Commentaries

Leapfrogging the primary care gap: How artificial intelligence can be used as a tool for universal health coverage in low-resource setting

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Introduction

In 1946, the World Health Organization (WHO) declared that the enjoyment of the highest attainable standard of physical and mental health is one of the fundamental rights of every human being.[1] Over 70 years have passed and 194 member states have adopted the principles of this constitution, yet over half of the world's population still do not have full coverage of essential health services, including primary care.[2] In accordance with the 2030 Sustainable Development Goals (SDGs), all WHO member states have agreed to achieve universal health coverage (UHC) by 2030.[3] Since the adoption of the SDGs, both governments and grass-roots organizations have created, piloted, and/or scaled a plethora of unique programs and strategies to increase access to essential health services. Many of these programs have been enabled using Artificial Intelligence (AI) technologies. The basis of AI technology is mimicry of the human thought process. Like the human brain, AI can perform tasks or reasoning processes to solve problems. Modern, narrow AI methods, powered by machine learning, enable computers to learn how to perform specific tasks and conduct constrained reasoning processes from large sets of data without being explicitly programmed how to do so.[4] This discussion focuses on the various uses of AI technologies as they apply to primary care, with a focus on low-resource settings.

AI in Primary Care

While AI has been used in many different settings for the past few decades, it has recently permeated into healthcare sector, both on a systemic level and at the bedside.[5] AI has been demonstrated to use multifaceted algorithms to identify patterns of illness and respective symptomatic presentations from large volumes of health data. This health data can include small datasets such as practice-specific data, or larger datasets from relevant medical journals, clinical guidelines, and textbooks. These patterns are then used to support clinical decision-making processes by family physicians and nurses.[6,7] In addition, AI systems have been shown to recognise patterns of diagnostic and therapeutic errors that are sometimes unavoidable in human clinical practice. This can help identify areas of personal improvement for clinical staff.[8] Moreover, AI technology can be used to extract useful information from a medical practice's patient population to assist with real-time inferences for health risk alerts and identifying local changes in illness patterns.[9]

Leapfrogging Classic Delivery of Primary Care

Addressing the primary healthcare gap in low- and middle-income countries (LMICs) is imperative to the attainment of the SDGs. While there are many universal primary care systems across the globe, most are in high-income countries. However, following the path of established health systems in high-income nations requires a great deal of financial and human resources.[10] For instance, Nigeria has approximately 14% of the number of doctors per capita relative to the Organization for Economic Cooperation and Development (OECD) average. To fill this gap in the health workforce by 2030, Nigeria would need to train approximately 12 times as many physicians. This comes with an approximate cost of US$ 51 billion – ten times the current annual Nigerian public health spending.[11]

Creating sustainable modes of healthcare delivery in low- and middle-income countries requires innovation. While AI technologies are currently being used in the context of healthcare across various high-income countries, their use in LMICs is minimal. However, AI offers the prospect of low-cost, high-yield solutions to improving access to primary care services in emerging economies. While this may not follow archetypal methods of healthcare, AI may offer a means to leapfrog the classic delivery of health services seen in high-income nations with developed health systems.

AI has a variety of potential uses to support health systems in LMICs. This potential has been identified at the level of the United Nations (UN). In 2017 and in 2018, the UN hosted a global meeting to discuss the development and use of AI applications as a tool for poverty alleviation through the delivery of critical public services, including primary healthcare services.[12] Furthermore, a great deal of pilot studies have emerged exploring the applications of AI to improve individual and population health in low-resource settings. These studies usually identify the predominance of mobile phone penetration as being remarkably high in LMICs. This in conjunction with developments in cloud computing and significant national investments in telemedicine and mobile health (mHealth) infrastructure at the level of government ministries has created an optimal environment for the implementation of AI technologies in healthcare systems across various LMICs.[13,14]

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AI in Low Resource Settings

Using AI technologies as a means to supporting healthcare services in LMICs has a great deal of potential in various realms. This includes increasing access to personalized healthcare support, guiding diagnostic power and treatment choice for community health workers, and streamlining the use of evidence-based medicine.

Increasing Access to Personalized Healthcare Support

With the boom in the telecommunications industry in various emerging economies, many people, regardless of income bracket, own a mobile phone. The International Telecommunications Unit estimates that there are 98.7 mobile-cellular telephone subscriptions per 100 people in LMICs.[15] This level of phone ownership has allowed for the success of various innovations in mHealth. Many start-up companies, as well as nationalized health systems use mHealth as a means to make primary care services more accessible to those who cannot reach and/or cannot afford classic methods of healthcare delivery. Many mHealth pilot programs utilize AI technologies to provide evidence-based health advice to their users. For instance, SophieBot, a healthcare app developed in Kenya, uses AI to answer personalized questions on sexual and reproductive health posed by service users through text or voice chats.[16] SophieBot, like many other AI-supported mHealth initiatives, provides people with the tools to address minor health concerns without having to physically see a primary care provider, and triage more serious health concerns while directing them to the most appropriate level of healthcare provision. This can be essential for people who do not have the means to access standard healthcare services. However, an AI-supported mHealth model of healthcare delivery has not yet been optimized to the level in which a physician can approach clinical presentations in complex, heterogeneous populations. It is imperative that clinical decision-making involves the societal, clinical, and personal contexts of an issue. This is especially pertinent in low-resource settings, wherein an intersectional approach that acknowledges both the physical and social determinants of health are accounted for when making a treatment plan. As such, questions arise around the lack of a humanistic element to the delivery of these AI-enabled health services.[17]

Guiding Diagnostic Power and Treatment Choice for Community Health Workers

In recent years, community health workers (CHWs) have been the driving force of success for many large-scale public health initiatives in various LMICs, including antenatal screening, vaccination, and cervical screening programs. CHWs are able to provide basic healthcare services and are essential front-line health workers in rural and remote areas of many countries. This invaluable health workforce can be supported by AI technologies to provide health services that address the most common health issues seen in primary care settings. For instance, CHWs can input signs and symptoms, or pose individualized health questions to an AI platform that uses standard clinical practice guidelines to support their clinical decision-making process. By expanding the cadre of health services that CHWs can provide, people in remote areas can have many of their minor health issues addressed in their communities. With that said, these technologies must have a human-centred design to ensure that they are simple and user-friendly.

Evidence-Based Medicine

AI may be used to support primary care physicians in using evidence-based medicine to identify and treat more complex diseases that may otherwise require referrals to higher levels of care. While evidence-based medicine is a widely accepted practice, it is often difficult for physicians to stay up-to-date with constantly changing diagnostic and treatment guidelines. Current AI technologies can provide highly personalized data to support clinical diagnoses and treatment through analyzing millions of data points in medical literature and rapidly identifying pertinent patterns that match a patient's presentation. This detailed analysis combined with a primary care physician's understanding of a patient's medical and social needs can allow for an evidence-based approach to healthcare delivery that appreciates the unique social, emotional, and cultural milieu of each patient. This is especially pertinent in resource-limited settings where referral services are physically, financially, or temporarily inaccessible to patients.

Conclusion

AI technologies provide great potential in revolutionizing the delivery of primary care services in low-resource settings. In the race to achieving universal health coverage by 2030, AI can act as a tool that improves access to low-cost, evidence-based healthcare advice and services in LMICs, especially in remote areas. Furthermore, AI can support primary care physicians in providing high-quality, patient-centred care through highly tailored delivery of evidence-based diagnostic and treatment guidelines. While AI has already demonstrated its effectiveness in improving access and quality of care in a variety of low-resource settings, many of these projects have been implemented on small scales. The expansion of these technologies requires acknowledging the novel gaps and issues that arise from AI-enabled health services. For instance, the lack of a humanistic element to AI-enabled health services may impede on the holistic delivery of healthcare services. Furthermore, the use of cloud-based technologies raises legal and ethical implications regarding confidentiality and security of personal health data. Ultimately, AI technologies developed using a robust ethical framework have the potential to enable the provision of accessible, acceptable, and affordable primary care services, especially to those that are out of the reach of their current healthcare system.

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