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The Role and Application of Artificial Intelligence (AI) in Leveraging Big Data in the Healthcare Domain

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A B S T R A C T

The increasing incidence of diverse diseases and various forms of cancer on a global scale underscores the urgency for innovative preventive and therapeutic approaches within healthcare. Advanced stages of diseases and certain types of cancers, frequently resistant to traditional treatment methods, highlight the critical significance of early diagnosis. Detecting these conditions at an early stage significantly enhances the prospects for successful intervention and treatment. In the realm of healthcare, the advent of technologies like digital imaging has revolutionized the way patient information is captured. This has led to the accumulation of vast datasets, necessitating a shift towards more sophisticated analytical tools. Artificial Intelligence (AI) emerges as a crucial player in this scenario, leveraging its capabilities to sift through and interpret the extensive patient data with remarkable efficiency. By harnessing the power of big data, AI not only facilitates more effective analysis but also holds the potential to revolutionize the early detection process for various types of cancers. The synergy between artificial intelligence and extensive patient data sets a promising foundation for advancing diagnostic capabilities and ultimately improving patient outcomes. In this letter, the role of AI in utilizing big data in the healthcare domain is examined. Additionally, some leading centers in the field of collecting large datasets for early detection of cancers are introduced.

Keywords: *Healthcare, Artificial Intelligence, Big Data, Machine Learning.*

1. Introduction

In recent decade, many chronic diseases, cardiovascular diseases, and various types of cancers have become prevalent worldwide in different societies (1). This trend may be a result of the aging population, increased stress levels, and the prevalence of modern lifestyles such as insufficient physical activity and the consumption of processed foods (2). The prevalence of these diseases and cancers in today's societies is one of the serious challenges in the field of public health, accompanied by widespread and multifaceted effects. This increase in prevalence includes issues such as rising healthcare costs, increased pressure on healthcare systems, and economic and social impacts resulting from diseases. Increasing public awareness of risk factors and lifestyle changes is effective in mitigating this trend. Additionally, cultural beliefs and attitudes may directly influence the prevalence and early detection of diseases and cancers (3). Effectively addressing these challenges necessitates comprehensive and coordinated efforts from communities, governments, and health organizations. These efforts should aim to enhance the treatment and management of patients while simultaneously fostering preventive measures and awareness regarding risk factors.

Most cancers are identified after individuals experience symptoms that prompt them to seek medical evaluation (4). This often means that cancers are diagnosed when they are locally invasive or metastatic, and no longer treatable with surgery or radiation therapy. Early detection of cancer in its initial stages, when treatment is likely to be most effective, offers the highest chances of survival to patients. Early diagnosis of various cancers has crucial benefits in the field of health and treatment. Early detection provides the primary advantage of increasing the likelihood of effective and successful treatment for patients. With early detection, the possibility of identifying and treating the early stages of cancers increases, minimizing the delay in the disease process and its progression (5). This not only extends the lifespan of patients but also reduces healthcare costs. Furthermore, early diagnosis contributes to reducing mortality rates associated with specific diseases, mitigating negative economic and social impacts. Additionally, early diagnosis plays a significant role in prevention and allows for more effective preventive measures (3). Overall, early diagnosis plays a fundamental role in improving the quality of life for individuals, reducing healthcare costs, and controlling the progression of various diseases and cancers.

Today, the use of new technologies in the healthcare sector, such as digital imaging techniques, molecular biology diagnostics, and the creation of electronic patient records, has resulted in the generation of big and diverse data related to patients (6). Big data includes information from medical tests, medical images, disease histories, and genetic information, which, through precise analysis, can provide valuable insights for the early diagnosis of various cancers. The utilization of big data in the early detection of cancers introduces new capabilities for improving the diagnostic process and patient management (7). Furthermore, big data empowers healthcare professionals to quickly and accurately examine complex patterns and relationships within the data. This information can serve as effective decision-making tools for physicians, enhancing the diagnosis, treatment decision-making, and prediction of disease outcomes (8). Certainly, the management of big health datasets and the methods for their analysis to discover inherent patterns require advanced approaches, which will be further explored in the continuation of this discussion.

2. Discussion

The effectiveness of big data in the early detection of cancers heavily depends on how big healthcare datasets are stored. If the storage of large healthcare data is done in a unified and targeted manner, the mentioned benefits can be realized. For this reason, various national research projects worldwide have been established to collect and store large healthcare datasets for the prevention and early detection of various cancers. In 2019, in Bangladesh, a project named "Amader Gram" was initiated to establish a cancer center, privately operated and supported by the government of Bangladesh (9). This center focuses on comprehensive community healthcare, addressing the diagnosis and treatment of non-communicable diseases. It provides primary care, cancer services, and care for other non-communicable diseases. Moreover, in Sri Lanka, the Cancer Early Detection Center (CEDC) of the Ministry of Health has successfully offered early cancer detection services for the country in recent years, with public and private collaboration (10). This center conducts screening and prevention guidance for common and preventable cancers, including breast and cervical cancer screenings. The Early Cancer Detection Clinic at Massachusetts General Hospital (Boston) was established for research in early cancer detection by the General Cancer Center (11). The initial visit at this clinic involves a comprehensive consultation with an oncology specialist or an Advanced Practice Provider (APP). Additional tests may include mammography, CT scans, colonoscopy or endoscopy, PAP smear for women, MCD blood tests, biopsy, and screening for individuals with a potential genetic predisposition to cancer. For patients and families with a hereditary cancer risk, this clinic offers comprehensive care, including preventive screening options, genetic tests, and education.

Canary Center at Stanford is a global research center dedicated to early cancer detection programs (12). The mission of this center is to discover and implement low-invasive diagnostic and imaging strategies for the early and treatable detection and prediction of cancers. The Canary Center is the world's first center conducting research in both in vivo and in vitro diagnostics, providing these tests through advanced facilities and collaborative research programs in molecular imaging, proteomics, chemistry, cellular, and molecular imaging (12). They are also in the process of building a cancer diagnostic platform that aims to provide a response for next-generation cancer care worldwide. The Early Cancer Institute at the University of Cambridge is the only British institution dedicated to early cancer. This institute is a leading global center for research

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in early cancer detection. It forms a highly interdisciplinary and collaborative ecosystem of experts striving to innovate early detection technologies. Currently, they comprise eight research groups, with their main research objectives being risk prediction, early cancer detection, and monitoring to prevent the development of fatal cancers. They also conduct big data analysis and AI for developing predictive risk tools, collaborating closely with the Epidemiology of Genetic and Genomic Medicine Center at the University of Cambridge, England.

The growth of big data has rendered traditional research approaches insufficient to cope with the challenges of data analysis. Consequently, there has been an increasing trend in the use of AI methods and approaches to provide alternative solutions. AI utilizing machine learning, mathematical models, and computer algorithms, aims to mimic and simulate human cognitive functions (13). This technology encompasses various subfields such as machine learning, natural language processing, computer vision, and intelligent programming. By combining the computational capabilities with advanced algorithms, AI serves as a powerful tool across diverse domains, from healthcare to industry, finance to transportation, education to entertainment (14). Key applications of AI include natural language processing for understanding and generating human texts, computer vision for image and video detection and interpretation, and intelligent programming to enhance system performance. One of the critical aspects of AI is its ability to analyze big data, predict complex patterns, and make intelligent decisions (15). Machine learning, utilizing large datasets, enables the extraction of intricate patterns and the creation of predictive models for intelligent decision-making through computer computations.

AI leverages big data in the healthcare domain to enhance processes related to diagnosis, prevention, and disease management (16). One prominent application of AI in this field is the early detection of diseases and cancers. Through precise analysis of large medical datasets, including medical images, laboratory data, and patient records, machine learning algorithms can identify patterns and disease-related samples, leading to more accurate and faster disease diagnosis (16). In fact, AI models, utilizing big data analytics, can identify hidden patterns and samples in the data, even in the early stages, accurately diagnosing cancer. Furthermore, in the realm of prevention, AI can assist individuals and healthcare professionals by analyzing data on chronic diseases and creating preventive models, enabling more effective preventive measures. Based on big data, AI systems can rapidly analyze patterns and changes in population health and recommend preventive actions tailored to specific community needs (17). AI also plays a crucial role in disease management and treatment planning. Big data can be used to predict the need for specific treatments, provide decision support for healthcare professionals, and enhance monitoring systems for healthcare services. This technology can have a significant impact on improving the quality of healthcare services, reducing costs, and increasing effectiveness in patient treatment. In conclusion, AI benefits from big healthcare data to develop innovative and optimized solutions in the areas of diagnosis, prevention, and disease management. By establishing connections between different datasets, this technology enables more intelligent decision-making and contributes to improvements in healthcare systems.

3. Conclusion

Research on AI techniques in big healthcare data proves invaluable, offering essential insights and details crucial for the health community. This exploration sheds light on the practical applications of these methods, addressing the specific needs and interests within the healthcare domain. AI uses big healthcare data to revolutionize diagnosis, prevention, and disease management. Notably, it excels in early disease detection by analyzing big medical datasets, particularly images and records, leading to accurate and rapid diagnoses. In prevention, AI models analyze chronic disease data to create tailored preventive measures using machine learning techniques. In disease management, AI predicts treatment needs, supports decision-making for healthcare professionals, and enhances monitoring systems. This integration of AI and big data significantly improves healthcare quality, reduces costs, and increases treatment effectiveness. Ultimately, AI offers innovative solutions by leveraging vast healthcare datasets, improving decision-making, and enhancing overall healthcare systems.

Authors' Contributions

H. J: Conceptualization of the study, Literature review. N. B: Manuscript drafting, and critical revision.

Transparency Statement

Not Applicable.

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Declaration of Interest

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Ethics Considerations

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References

1. Finney Rutten LJ, Blake KD, Skolnick VG, Davis T, Moser RP, Hesse BW. Data resource profile: the national cancer institute's health information national trends survey (HINTS). International journal of epidemiology. 2020;49(1):17-j. [PMID: 31038687] [PMCID: PMC7124481] [DOI]
2. Majnarić LT, Babič F, O'Sullivan S, Holzinger A. AI and big data in healthcare: towards a more comprehensive research framework for multimorbidity. Journal of Clinical Medicine. 2021;10(4):766. [PMID: 33672914] [PMCID: PMC7918668] [DOI]
3. Fitzgerald RC, Antoniou AC, Fruk L, Rosenfeld N. The future of early cancer detection. Nature medicine. 2022;28(4):666-77. [PMID: 35440720] [DOI]
4. Crosby D, Bhatia S, Brindle KM, Coussens LM, Dive C, Emberton M, et al. Early detection of cancer. Science. 2022;375(6586):eaay9040. [PMID: 35298272] [DOI]
5. Ibrahim J, Peeters M, Van Camp G, de Beeck KO. Methylation biomarkers for early cancer detection and diagnosis: Current and future perspectives. European Journal of Cancer. 2023;178:91-113. [PMID: 36427394] [DOI]
6. Karatas M, Eriskin L, Deveci M, Pamucar D, Garg H. Big Data for Healthcare Industry 4.0: Applications, challenges and future perspectives. Expert Systems with Applications. 2022;200:116912. [DOI]
7. El Khatib M, Hamidi S, Al Ameeri I, Al Zaabi H, Al Marqab R. Digital disruption and big data in healthcare-opportunities and challenges. ClinicoEconomics and Outcomes Research. 2022:563-74. [PMID: 36052095] [PMCID: PMC9426864] [DOI]
8. Guo C, Chen J. Big data analytics in healthcare. Knowledge Technology and Systems: Toward Establishing Knowledge Systems Science: Springer; 2023. p. 27-70. [DOI]
9. Amader Gram Cancer Care & Research Center. Available from: https://www.agcancercare.org/.
10. Cancer Early Detection Centre. Available from: https://www.nccp.health.gov.lk/en/cedc.
11. Mass General Cancer Center. Available from: https://www.massgeneral.org/cancer-center.
12. Canary Center at Stanford for Cancer Early Detection. Available from: https://canarycenter.stanford.edu.
13. Wang H, Fu T, Du Y, Gao W, Huang K, Liu Z, et al. Scientific discovery in the age of artificial intelligence. Nature. 2023;620(7972):47-60. [PMID: 37532811] [DOI]
14. Zhang B, Zhu J, Su H. Toward the third generation artificial intelligence. Science China Information Sciences. 2023;66(2):121101. [DOI]
15. Rubinger L, Gazendam A, Ekhtiari S, Bhandari M. Machine learning and artificial intelligence in research and healthcare. Injury. 2023;54:S69-S73. [PMID: 35135685] [DOI]
16. Loh HW, Ooi CP, Seoni S, Barua PD, Molinari F, Acharya UR. Application of explainable artificial intelligence for healthcare: A systematic review of the last decade (2011–2022). Computer Methods and Programs in Biomedicine. 2022:107161. [PMID: 36228495] [DOI]
17. Sun L, Gupta RK, Sharma A. Review and potential for artificial intelligence in healthcare. International Journal of System Assurance Engineering and Management. 2022;13(Suppl 1):54-62. [DOI]

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