

World Health Organisation

The question of integrating AI and emerging technologies in healthcare systems

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Introduction

The integration of Artificial Intelligence (AI) and emerging technologies into healthcare systems has dramatically increased in the past decade. Since the mid-20th century, healthcare systems have faced persistent challenges such as aging populations, rising costs, and unfair access to healthcare. Artificial Intelligence (AI) was introduced as a turning point in comparison to past reforms focused on financial structuring and the formation of new policies. The use of artificial intelligence has already shown great potential, and it has contributed to crucial developments in fields including pathology, drug discovery, genomics, radiology and prevention. However, there are ethical, legal, commercial and social issues with the use of AI in healthcare. Although AI is not the only source of these issues, for half a decade, the use of computers and software in healthcare has generated obstacles for developers, governments and providers. These have since been exacerbated with the emergence of AI, presenting new ethical issues that go beyond the scope of traditional regulators and healthcare participants. If it is to be widely used for the sake of improving human health, addressing the issues of protecting human autonomy and providing fair access to AI technology are integral first steps of development. In this report, we will explore the potential of Artificial Intelligence in transforming healthcare systems, the ethical and social challenges it introduces, the main contributors involved in this development, and the potential solutions that can be established in response to AI's challenges.

Definition of Key Terms

Artificial Intelligence (AI)

Artificial Intelligence refers to computer systems that can perform complex tasks normally done by humans. This includes decision making, reasoning, creating, etc.

Algorithm

An algorithm is a step-by-step set of instructions a computer follows to solve a problem or perform a task, such as sorting data or making predictions.

Data set

A dataset is a structured collection of data used for analysis or to train algorithms.

Algorithmic bias

Algorithmic bias refers to the production of unfair, inaccurate or discriminatory outcomes due to biased data, flawed design or lack of representation of diverse groups.

General Overview

Artificial intelligence has already demonstrated a lot of promise and helped advance important areas including pathology, drug development, genetics, radiology, and prevention. Furthermore, it has also shown potential in helping health-care providers prevent errors when treating patients and handling challenging medical situations. However, AI systems are currently unable to reason in the same way that experienced doctors can, based on their “common sense” or “clinical intuition experience” that they have developed during their years of work (Bajwa et al.). Instead, AI identifies correlations and patterns in large data sets in order to make decisions/diagnoses, rather than making conclusions based on hands-on experience and context clues. Healthcare institutions are now starting to use AI technology to automate repetitive and time consuming procedures. Additionally, significant progress has been made in showcasing AI’s application in precision diagnostics (such as radiotherapy planning and diabetic retinopathy).

Further elaborating on the advantages of AI, AI uses big data sets to evaluate patients’ risk exposure and predict disease. For instance, Google has partnered with health delivery networks in order to incorporate prediction models that notify physicians of high-risk illnesses like sepsis or heart

failure (Chustecki). These models can also be used in order to predict populations at risk of certain diseases.

AI has largely advanced surgical practices in recent years. In fields like gynecology, prostate surgery and oral and maxillofacial procedures, robotic systems have improved both the accuracy and consistency of surgical operations. Additionally, AI-driven telesurgery makes it possible for operations to be performed remotely while also allowing for enhanced monitoring of the surgical process. Furthermore, AI-assisted surgical mentorship enables experienced surgeons to provide real time support and feedback to their coworkers during procedures, ultimately leading to better surgery outcomes.

The implications of AI in healthcare systems

Although AI has tremendous potential for the medical field, there are a number of social and ethical issues that come with implementing this technology into medicine. For instance, oxygen administration - one of the most frequent medical therapies - measures levels in the blood through a pulse oximeter. This pulse oximeter measures oxygen saturation by sending infrared light through the skin. Due to the device's systemic error of overestimating the oxygen-saturation levels in non-white patients, the measurements taken by this device are known to vary based on the skin color of the patient. Therefore, compared to white patients, patients with darker skin are three times more likely to experience an occult hypoxemia (low levels of oxygen in blood) that is not identified by pulse oximeters. This example demonstrates how inequalities in healthcare can begin with systemic errors and clinical measurements, which can develop into incorrect medical judgements on entire patient groups, something which can be largely amplified by the integration of AI. Because AI is currently a technology that uses data-based conclusions to approach medical situations, the absence of representation of several groups of the human population leads to AI reinforcing the bias it has interpreted from these medical datasets. This is an issue that can lead to potentially fatal outcomes and misdiagnoses when using it as a decision-making tool illustrating the danger of biases within traditional tools being systemically embedded into AI frameworks, and thus magnified.

Additionally, the integration of AI into healthcare raises various ethical concerns. General Data Protection Regulation (GDPR) was put into force in the European Union (EU), which modified privacy laws in other nations such as the US and Canada. According to these regulations, the union-based processor or controller processes all personal data as well as the operations of foreign communities and businesses in order to adequately protect the information of natural persons -

meaning that GDPR applies to any entity that handles EU citizens data, no matter where its located in order to protect patient information. In addition, employers are prohibited from making discriminatory judgements based on patients' genetic health information in the US by the GINA (Genetic Information Non-discrimination Acts). As mentioned before, the role of AI in medicine is to analyse data sets in order to improve diagnoses and outcomes, accelerating health research activities and analyzing consumer data. Whilst these are apparent advantages to AI, there are nevertheless still some important concerns about robots possessing patient data.

Building on this issue, a key concern is accountability in these frameworks. Specifically, who is responsible if AI makes a harmful or even life threatening medical decision. Traditional healthcare liability is based on human error, but AI complicates this by introducing algorithmic decision-making with minimal human oversight. If a misdiagnosis occurs due to an AI algorithm, the rising question is "who is to blame?" - the software developer, the healthcare provider, or the AI system itself?

Furthermore, the social gap issue is another social implication that comes from incorporating AI into healthcare and AI growth overall. An increase in social inequality and lack of social justice is introduced as AI is put into the picture, mainly due to the lack of accessibility of AI in LEDC's, widening the gap between developing and advanced countries. This gap creates a two-tiered global health system where wealthy nations benefit from the incorporation of AI in medicine, and underdeveloped countries like Haiti, South Sudan or Nepal where healthcare systems are already fragile miss opportunities to address issues such as disease outbreaks. For instance, AI in the U.S. is helping doctors detect cancer (specifically skin cancer) early while clinics in sub-Saharan Africa may still struggle with access to clean water, basic diagnostic equipment or trained personnel. The result is a growing health divide where AI advancement increases global health inequality. Without international support or investment in AI medical systems, these countries are at risk of becoming permanently excluded from the benefits of AI-driven healthcare.

Additionally, it appears challenging and essentially impossible to integrate AI into *every* aspect of healthcare. Humans and medical robots might not evolve together in a short time because of the emotions that are personal to the human experience. Autonomous robotic systems do not communicate with each other in the same way that humans do when they seek or provide consultation to each other. Furthermore, in the near future it seems improbable that patients consent to machine to human consultation rather than traditional human to human consultation in healthcare. Further, the patients' healing process is greatly impacted by the empathy and compassion

with which doctors and nurses are expected to treat them. For instance, any examination in gynecology and obstetrics requires an empathic and compassionate environment fostered by the doctors/nurses, which robotic physicians and AI cannot provide.

Major Parties Involved

WHO (World Health Organisation)

The WHO has involved themselves in the integration of AI by ensuring that ethical and safe guidelines are placed on the use of such mechanisms in medicine, and that the development of AI is accessible to all countries. In 2021, WHO published a report *"Ethics and Governance of Artificial Intelligence for Health"*. This report outlined the six core components of responsible use of AI: human autonomy, safety, transparency, accountability, equity and sustainability. WHO's impact is especially crucial for standardising best practices and aiding nations with weak frameworks. WHO also draws attention to the possibility that if AI technologies continue to be researched and developed in high-income countries then global health disparities are bound to worsen. WHO sets themselves as the regulatory framework that encourages transparent, ethical and safe use of Artificial Intelligence in the medical field.

The European Union (EU)

On August 1st 2024, the EU introduced the European Artificial Intelligence Act, also known as the AI Act - the first regulation framework on AI by a major regulator globally. The AI Act aims to set clear obligations, regulations and guidelines on AI developers. Three risk categories are assigned to AI applications by the Act. First, programs and platforms that pose an intolerable risk are banned. Second, specific legal requirements apply to high-risk applications - such as CV scanners that rank job applicants. Finally, applications that are not classified as high-risk or banned are not subject to regulation.

In addition, focusing on the medicinal aspect of ethical AI use that the EU has contributed to, the EDHS (European Health Data Space) entered into force in 2025. This data space fosters ethical standards, compliance and data protection while still allowing for state-of-the-art AI solutions to advance by permitting the training, testing and evaluation of algorithms. This includes algorithms used in digital health applications, medical devices and AI-driven clinical support systems. The European Commission has also stated that the EDHS enables individuals to take charge over their

health information and facilitates the transfer of data for healthcare delivery throughout the EU, allows for the consistent, reliable and effective reuse of health data for research, policy making and innovation and promotes a genuine single market for electronic health record systems. By doing so, the EDHS allows the EU to use and reuse health data for the benefit of patients, researchers, innovators and regulators, as well as to fully profit from the promise of a safe and sure exchange of data. Similar to WHO, the EU contributes to the ethical development of AI by enforcing regulatory frameworks and guidelines to AI developers.

The United States of America (U.S.A.)

As a frequent user of Artificial Intelligence, The United States plays a leading role in the integration of AI in medicine. The U.S. is home to major AI healthcare providers/developers such as Google Health, Amazon Web Services and IBM Watson Health. These developers have all created AI tools for diagnostics, imaging, hospital operations and personalized treatment plans. Regarding regulations, the U.S. Food and Drug Administration (FDA) has taken the lead in authorizing and monitoring AI technologies. In 2021, the FDA introduced the "Artificial *Intelligence and Machine Learning Software as a Medical Device*" (SaMD) action plan, which outlines a framework for regulating continuous learning algorithms in clinical settings. Medical institutions like the Mayo Clinic and Stanford Health Care are major integrators of AI in medical trials, specifically in areas like cancer detection, robotic-assisted surgery and digital diagnostics. The United States still faces many obstacles despite its quick development in AI. These challenges include algorithmic bias, protecting patient data and addressing inequalities in access to AI medical innovation. Despite this however, the country still manages to set the standard for AI development globally.

China

China being one of the main nations that firmly support the use of AI in their medicine, have applied AI in their healthcare systems through government-backed programs like “Healthy China 2030”. Since president Xi Jinping has placed health at the core of the nation’s whole policy-making process, it is now official government policy to incorporate health into all policies. The government’s enormous political decision to spend on health was made clear at the China National Health Conference (2016), the most significant national health gathering in two decades. After this conference, China’s leaders made sure that health became a clear national political priority by having the State Council and China’s Central Party Committee approve the “Healthy China 2030” plan. With this plan, China aims to transform its healthcare systems using 4 strategic pillars as guidance to

achieve their goal: Equitable access and outcomes, healthcare systems transformation, technology and innovation, and environmental sustainability. Focusing on their third pillar, China has incorporated AI and big data into its healthcare system in order to support the "screening-diagnosis-treatment" pathway. This refers to the full process of detecting a disease early(screening), identifying it early(diagnosis) and delivering proper care(treatment). As a result of this, the project screened out more than 3000 cases of colorectal cancer while also managing to complete risk assessments/tests for nearly 4.6 million people. This example demonstrates China's active contribution to the usage and development of AI in medicine along with the highly positive impacts it can have on a nation's healthcare efficiency.

Timeline of Key Events

1972	One of the first Artificial Intelligence programs in medicine - MCYIN - was developed in Stanford. It was designed to diagnose and treat blood infections based on patients' recorded symptoms and medical test results
2016	China National Health Conference is held and "Healthy China 2030" action plan is created
2019	Racial algorithmic bias found in U.S. healthcare algorithm
2021	WHO publishes "*Ethics and Governance of Artificial Intelligence for Health*", which outlined the 6 core principles of ethical AI use.
2021	European Commission proposes the AI Act
2023	China begins to expand "Healthy China 2030" plan
August 1st, 2024	European Artificial Intelligence Act (AI Act) is implemented

Previous Attempts to solve the Issue

The European Artificial Intelligence Act

Being proposed in 2021 and then adopted in 2024, the EU AI Act was developed in order to have a legal framework to regulate AI, and it was the first Act to do so. As concluded before, it requires strict testing, transparency and human oversight for medical AI systems before exchange across EU countries. Its impact has been largely positive, as it set a global precedent for AI regulation and pushed developers to prioritize ethical design and safety. It has improved trust in AI healthcare tools and greater accountability across EU member states.

WHO ethical guidelines

In 2021, WHO published a report "*Ethics and Governance of Artificial Intelligence for Health*". This report outlines the six core principles that countries and developers should follow when designing and regulating AI systems: human autonomy, safety, transparency, accountability, equity and sustainability. These principles emphasize the importance of keeping human reasoning at the center of AI care, ensuring that AI systems are understandable and explainable, and reducing the possibility of there being algorithmic bias in medical data sets. As the first comprehensive global framework of its kind, this report serves not only as ethical guidance but also as a foundation for future international cooperation on AI regulation, particularly in countries that lack robust legal or technological infrastructure.

OECD AI Principles

The OECD (Organisation for Economic Co-operation and Development) created a set of internationally agreed upon principles for trustworthy AI. These principles emphasize key values such as transparency, robustness, fairness, accountability, and respect for human rights, encouraging governments and developers to design AI systems that are trustworthy and beneficial to society. The principles specify that AI must be clear and comprehensible, operate with dependability and security, and be applied in ways that avoid fostering bias or discrimination. These principles are among the most widely accepted models for AI governance in the world, having been adopted by over 40 nations, including OECD members and a number of non-members like Argentina, Brazil and Singapore. The OECD principles have influenced national policies, regulatory strategies and ethical codes even though the principles are not legally binding. They represent an international

commitment to using AI in ways that reflect democratic values and public welfare. The principles also act as a model for nations creating their own AI laws.

UK NHS AI Lab

The NHS AI Lab was created by NHS England and the Department of Health and Social Care to foster the safe, ethical, and effective adoption of AI in medicine. It was established in 2019 with an initial investment of £143 million - £170 million from the Department of Health and Social Care. The Lab serves as an enabler and strategist, offering resources including case studies, procurement guidance, an AI knowledge repository, and assistance with regulation and incident reporting to developers, physicians, and politicians. Early evidence that AI tools financed by the Lab have produced substantial cost savings and patient care improvements was discovered in a 2024 independent study by the University of Edinburgh and NHS Arden & GEM. One non-elective diagnostic tool saved over £44 million for over 150,000 patients. It also noted the main obstacles to scaling AI, including workforce readiness, technological integration, and procurement challenges, emphasising the continued need for coordinated leadership, consistent funding, and clinician involvement. The NHS AI Lab remains crucial to the UK's role in shaping the future of AI in healthcare.

Healthy China 2030

Established in October 2019, the "Healthy China 2030" action plan was launched in order to set a framework for governments to partner with private technology firms to responsibly integrate AI into healthcare systems. It's a national policy framework that places health at the center of China's development, with one of its four structural pillars focusing on "technology and development". As mentioned earlier, China works towards modernizing health infrastructure, diminishing disparities regarding access to AI, and creating a model of state-led health development.

Possible Solutions

Artificial Intelligence "Shadowing" clinical trials

In this setup, the AI technology runs in real-time alongside human healthcare professionals but does *not* influence any medical decisions in the process. Meanwhile, it generates its own diagnosis while analysing the patients symptoms and complaints and then compares its results to

those of the human doctors it was working with. This system allows AI systems to be tested on their accuracy, safety and decision making in healthcare without putting patients at risk. Further, hospitals can track blind-spots in the technology and then adjust the algorithm or decide if it's ready for real use. It also builds trust between physicians and AI by letting them see first hand how AI performs without having to be expected to depend on it in high-risk situations.

Global AI error-reporting network

This network, which should likely be led by organisations like WHO, would allow hospitals and physicians to anonymously report AI errors. This system would collect cases of misdiagnosis, data misinterpretation or bias by AI technologies, and notify AI developers and healthcare providers/researchers to learn from past mistakes and improve algorithms that often have cases of algorithmic bias. It would also provide data for global policy development, helping countries at different stages of AI integration to predict risks and adopt the best practices.

“Patient check-in” AI feature

As established throughout this report, AI technology has the ability to analyse data to make scientifically based decisions on patient treatment. However, it has become aware that AI does not embody the emotional intelligence needed when taking care of patients. The “Patient Check-in” feature addresses this need by allowing AI systems to detect discomfort or emotional distress in a patient's tone, and then immediately alerting a doctor or nurse when the system is triggered. This ensures that AI supports and does not replace the gap of emotional intelligence that human nurses or doctors fill, and builds trust in patients by showing that there is always a human worker available when they need one.

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