ARTIFICIAL INTELLIGENCE IN EARLY CANCER DETECTION: A NEW ERA IN ONCOLOGY

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Abstract. Artificial Intelligence (AI) has emerged as a transformative tool in the field of oncology, particularly in the early detection of cancer. By enhancing diagnostic accuracy and enabling faster analysis of medical imaging and biomarkers, AI offers the potential to significantly improve patient outcomes. This article reviews current applications of AI in cancer screening, highlights clinical successes, and discusses ethical and practical challenges associated with its implementation.

Keywords. Artificial intelligence; Cancer detection; Oncology; Machine learning; Imaging diagnostics; Early diagnosis; Healthcare technology.

Introduction. Early detection of cancer is widely recognised as a critical factor in improving survival rates and reducing treatment costs. Traditional diagnostic methods, including imaging and biopsy, though effective, are limited by subjectivity, inter-observer variability, and delays in interpretation. The application of artificial intelligence (AI) in oncology seeks to address these limitations by automating and augmenting diagnostic processes.

Machine learning (ML) and deep learning (DL) algorithms have been developed to analyse radiological images, pathology slides, and genomic data. AI-powered tools such as convolutional neural networks (CNNs) have demonstrated exceptional accuracy in identifying early-stage cancers, including lung, breast, and colorectal cancers. AI systems trained on large datasets have been shown to outperform radiologists in certain diagnostic tasks, particularly in mammography and lung nodule detection.

Furthermore, AI has been integrated with digital pathology to detect malignant features in histological samples with high sensitivity. Natural language processing (NLP) has also been applied to electronic health records (EHRs) to flag patients at risk and recommend appropriate screening protocols.

The integration of AI into cancer diagnostics has the potential to enhance detection speed and reduce human error. Early identification of malignancies can lead to less invasive treatments and improved prognosis. AI systems can also function in low-resource settings, where access to specialists is limited, thereby democratising healthcare.

Additionally, AI tools offer opportunities for real-time feedback during endoscopic procedures and can assist in triaging patients for urgent diagnostic evaluation. Predictive analytics powered by AI can help identify high-risk populations and personalise screening strategies based on patient history and genetic predisposition.

Despite its promise, the adoption of AI in oncology raises several challenges. Data privacy, algorithmic bias, lack of transparency in decision-making (the "black box" problem), and regulatory hurdles remain major concerns. Models trained on non-representative datasets may perpetuate healthcare disparities.

Clinicians must also be trained to interpret AI outputs appropriately, ensuring that human oversight remains central to patient care. Legal and ethical frameworks must evolve to govern the accountability and safety of AI-driven diagnoses.

Conclusion. Artificial intelligence represents a paradigm shift in the early detection of cancer. As technological capabilities continue to evolve, AI is expected to play an increasingly prominent role in diagnostic oncology. However, responsible implementation, guided by ethical standards and rigorous validation, is essential to harness its full potential and ensure equitable patient outcomes.

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