰ Park SY, Seo JS, Lee SC, Kim SM. *Future Information Technology: FutureTech*. Vol. 85. Berlin Heidelberg: Springer; 2013. Application of an artificial intelligence method for diagnosing acute appendicitis: the support vector machine; p. 92.

³¹ Cascianelli S, Scialpi M, Amici S, et al. Role of artificial intelligence techniques (automatic classifiers) in molecular imaging modalities in neurodegenerative diseases. *Curr Alzheimer Res*. 2017;14:198–207.

³² Setlak G, Dąbrowski M, Szajnar W, Piróg-Mazur M, Kozak T. Artificial intelligence approach to diabetes diagnostics. <https://pdfs.semanticscholar.org/40f3/e4017d497bffe556f882d4f1389462296b59.pdf> *Semantic Scholar*. 2009 Accessed on June 20, 2025

³³ Delen D, Walker G, and Kadam A. Predicting breast cancer survivability: a comparison of three data mining methods. *Artif Intell Med*. 2005;34:113–127. [PubMed]

³⁴ Jayatilake D, Ueno T, Teramoto Y, et al. Smartphone-based real-time assessment of swallowing ability from the swallowing sound. *IEEE J Transl Eng Health Med*. 2015;3:2900310. [PubMed] [Google Scholar]

supplies, dispense prescription drugs and help with sanitation and clinical management.³⁵

3.1.4. Advancement of mHealth: With the rapid progression in technological advancements comes the possibility of the healthcare sector to leverage on AI technologies or techniques like machine learning, data analytics, etc., to promote digital health which comprises electronic health (eHealth) and mobile health (*mHealth*) and also to improve wellness. A study has shown that the use of mHealth has significantly increased since COVID-19, and agreeably, mHealth is one significant area of the healthcare information technology (IT) terrain that has recently witnessed significant growth,³⁶ considering the integration or deployment of mHealth technologies to keep track of life-threatening conditions including asthma, diabetes, and sleep apnea and to assure the safety and well-being of patients.³⁷

3.1.5. Drug discovery and development: The pharmaceutical industry's progression is significantly hindered by the exorbitant costs associated with drug development and the extensive human labour required for research. The cost of advancing a single drug through clinical trials is estimated at an average of \$1.3 billion, with a mere 10 percent of these drugs ultimately achieving market approval.³⁸ On top of that are the ever-increasing regulatory obstacles and the difficulties in continuously discovering drug molecules that are substantially better than what is currently marketed. This makes the drug innovation process both challenging and inefficient with a high price tag on any new drug products that make it onto the market.³⁹ However, with recent technological advancements, particularly in AI, the drug development process is sped up and the challenges ameliorated. That can be credited to AI's capabilities and help in drug design, prediction of any side effects, and identification of ideal candidates for clinical trials, thereby giving a boost to the healthcare industry. As AI keeps advancing, it will drive significant improvement in clinical trial design and optimization of drug manufacturing processes in general. It has been further projected that with evolution through upcoming years, AI can become powerful enough to integrate and analyse patient details to build their 'digital twins' that can be utilised as virtual cohorts for testing drug and treatment safety and efficacy.⁴⁰

3.1.6. Electronic Health Records: Big real data are being created by the widespread introduction of electronic health record (EHR) systems in healthcare, which create new spaces for clinical study. Real-world conditions and treatment procedures are recorded in EHR providing abundant and more generalisable empirical evidence of effectiveness relative to conventional randomised clinical trials.

³⁵ Matthew U, Medical Robots Transforming Healthcare: 11 Example. From doing administrative tasks to performing surgeries, these medical robots are bringing innovation to the healthcare industry. <https://builtn.com/robotics/surgical-medical-healthcare-robotics-companies>

³⁶ Chib A, Lin SH. Theoretical advancements in mHealth: a systematic review of mobile apps. *J Health Commun.* 2018;23:909–955.

³⁷ Guillodo E, Lemey C, Simonnet M, et al. Clinical applications of mobile health wearable-based sleep monitoring: systematic review. *JMIR Mhealth Uhealth.* 2020;8:0. [[Google Scholar](#)]

³⁸ Daley S (Supra)

³⁹ Hughes J.P., Rees S., Kalindjian S.B., Philpott K.L. Principles of early drug discovery. *Br J Pharmacol.* 2011;162(6):1239–1249. [[Google Scholar](#)]

⁴⁰ Mayorga-Ruiz I, Jiménez-Pastor A, Fos-Guarinos B, López-González R, García-Castro F, Alberich-Bayarri Á. *In Artificial Intelligence in Medical Imaging: Opportunities, Applications and Risks.* Cham: Springer; The role of AI in clinical trials; pp. 231–243. [[Google Scholar](#)]

AI simplifies patient record management, improving data handling and retrieval. It streamlines access to critical patient information, making it easier for healthcare professionals to provide timely and accurate care. AI enhances interoperability by easing the sharing of data between different healthcare systems. It enables seamless communication and collaboration across institutions, leading to better patient outcomes. Some healthcare networks are already using AI to assist with data extraction from free text, clinical documentation, and data entry within EHRs. AI-driven decision support systems help clinicians make informed choices, improving patient care.⁴¹

AI has great potential in making existing EHR systems more flexible, intelligent, and valuable. By leveraging AI technologies, healthcare organisations can enhance security, reduce clinician burnout, and ultimately improve patient outcomes. With the more and more widespread implementation of EHR internationally, the usage of EHR data to promote clinical practice is increasingly required but one big challenge to this is that a vast amount of data in EHR remains narrative, and therefore seriously calls for protection.

3.1.7. Virtual Assistants and Chatbots: AI-powered virtual assistants and chatbots play a role in healthcare systems by providing patients with personalised health information, answering queries, and assisting in scheduling appointments. These conversational agents utilize natural language processing to understand and respond to patients' questions, thereby improving access to healthcare information and reducing administrative burden.

Despite these phenomenal applications of AI towards the advancement of healthcare, all challenges, especially those related to data privacy, bias, and the need for human expertise must be addressed for the responsible and effective implementation of AI in healthcare.⁴² Furthermore, collaboration with key stakeholders to certify models and develop governance frameworks for Responsible Healthcare General Intelligence is vital.⁴³

3.2. THE SHORTCOMINGS OF AI IN HEALTHCARE

While the application of AI in delivery of healthcare is helpful and has very promising potential, there are significant technical and ethical challenges related to the wider adoption and deployment of AI into healthcare systems. These challenges include, but are not limited to, data quality and access, technical infrastructure, organisational capacity, and ethical and responsible practices in addition to aspects related to safety and regulation. *Coiera* unfolds the concern that AI research is largely led and driven by computer scientists without medical training and that

⁴¹ Thomas H. Davenport, Tonya M. Hongsermeier, and Kimberly Alba Mc Cord, 'Using AI to Improve Electronic Health Records' (Harvard Business Review, 13 December 2018) <https://hbr.org/2018/12/using-ai-to-improve-electronic-health-records> accessed 1 July 2025.

⁴² Shuroug A. Alowais, Sahar S. Alghamdi, Nada Alsuhebany, Tariq Alqahtani, Abdulrahman I. Alshaya, Sumaya N. Almohareb, Atheer Aldairem, Mohammed Alrashed, Khalid Bin Saleh, Hisham A. Badreldin, Majed S. Al Yami, Shmeylan Al Harbi & Abdulkareem M. Albekairy. (2023). Revolutionizing healthcare: the role of artificial intelligence in clinical practice. BMC Medical Education, 23, Article number: 6891 Retrieved from <https://bmcomeduc.biomedcentral.com/articles/10.1186/s12909-023-04698-z> Accessed on June 18, 2025

⁴³ World Economic Forum, <https://www.weforum.org/agenda/2023/06/emerging-tech-like-ai-are-poised-to-make-healthcare-more-accurate-accessible-and-sustainable/> Accessed on June 20, 2025

there have been comments that this has led to a very technologically focused and problem oriented approach in the application of AI in healthcare delivery.⁴⁴ Modern-day healthcare delivery models are very dependent on human reasoning, empathy, patient-doctor communication and establishing professional relationships with patients to ensure compliance with required standards. AI systems are automated. They have no emotions and therefore lack empathy or human feel: these aspects are things that AI cannot easily replace.

AI and its practical and sustainable application also face some obvious financial and maintenance challenges, considering its cost-effect vis-a-vis the economic status of healthcare users. Not everyone who really needs the quality or expedited healthcare services through AI can afford it.

AI requires quality data analysis both at the input level as well as during integration within AI, which can develop bias from both human and machine errors, and which over time leads to biased output, perceived as a lack of empathy and improper medical attention toward patients. This raises ethical considerations concerning the corruptible and biased tendencies of AI programs. A clear example of the ethical flaws of AI lies in facial recognition software, which is susceptible to racial discrimination and could be particularly dangerous in plastic surgery.⁴⁵ There are also shortcomings owing to risks such as cyber-attacks on AI framework as well as the evolution of bias in the complex aftermath of the massive digital network and unsupervised machine learning processes that may not be resolvable by simplistic methods.⁴⁶

AI-enabled healthcare systems that involve the transfer of patient data across borders may face privacy challenges due to varying data protection regulations and standards. Ensuring compliance with applicable privacy laws becomes more complex when data is shared or stored in jurisdictions with different privacy frameworks

The algorithms used to train AI can first be biased, and will result in bias due to the interpretations from the data available and may impact important clinical and surgical decisions.⁴⁷ Some algorithms may present their interpretations and conclusions with little or no insight as to why the outcome was predicted, known as the 'black box'. The lack of transparency, explainability and conclusive evidence linking the variables to the cause-and-effect relationship between them leaves the healthcare users unable to trust the technology.⁴⁸

Although the emerging use of artificial intelligence in health care has allowed progress to be achieved in terms of diagnosis and prognosis, there are ethical considerations surrounding its use. As AI is interposed within the doctor-patient relationship, the integrity of informed consent

⁴⁴ Coiera EW. Artificial intelligence in medicine: The challenges ahead. *Journal of the American Medical Informatics Association*. 1996;3(6):363-366

⁴⁵ What is artificial intelligence surgery? Gumbs AA, Perretta S, d'Allemagne B, Chouillard E. *Art Int Surg*. 2021;1:1–10. [[Google Scholar](#)]

⁴⁶ Artificial intelligence in medicine and the disclosure of risks. Kiener M. *AI Soc*. 2021;36:705–713. [[Google Scholar](#)]

⁴⁷ Artificial intelligence in anesthesiology: current techniques, clinical applications, and limitations. Hashimoto DA, Witkowski E, Gao L, Meireles O, Rosman G. *Anesthesiology*. 2020;132:379–394. [[Google Scholar](#)]

⁴⁸ Artificial intelligence in brain tumour surgery-an emerging paradigm. Williams S, Layard Horsfall H, Funnell JP, et al. *Cancers (Basel)* 2021;13:5010. [[Google Scholar](#)]

may be jeopardised. This can be seen in everyday life with people downloading mobile health apps, such as those that help track menstruation, improve medication adherence, and provide dietary guidance. The use of these applications requires merely the signing of a user agreement, as well as the acceptance of regular updates, and changing terms of service, which compromise transparency for the user. While a human would be able to ensure understanding and compliance of their patients, in the case of these mobile apps the user is the only advocate for their own consent and medical knowledge. The so-called black box algorithm, whereby humans, even those who design AI models, cannot completely understand how they combine variables to make predictions, undermines the time-honoured scientific method, which lies at the very heart of medical practice.⁴⁹

4.0. DATA PROTECTION IN HEALTHCARE

Healthcare is becoming more patient-centric with personalised approaches to decision-making. This allows data to be used to improve patient and population wellness, patient education and engagement, prevention and prediction of diseases and care risks, medication adherence, disease management, disease reversal or remission, and individualization and personalization of treatment and care. With the rise of electronic health records (EHRs) and other AI or digital systems, securing patient data is paramount.

The General Data Protection Regulations (GDPR) is the foremost data protection framework that is applicable in Europe, though many nations of the world (including) Nigeria have drawn inference from it to develop their local data protection legislations.

4.1. *Key aspects of data protection as defined by the GDPR include:*

- a) **Lawfulness, Fairness, and Transparency:** Personal data must be processed lawfully, fairly, and in a transparent manner in relation to the data subject.
- b) **Purpose Limitation:** Data must be collected for specified, explicit, and legitimate purposes and not further processed in a manner incompatible with those purposes.
- c) **Data Minimization:** Only the data necessary for the purposes for which they are processed should be collected.
- d) **Accuracy:** Personal data must be accurate and, where necessary, kept up to date. Inaccurate data should be corrected or deleted without delay.
- e) **Storage Limitation:** Personal data should be kept in a form that permits identification of data subjects for no longer than necessary for the purposes for which the data are processed.

⁴⁹ Ghadeer A, Alexandra K, Ellerose F, Darragh Q, and Gerard F, Emerging role of artificial intelligence in global health care, Health Policy and Technology, Volume 11, Issue 3, 2022, 100661, <https://doi.org/10.1016/j.hlpt.2022.100661> (Retrieved from <https://www.sciencedirect.com/science/article/pii/S2211883722000685> on June 30, 2025)

- f) **Integrity and Confidentiality:** Personal data must be processed in a manner that ensures appropriate security, including protection against unauthorised or unlawful processing and against accidental loss, destruction, or damage, using appropriate technical or organisational measures.
- g) **Accountability:** Data controllers are responsible for, and must be able to demonstrate, compliance with these principles.

The GDPR also enhances the rights of individuals by granting them specific rights, such as the right to access their data, the right to rectification, the right to erasure (right to be forgotten), the right to restrict processing, the right to data portability, and the right to object to certain processing activities. On the whole, the GDPR establishes a comprehensive legal framework for data protection, emphasising the importance of respecting and safeguarding individuals' personal data throughout its lifecycle.

Furthermore, the WHO's Global strategy on digital health 2020-2025⁵⁰ emphasises that **health data** are to be classified as sensitive personal data, or personally identifiable information, that require a high safety and security standard. **Health data** has been said to refer to the systematic application of information and communications technologies, computer science, and data to support informed decision-making by individuals, the health workforce, and health systems, to strengthen resilience to disease and improve health and wellness. It includes all data pertaining to the health status of a data subject which reveal information relating to the past, current or future physical or mental health status of the data subject. This includes information about the natural person collected in the course of the registration for, or the provision of, health care services to that natural person; a number, symbol or particular assigned to a natural person to uniquely identify the natural person for health purposes; information derived from the testing or examination of a body part or bodily substance, including from genetic data and biological samples; and any information on, for example, a disease, disability, disease risk, medical history, clinical treatment or the physiological or biomedical state of the data subject independent of its source, for example from a physician or other health professional, a hospital, a medical device or an in vitro diagnostic test.⁵¹ This therefore stresses the need for a strong legal and regulatory base to protect privacy, confidentiality, integrity and availability of data and the processing of personal health data, and to deal with cybersecurity, trust building, accountability and governance, ethics, equity, capacity building and literacy, ensuring that good quality data are collected and subsequently shared to support planning, commissioning and transformation of services.

The world over, nations should leverage on the above mentioned policy regulations to develop forward-going stringent rules and regulations to safeguard sensitive patient information.

4.2. Healthcare providers and their business associates must balance protecting patient privacy while delivering quality patient care and meeting the strict requirements set forth in regulations such as the GDPR; the Health Insurance Portability and Accountability Act (HIPAA) applicable in the U.S.A; and the Data Protection Act 2023 applicable in Nigeria. Since protecting patient confidentiality and securing healthcare data are essential for maintaining trust and

⁵⁰ (Supra)

⁵¹ Regulation 35, GDPR

ensuring quality care, the following have been proposed as *Best Practices for Healthcare Data Protection*.⁵²

- a) Educate healthcare staff about security risks.
- b) Restrict access to data and applications.
- c) Implement data usage controls.
- d) Log and monitor data use.
- e) Encrypt data at rest and during transit.
- f) Secure mobile devices.
- g) Mitigate risks related to connected devices.
- h) Conduct regular risk assessments.

5.0. CONVERGENCE OF ARTIFICIAL INTELLIGENCE AND DATA PROTECTION IN HEALTHCARE

All AI tasks and solutions use some form of data, regardless of their characteristics, to facilitate machines to learn, adapt and improve on their learning. While data is the most important ingredient for training AI and Machine Learning algorithms, its quality greatly influences the success of such AI solutions' safety and effectiveness. Data can take any form, including character, text, words, numbers, pictures, sound or video. Also, these data can be structured, semi-structured or unstructured:

Structured data are highly organised information that are generally stored in relational databases that are easily searchable, readily analyzable by both humans and algorithms, and also ordered in a manner that follows a specific model or schema. Data stored in electronic medical records, mobile devices and Internet of Things (IoT) devices, etc., can be examples of structured data.

Semi-structured data does not conform to a rigid schema like structured data, but still contains some organisational properties such as tags or markers. It is flexible in terms of data representation; and easier to manage than unstructured data while retaining some ability to be analysed using standard tools. Lab results, clinical documentation and telemedicine records are examples of semi-structured data.

Unstructured data lacks a predefined schema or data model. It is stored in various formats; often qualitative; consists of text-heavy or multimedia content that is rich in information and as a result, it often requires advanced processing techniques to analyse. Pathology reports, Radiology images (e.g., X-rays, MRIs, CT scans), ultrasound images, and other diagnostic imaging files that are stored as binary data and often require specialised software to interpret, etc., can be examples of unstructured data.

Artificial intelligence and data protection are interoperable. That means that both concepts and systems can, and will need to be deployed in alignment with each other, in order to achieve better health outcomes. AI systems thrive on data and they may be designed using data and datasets from specific populations. As with any therapeutics, once deployed, the AI systems will

⁵² Singh S, 'The Importance of Securing Healthcare Data for Patients' (*World Economic Forum*)
<https://www.weforum.org/agenda/2022/08/the-importance-of-securing-healthcare-data/> accessed 1 July 2025

be utilised by a larger population and potentially variable end-users with several sensitive personal data.

While it is agreeable that digital transformation of healthcare can be disruptive, technologies such as the Internet of Things, virtual care, remote monitoring, Artificial Intelligence, big data analytics, blockchain, smart wearables, platforms or tools enabling data exchange and storage and tools enabling remote data capture and the exchange of data and sharing of relevant information across the health ecosystem creating a continuum of care have proven potential to enhance health outcomes by improving medical diagnosis, data-based treatment decisions, digital therapeutics, clinical trials, self-management of care and person-centred care as well as creating more evidence-based knowledge, skills and competence for professionals to support health care.

Consequent on the above, prioritising data privacy and security becomes essential. All AI/machine learning solutions must uphold stringent privacy standards, safeguarding patient data, confidentiality and safety. When combined with privacy-enhancing technologies, integrating AI and machine learning in healthcare holds immense potential. As such, responsible use, coupled with data privacy and protection, can transform global health, enhance patient care and bridge healthcare gaps for a healthier, more equitable world.⁵³

6.0. DIVERGENCE OF ARTIFICIAL INTELLIGENCE AND DATA PROTECTION IN HEALTHCARE

Despite the great benefits as well as the great reliance of AI technologies on health data for the advancement of healthcare, there are many areas where between the two concepts – AI and Data Protection – conflict themselves even to the detriment of the populace.

The key areas of divergence between artificial intelligence (AI) and data protection in healthcare include, but not limited to the following concerns:

6.1. Data access vs. Data privacy: Health-related AI applications are in crucial need of patient data during the development of the AI model in the training, validation and test phases. These health data are often initially collected for a different purpose than AI development, and this secondary use requires a valid ethical and legal basis. The use of health data for AI development raises important data privacy concerns, both at individual and group levels.⁵⁴ Thus, there is a tension between incentives and actions that promote AI and incentives and actions that limit access to the required data. There is a tension between the "data hunger" of AI and the need to protect patient privacy. *Sorell et al* posit that "the data hunger of AI runs up against the very norm of personal data minimization" required by the GDPR⁵⁵ and this alone, leads to complex

⁵³ Saemoon Y, Amara A, Emerging tech, like AI, is poised to make healthcare more accurate, accessible and sustainable. World Economic Forum <https://www.weforum.org/agenda/2023/06/emerging-tech-like-ai-are-poised-to-make-healthcare-more-accurate-accessible-and-sustainable/> Accessed June 27, 2025

⁵⁴ McLennan S., Kahrass H., Wieschowski S., Strech D., Langhof H. (2018). The Spectrum of Ethical Issues in a Learning Health Care System: a Systematic Qualitative Review. *Int. J. Qual. Health Care.* 30 (3), 161–168. 10.1093/intqhc/mzy005 [[Google Scholar](#)]

⁵⁵ Sorell T., Rajpoot N., Verrill C. (2022). Ethical Issues in Computational Pathology. *J. Med. Ethics.* 48 (4), 278–284. 10.1136/medethics-2020-107024 [[Google Scholar](#)]

dilemmas. The Article 10 of the EU AI Act for example, requires the highest levels of data quality and quantity for sufficient training, validation, and testing as well as the necessary heterogeneity to cover relevant patient (sub)populations and variants in the intended clinical setting. This requires broad access to healthcare data, and tools not fulfilling these requirements would not be permitted. Consequently, countries are obligated to decide on how to balance the positive goals of secondary-use activities like healthcare AI with mitigating associated privacy risks. Countries and healthcare systems need to develop adequate frameworks to guard against the risks of data breaches and misuse.

6.2. *Transparency and Explainability:* Many AI models used in healthcare are complex "black boxes", making it difficult to explain how they arrive at decisions. This lack of transparency can conflict with data protection principles like the right to explanation. Regulators are pushing for more explainable AI in healthcare.

6.3. *Patient autonomy vs. AI-driven decision-making, Liability and accountability:* AI may make decisions that do not just conflict with patient preferences or values, but are difficult to trace and challenge, thereby raising ethical and accountability concerns. When AI systems make such critical medical decisions to the detriment of a patient, it is unclear who is liable - the healthcare provider, the AI developer, or the data controller. Regulators are still grappling with questions of accountability for AI-driven harms. This is one point where regulatory reforms are immediately required.

6.4. *Consent and control Vs Challenges in anonymizing patient data for AI use:* Patients may have limited control over how their data is used to train AI models. The traditional "consent or anonymize" approach may not be sufficient, and new data governance models are needed.

Agreeably, artificial intelligence (AI) has enormous potential for improving health outcomes and helping countries achieve universal health coverage. However, for AI to have a beneficial impact on people's health, these areas of divergence highlight the need for a balanced approach that reconciles the benefits of AI in healthcare with the need to protect patient data and ensure ethical development and deployment of AI. Furthermore, these ethical considerations and human rights must be placed at the centre of its design, development and use in the healthcare industry.

In summary, the drive to leverage the power of AI in healthcare must be carefully balanced against the need to protect patient privacy, ensure transparency and fairness, and establish clear lines of responsibility. Ongoing collaboration between policymakers, healthcare providers, and AI developers is crucial to navigate these complex issues.

7.0. BRIDGING THE GAPS BETWEEN HEALTHCARE, AI AND DATA PROTECTION

While technological advancement is a welcome development in furtherance of healthcare delivery, many countries, especially the developing and underdeveloped ones, still require functional legal and institutional support for the development, regulation and consolidation of digital health strategies and the implementation of their action plans, which usually requires more resources and capabilities. Having the appropriate regulations and institutions in place will establish the appropriate use of digital technologies while also helping in intently addressing the

major impediments that these countries face in engaging with and accessing new health strategies and technologies. Such impediments include but not limited to:

- a) Lack of an appropriate enabling environment for technology and digital health to thrive.
- b) Insufficient national budgetary allocation to support healthcare development; as well as insufficient resources and infrastructure to support the digitalization and transformation in healthcare delivery.
- c) Poor education of healthcare professionals and allied workers in emerging healthcare technologies, lack of technical or technological know-how and lack of human capacity development.
- d) Poor internet connectivity and digital divide. Digital divide refers to the gap between demographics and regions that have access to modern information and communications technology and those that do not or have restricted access. This technology can include the telephone, television, personal computers and the internet.
- e) Issues with technology ownership, privacy, cyber security, etc, that work against adapting and implementing global standards and technology flows.
- f) Lack of well-developed strategies for pseudonymization and anonymization of health data, in respect for individuals' right to privacy.
- g) Lack of public awareness and digital health literacy.

7.1. TOPICAL AREAS FOR REGULATORY CONSIDERATIONS

7.1.1. Documentation and transparency: Effective, accurate and comprehensive documentation is essential to allowing a transparent evaluation of AI systems for health. These will help to establish trust and guard against algorithmic biases and data mining or data dredging. AI can be seen as a “*product*” which within *Section 167* of the *Federal Competition and Consumer Protection Act, 2018 applicable in Nigeria*, “*includes goods or services.*” Consequently, it is pertinent that the same regulatory expectations and standards that ensure the safety and effectiveness of regulated products also apply to AI systems deployed in regulated and sensitive domains like healthcare. While users feast on the immense benefits of AI in healthcare, documentation and transparency will make it feasible for regulators to be able to trace back the ideation and conception, development, training, validation and deployment process of AI systems. In the WHO’s perspective, aspects requiring careful documentation include specifying the problem that developers are attempting to address, the context in which the AI system is proposed to function, and the selection, curation, labelling and processing of training datasets used in the development process.⁵⁶

7.1.2. Risk evaluation, management and AI systems development lifecycle approaches: The integration of Artificial Intelligence (AI) into healthcare has the potential to improve patient outcomes but however, this technological advancement also introduces several add-on risks that

⁵⁶ Regulatory Considerations on Artificial Intelligence for Health. Geneva: World Health Organization; 2023.

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must be carefully managed to ensure the benefits outweigh the potential downsides. Consequently, a holistic risk evaluation and management approach that includes addressing risks associated with cybersecurity threats to an AI system, and the system's vulnerabilities, have become pertinent throughout the total lifecycle of any AI system, medical devices or procedure, including during pre- and post-market deployment, taking account of the full context in which the AI system may be used.

7.1.3. *Intended use and analytical and clinical validation:* AI systems are complex, dependent not only on the constituent codes that they are built with but also on the training data, clinical setting and user interaction. Owing to this and many more factors, the security, safety and performance and output of AI systems, can be highly context-dependent and that makes the statement or description of the intended use have a substantial role both to inform end-users where the tool can be utilised safely and appropriately and, to allow regulators to assess whether the evidence of the analytical and clinical validation steps is apt and sufficient for the intended use.

Developers and manufacturers should provide a clear clinical and scientific description or explanation of their AI tool's intended performance. On this note, a proper statement or description of the relevant use case should cover the *intended setting* (geography, type of care facility), *the target population* (ethnicity, race, gender, age, disease type, disease severity, comorbidities) *the intended user* (health-care provider or patient) and *the clinical situation* for which the AI system is developed. This is important considering that many technological interventions, tests and guidelines are prone to bias, unfairness or unreliability, and also considering that AI systems which are highly sensitive to the characteristics of the data they were trained on are prone to failure with unseen data types (such as a new disease feature or population type or context that was not previously encountered).

7.1.4. *Data quality:* One of the key challenges that developers face is the availability of sufficient or good-quality datasets that are clinically relevant to support the development of AI and other technological systems in advancement of healthcare. The lack of good-quality datasets for use in the development of AI systems may not only hinder their effectiveness and potential benefits but can also lead to many problems, such as bias and errors. On this note, the WHO recommends that a clear data management plan should be pre-specified and well documented when managing datasets for Machine Learning models. Data management approaches should be risk-based and fit for purpose.⁵⁷

7.1.5. *Privacy and data protection:* Information privacy is the right to have some control over how your personal information is collected and used. With speed-of-light technological innovation in many sectors, including healthcare, information privacy is becoming more complex by the minute as more data is being collected and exchanged. As the technology gets more sophisticated (indeed, invasive), so do the uses of data. Data protection, on the other hand, includes the requirements and methods used to store and organise data in a physically secured manner to prevent unauthorised access and use. Data protection, although also a legal issue, is

⁵⁷ Regulatory Considerations on Artificial Intelligence for Health. Geneva: World Health Organization; 2023. Licence: CC BY-NC-SA 3.0 IGO.

focused on securing data against unauthorised access, malicious attacks and preventing the potential exploitation of stolen data for profit. Privacy issues surges as the demand for health data increases and while security is necessary for protecting data, it may not be sufficient for addressing privacy.⁵⁸ Several countries and regions have data protection regulations and privacy laws that regulate the collection, use, disclosure and security of personal information.⁵⁹ As such, the developers of AI-based therapeutic applications or systems for healthcare, need to early in the development process, gain good understanding of applicable international, regional and national data protection regulations and privacy laws, including special regulatory provisions related to sensitive information such as genetic or health data. Developers must take privacy into account as they design and deploy AI systems; be aware of the nuances of the different jurisdictions' regulations and laws; and should consider documenting their privacy policy and data protection practices accordingly.

7.1.6. Engagement and collaboration: Appropriate engagement and collaboration between developers, manufacturers, healthcare practitioners, patients, patient advocates, policy-makers, regulatory bodies and other stakeholders can, where applicable, can improve the safety, quality and advancement of healthcare by use of artificial intelligence.

7.1.7. Governance Frameworks & Standards: Developing forward-going governance frameworks and technical standards for AI use and data protection are necessary to ensure universal health coverage and privacy.

CONCLUSION

Artificial intelligence (AI) has become a transformational force in healthcare, giving immense push to medical research, care delivery and health system operations. AI has an evident potential to strengthen health service delivery to underserved populations, enhance public health surveillance, advance health research and the development of medicines, support health systems management and enable clinical professionals to improve patient care and perform complex medical diagnoses.

The demand for healthcare services is ever increasing and many countries (such as Nigeria) are experiencing a paucity of healthcare practitioners, especially physicians and Nurses. Healthcare institutions are also fighting to keep up with all the technological developments vis-a-vis the high expectations of many patients with respect to levels of service and outcomes.⁶⁰ Technological advancements have provided opportunities for on-demand healthcare services using health tracking apps and search engines and have also enabled a new form of healthcare delivery -

⁵⁸ What is privacy? International Association of Privacy Professionals (IAPP); 2020 (<https://iapp.org/about/what-is-privacy/>), accessed 29 May 2025).

⁵⁹ Greenleaf G. Global, Tables of Data Privacy Laws and Bills, 7th Edition (February 11, 2021) 169 Privacy Laws & Business International Report; 2021:6–19. <http://dx.doi.org/10.2139/ssrn.3836261>, accessed 29th May 2025).

⁶⁰ Kirch D.G., Petelle K. Addressing the physician shortage: the peril of ignoring demography. *JAMA*. 2017;317(19):1947–1948. [[Google Scholar](#)]

Telehealth, via remote interactions, available anywhere and anytime. Such services are relevant for underserved regions and places lacking specialists and help reduce costs and prevent unnecessary exposure to contagious infections at the regular clinics. Telehealth technology is also relevant in developing countries where the healthcare system is expanding and where healthcare infrastructure can be designed to meet the current needs.⁶¹ While all of these concepts or solutions are quite clear, helpful and much appreciated - thus potentially improving patient outcomes by reducing morbidity and mortality, there is still need for continuous research, effective regulation and substantial independent monitoring to ensure the optimum and equitable use of AI, patient safety, security and continued respect for their privacy and personal data.⁶² That is because existing and emerging AI technologies, including large language models, are being rapidly deployed without a full understanding of how such AI systems may perform – potentially either benefitting or harming end-users, including health-care professionals and patients.

RECOMMENDATIONS

- a) Promote and facilitate digital health competencies in the education and training curricula of all health professionals and allied workers;
- b) Promote capacity-building for leaders of public health authorities, affiliated agencies and policy-makers to take informed decisions to support digital health investments.
- c) Public awareness campaigns and programmes should be engineered towards improving digital health literacy at the population level. That should involve engagement of patients, families and communities, and education of patients about improvements in healthcare technology, its pros and cons. That is because creating international, national and community-based communication campaigns to sensitise people on the benefits of AI technologies to health solutions and the use of their data for public interest research, will promote and enable people to be actors and encouragers of innovation.
- d) Establish proper monitoring and evaluation models to facilitate monitoring the deployment, use or contribution of AI and other digital systems to healthcare processes, health workforce processes, and individual and community health needs.
- e) All healthcare and service providers should undergo a strong and reliable digital identification, authentication and authorization processes that align with nationally appropriate means as well as global standards that will help build or

⁶¹ Combi C., Pozzani G., Pozzi G. Telemedicine for developing countries. *Appl Clin Inform.* 2016;07(04):1025–1050. [[Google Scholar](#)]

⁶² Adam B, Kaveh M, The rise of artificial intelligence in healthcare applications. doi: [10.1016/B978-0-12-818438-7.00002-2](https://doi.org/10.1016/B978-0-12-818438-7.00002-2) Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7325854/> on June 24, 2025

- guarantee trust in the collection, processing, storage, management and exchange of patients' health data.
- f) Privacy and data protection should be considered during the design and deployment of AI systems. Early in the development process, developers should consider gaining a good understanding of applicable data protection regulations and privacy laws and should ensure that the development process meets or exceeds such legal requirements. It is also important to consider implementing a compliance programme that addresses risks and ensures that the privacy and cybersecurity practices take into account potential harm as well as the enforcement environment.
 - g) Further research and enforceable regulation are necessary to ensure the optimum and equitable use of AI and to overcome challenges such as data insecurity, lack of awareness or technical-know-how on AI techno, algorithmic bias, and other ethical and liability issues.
 - h) To overcome ethical issues such as algorithmic bias, lack of transparency and explainability, etc., surgeons need to attain a sound technical knowledge of AI and work alongside scientists and AI experts from ideation, development, and training and up to deployment and usage stages. This is to ensure its ethical use as well as its best practical use in assessing patient risk factors and making surgical decisions with the utmost precision.
 - i) In furtherance of compliance monitoring, policy makers, healthcare providers and governments need to stay updated with changes in regulations and industry best practices to ensure ongoing compliance. Regular review and update of laws, policies, procedures, and controls to align with evolving privacy and security requirements, is paramount.