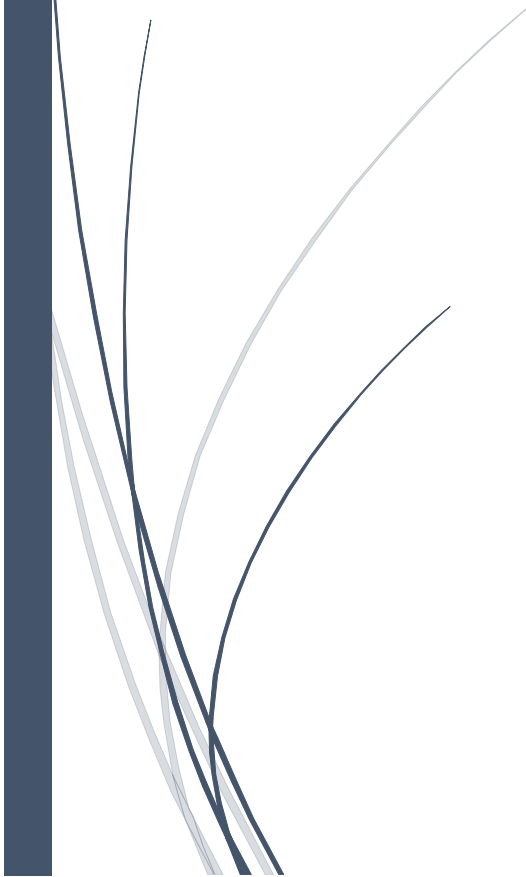


The logo for RADemics, featuring a dark blue vertical bar on the left and a blue arrow pointing right with the text "RADemics" inside.

RADemics

Future Trends and Clinical Case Studies in Smart Disease Diagnosis and Targeted Therapy

An abstract graphic consisting of several thin, curved lines in dark blue and light grey, originating from the bottom left and extending upwards and to the right.

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AL AIN UNITED ARAB EMIRATES, GURU GHASIDAS
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Future Trends and Clinical Case Studies in Smart Disease Diagnosis and Targeted Therapy

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Abstract

Rapid advancements in artificial intelligence, machine learning, precision medicine, and digital healthcare technologies have transformed modern disease diagnosis and targeted therapeutic strategies by enabling intelligent, predictive, and personalized healthcare solutions. Growing prevalence of chronic diseases, infectious outbreaks, neurological disorders, cardiovascular complications, and cancer has accelerated the demand for smart healthcare systems capable of delivering accurate diagnosis, real-time patient monitoring, and adaptive therapeutic interventions. Intelligent diagnostic frameworks integrating deep learning, wearable biosensors, explainable artificial intelligence, multimodal biomedical analytics, Internet of Medical Things infrastructures, and cloud-based clinical platforms contribute significantly toward enhanced disease prediction, automated medical image interpretation, and early-stage clinical decision-making. Simultaneously, targeted therapy supported through genomics, computational biology, intelligent drug discovery, digital twin technologies, and predictive therapeutic modelling has improved treatment precision and individualized healthcare management across multiple medical domains. This book chapter presents a comprehensive exploration of future trends and clinical case studies associated with smart disease diagnosis and targeted therapy within next-generation healthcare ecosystems. Detailed discussion includes AI-assisted diagnostic support systems, intelligent mobile healthcare applications, infectious disease detection and surveillance, quantum computing applications in precision therapy, wearable biosensor technologies, and AI-driven drug repurposing frameworks. Clinical case studies from oncology, cardiovascular medicine, remote patient monitoring, and infectious disease management demonstrate the practical implementation and translational impact of intelligent healthcare technologies in real-world clinical environments. Significant attention also addresses challenges associated with algorithmic bias, healthcare data security, ethical governance, explainability, interoperability, and regulatory standardization due to increasing integration of autonomous computational systems within healthcare infrastructures. Emerging convergence among artificial intelligence, federated learning, edge computing, digital twins, quantum analytics, and personalized therapeutic modelling indicates substantial transformative potential toward predictive, preventive, precision-oriented, and patient-centric healthcare systems capable of improving global clinical outcomes and healthcare accessibility.

Keywords: Artificial Intelligence, Precision Medicine, Smart Disease Diagnosis, Targeted Therapy, Digital Twins, Intelligent Healthcare Systems

Introduction

Rapid expansion of intelligent healthcare technologies has created a transformative shift within modern medical science through integration of artificial intelligence, machine learning, biomedical analytics, and precision medicine frameworks. Increasing prevalence of chronic diseases, infectious outbreaks, neurological disorders, cardiovascular abnormalities, metabolic syndromes, and cancer has generated substantial pressure upon global healthcare infrastructures, creating urgent demand for advanced diagnostic and therapeutic solutions capable of improving clinical efficiency and patient outcomes [1]. Conventional healthcare systems frequently depend upon manual interpretation, generalized treatment protocols, delayed laboratory investigation, and fragmented clinical workflows that reduce diagnostic accuracy and therapeutic precision [2]. Smart disease diagnosis emerged as a critical healthcare innovation through utilization of computational intelligence, predictive analytics, multimodal biomedical data processing, and automated clinical decision-support systems. Deep learning architectures, neural network frameworks, and intelligent pattern-recognition systems currently support rapid analysis of radiological imaging, histopathological slides, genomic sequences, physiological signals, and electronic health records for accurate disease prediction and early-stage diagnosis [3]. Intelligent healthcare infrastructures therefore contribute toward reduction of human error, enhancement of clinical reliability, and optimization of personalized medical intervention across multidisciplinary healthcare environments. Continuous advancement within computational medicine also strengthens preventive healthcare strategies through predictive disease surveillance and adaptive patient monitoring systems capable of supporting large-scale healthcare management [4]. Integration of cloud computing, edge intelligence, wearable biosensors, and Internet of Medical Things technologies further accelerates development of interconnected healthcare ecosystems capable of delivering real-time clinical services across hospitals, diagnostic laboratories, remote healthcare facilities, and mobile healthcare platforms [5].

Artificial intelligence-driven diagnostic systems currently occupy a central role within modern healthcare research due to exceptional capability for processing large-scale biomedical datasets and identifying complex disease-associated patterns inaccessible through conventional analytical approaches [6]. Machine learning algorithms and deep neural network models support automated interpretation of computed tomography scans, magnetic resonance imaging, ultrasound imaging, retinal photographs, microscopic pathological specimens, and molecular biomarkers with substantial diagnostic precision [7]. Intelligent computational frameworks strengthen disease classification, anomaly detection, prognostic evaluation, and therapeutic response prediction through continuous learning from multidimensional healthcare data repositories. Explainable artificial intelligence technologies also receive increasing attention due to growing demand for transparency, interpretability, and accountability within automated clinical decision-making environments [8]. Black-box computational models frequently create limitations regarding physician trust, ethical governance, and regulatory compliance due to absence of understandable diagnostic reasoning. Explainable frameworks including SHAP, LIME, Grad-CAM, and attention-based visualization techniques support transparent interpretation of predictive outcomes through graphical and statistical explanation mechanisms capable of assisting clinicians during therapeutic validation and diagnostic confirmation procedures [9]. Smart diagnostic systems integrating multimodal biomedical analytics combine imaging datasets, genomic information, physiological signals, laboratory investigations, and patient history records for generation of comprehensive

clinical profiles supporting precision healthcare delivery. Such technological convergence strengthens personalized disease management and accelerates transition toward predictive and patient-centered healthcare ecosystems capable of addressing diverse medical challenges across global clinical environments [10].