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ARTIFICIAL INTELLIGENCE AND NEUROLOGY - OPPORTUNITIES AND CHALLENGES IN PAKISTAN

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The field of artificial intelligence (AI) has undergone rapid development in neurological disorders over the past few decades. AI relies on large volumes of high-quality data. As a result, their use in low-resource settings has been limited due to the lack of a digitized health care system. This article will address the challenges and opportunities involved in implementing AI for neurological care in Pakistan, as well as discuss the types of digital health care data and the benefits of applying AI in resource-limited countries.

MULTI DIMENSIONALITY OF DATA IN HEALTHCARE

We live in a data-rich environment, and technologies like virtual care, digital health, and digital therapeutics are anticipated to capture the high-quality data generated at the source to provide raw data for AI studies. Fortunately, health care data is multidimensional in nature in that it can be obtained from multiple sources and is ever-evolving with time (Figure 1a).¹ By digitizing the national health care storage system, Pakistan may also be able to leverage AI to develop accurate health information tailored to its population, which is an essential step towards precision medicine.

APPLICATION OF AI IN NEUROLOGY

There has been recent rapid growth in AI particularly in Neurology to detect and diagnose both acute and chronic neurological disorders. The process has been particularly successful in the field of Vascular Neurology where machine-learning algorithms are excellent for identifying infarcts or hemorrhages by converting the images into voxel matrices (segmentation) that allow for classification, grading, and prognostication.² These findings are significant for resource-limited countries such as Pakistan where stroke-trained neurologists are in shortage and many eligible stroke patients may not receive intravenous thrombolytic therapy because of a delay in diagnosis leading to increased morbidity and mortality. Furthermore, in epilepsy, the diagnosis of psychogenic non-epileptic seizures (PNES) is often achieved through long-term video electroencephalographic (EEG) monitoring, which is not readily available in Pakistan. Consequently, it is common for PNES to be missed, resulting in considerable chronic disability. Intriguingly, Vasta and colleagues demonstrated that PNES could be identified by machine learning algorithms combined with multivariate neuroimaging procedures.³ It included an automatic parcellation of the cortex by hemisphere, and metrics for thickness and surface area of the pial were used as features of the machine-learning algorithm. To diagnose PNES, the following parameters were used: cortical thickness, cortical surface area, and subcortical volume. Using this method, PNES were correctly distinguished from controls with an accuracy rate of 74.5%. There is no question that resource-limited countries can benefit from this technology since it may facilitate earlier diagnosis of PNES, resulting in fewer hospitalizations and avoidance of extensive EEG video testing. Besides diagnosing acute neurological disorders, AI has also been shown to aid in diagnosing chronic neurological diseases as well. For example, tremor is the most common movement disorder complaint presented in clinics, and an exciting study by Varghese and colleagues has shown that using deep learning algorithms in data collected via smartphone-based questionnaires and tablet-based Archimedean spiral drawings can assist in detailed tremor analysis, leading to quicker diagnosis.⁴ This is, in fact, a cost-effective technology that can be implemented in Pakistan. In addition, a study conducted in the UK demonstrated that deep learning algorithms employing imaging techniques and clinical judgment in language and behavioral variants of frontotemporal dementia could provide a more accurate clinical diagnosis and be economically feasible.⁵ Therefore, AI can facilitate the diagnosis and treatment of neurological diseases with more efficiency and accuracy for many patients in Pakistan.

EMERGING CONVERGENCE OF TECHNOLOGIES

Artificial intelligence can also be applied to the interpretation of multi-dimensional data and the development of algorithms that facilitate timely diagnosis which would be facilitated by the convergence of digital technologies within the healthcare industry (Figure 1b). AI will continue to gain significance in the foreseeable future as physicians and the healthcare industry rely on it to generate knowledge, identify trends, and develop algorithms which form the basis of critical decision-making.

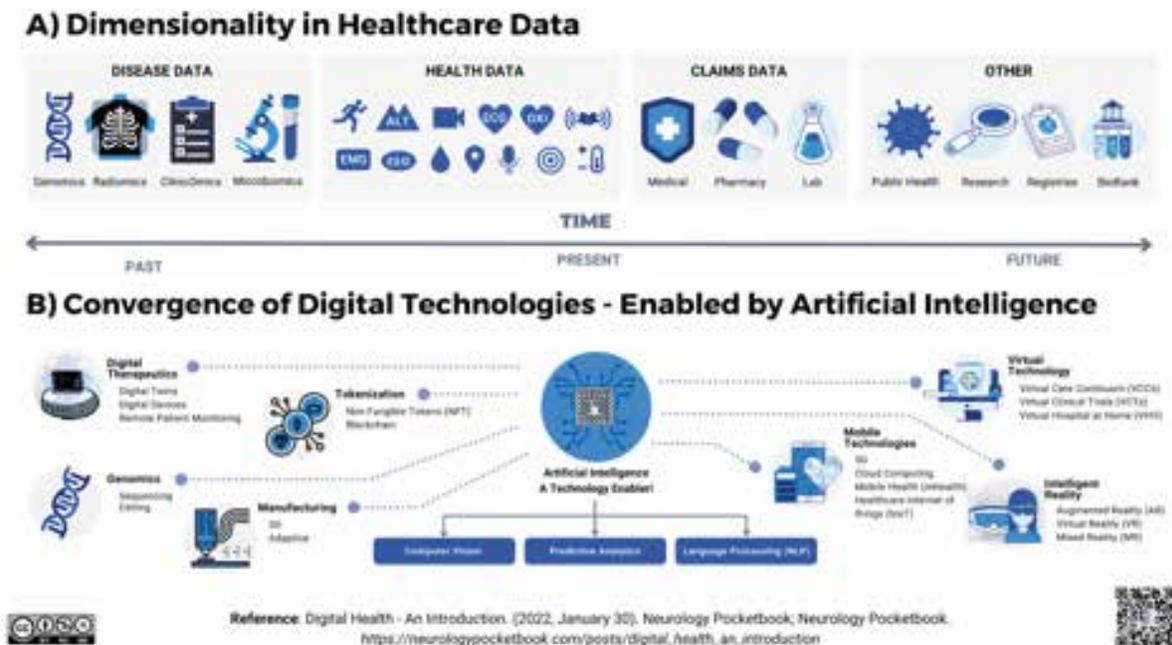
APPLICATION OF AI IN PAKISTAN

There is already evidence that high-income countries benefit from integrating AI into their healthcare ecosystem, thereby saving billions of dollars.⁶ Nevertheless, AI can have an impact on public health in resource-limited countries such as Pakistan, where mobile phone penetration has been rapidly expanding along with advances in cloud computing. Unfortunately, no substantial investments have been made in digitizing health information or implementing mobile health services. These factors have primarily affected the collection of high-quality health care data in Pakistan, which is necessary for the development of AI algorithms for prevalent neurological disorders in the country. For example, supervised machine learning applications require high-quality datasets used for identifying risk factors and making accurate health diagnoses using machine learning algorithms. Pakistan can consider using the OpenMRS system as many African countries do to build the infrastructure for a national electronic medical health system that would aid in the setting up of AI in the country.

CONCLUSION

AI holds tremendous potential for transforming healthcare services in Pakistan through a variety of critical public services. Innovation centers should be established in Pakistan that encourage collaboration between computer engineers and medical professionals. Furthermore, data science and AI should be introduced to medical school curricula. Additionally, resources should be allocated to develop a national electronic medical health system to assist in establishing AI in the country. Finally, the development of AI tools for resource-poor settings should be a priority in future research and investment, which will enhance the potential of AI to improve global health.

FIGURE 1: DIMENSIONALITY IN HEALTHCARE DATA (A) & CONVERGENCE OF DIGITAL TECHNOLOGIES -ENABLED BY ARTIFICIAL INTELLIGENCE (B)



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Adeel A Memon; data collection, data analysis, manuscript writing, manuscript review

Junaid S Kalia; data collection, data analysis, manuscript writing, manuscript review



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