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Commentry

Modern Era of Artificial Intelligence in Breast Cancer Screening and Diagnosis

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Breast cancer is one of the most significant threats to woman health in 21st century. While early therapy reduces the death rate, late diagnosis can be lethal. In united states, it is prevalent among women, with an estimated 55720 cases of female breast ductal carcinoma in situ (DCIS) and 297790 cases of invasive disease expected in 20231. Importantly, breast cancer survival rates vary greatly depending on the country, with high-income countries seeing rates of over 90%, while India and South Africa report rates of 66% and 40%, respectively2. Effective early detection and treatment methods have proven successful in high-income countries and should be utilized in areas with limited resources, where certain standard tools are already available. Additionally, most breast cancer drugs are already included in the WHO Essential Medicine List (EML), indicating that significant improvements in breast cancer outcomes can be achieved by implementing existing successful practises on global scale3. Despite improved therapeutic response in advanced breast cancer patients with molecularly targeted therapy still failed to attain better outcomes due to extensive breast cancer heterogeneity4-7. Therefore, we require enhanced risk assessment models for breast cancer to enable personalized screening approaches that achieve better outcomes with earlier detection and improved harm-to-benefit ratios than current screening guidelines. Till date, the exponential growth of computational power has spurred the artificial Intelligence (AI) revolution, enabling deep learning to enhance the predictive capabilities of imaging. As a results, AI-based imaging data has emerged as one of the most promising tools for precise breast cancer screening8-9. AI is a broad term that refers to diverse methods of enabling machines to replicate human decision making, which bridges computational radiology, machine learning (ML), and Deep learning (DL). Computational radiology detects lesions, classifies them according to breast Imaging Reporting and Data Systems (BIRDS), and model therapy responses through imaging biomarker extraction based on predictive and prognostic values with systematic reporting for diagnosis. ML is a subset of AI that encompasses method enabling computers to learn from training examples without explicit programming of extracted features10-11. However, ML relies on having significant predictive features in the input data for optimal performance. Importantly, DL was created to enhance the efficacy of artificial neural networks through the use of deep, multi-layered structure12-15. Moreover, the computational medical imaging field has observed a revolution in AI, thanks to the emergence of DL-based convolutional neural networks (CNNs). The DL- based CNNs have not only increased the usefulness of imaging in predictive models but have also became a promising tool for computerized breast imaging in breast cancer screening. Several studies have developed DL models of various architecture to improve the reproducibility of breast density assessment. These models are trained to automatically classify mammographic images into BIRDS density categories using assessment made by radiologists16. The field mammography based AI research is rapidly evolving with an increasing number of studies being conducted to assess breast cancer risk. Interestingly, it has already been hypothesized that the integration of AI in breast cancer screening has the potential to significantly improve the picture quality and accuracy of early cancer detection. Moreover, AI algorithms are utilized in the early breast cancer detection and treatment, using data from radiomics and biopsy slides. This is supported by a global effort to reduce false positive in mammograms. In 2023, a case was reported in The New York Times where AI software detected potentially cancerous area that were missed by doctors17. This demonstrates the usefulness of AI in cancer treatment and raises question about the boundaries between AI and human intelligence. Based on the current observation, AI could revolutionize current method of breast cancer screening and treatment with better therapeutic outcomes. Yet, the question of where to draw the line between AI and human intelligence remains unclear to clinician and computation scientists. AI relies on data collected from populations, leading to disparities in data from different socioeconomic condition and races. The credibility of AI studies is assessed through set outcomes that must be applicable. For AI to be fully accepted, a common code must be available to everyone, requiring equal data sharing. Also, the limited use of radiomics in clinical practice and the small size of retrospective studies limits AI's application in breast cancer screening. However, AI could potentially replace or aid radiologist in the future due to its non-invasive nature. Further research could increase AI's power in breast cancer screening.

The use of AI in breast cancer screening is of great importance as it can help identify cancer earlier than human oncologists, leading to improved chances of successful treatment and ultimately saving lives. It can also enhance the efficiency and accuracy of doctors in their diagnosis, reducing stress and fatigue. Moreover, AI-based diagnostic tools can deliver results superior to those attained by radiologists working alone, improving medical treatment. Although, cancer treatment decision must not only account for the diverse forms and progression of the disease, but also for patient's individual condition and capacity to undergo and respond to treatment. The growing presence of AI in breast cancer screening has the potential to enhance risk assessment and facilitate personalized screening recommendations.

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