

Abstract

The early detection of breast cancer is critical to improving patient outcomes and reducing mortality rates. Machine learning (ML) has emerged as a transformative tool in this domain, leveraging advanced algorithms to analyze medical imaging and predict cancer risks with unprecedented accuracy. This study explores the integration of ML techniques, such as convolutional neural networks (CNNs) for image analysis and predictive modeling for personalized risk assessment, to enhance early detection capabilities. By processing large volumes of data from mammograms, ultrasounds, and MRIs, ML models demonstrate improved sensitivity and specificity, particularly in challenging cases like dense breast tissue. Predictive modeling further refines diagnosis by incorporating patient-specific data, such as genetic markers and clinical history, to deliver tailored insights. Despite these advancements, challenges such as data quality, model interpretability, and ethical considerations remain. This abstract outlines the potential of ML to revolutionize breast cancer screening, highlights its current limitations, and underscores the importance of interdisciplinary collaboration, robust validation, and ethical AI practices to ensure effective and equitable implementation in clinical settings.