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Review Article

Artificial Intelligence (AI) in Diagnostics and Allied Health Sciences: Current Trends and Future Perspectives

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Abstract
Artificial Intelligence (AI) is rapidly changing the field of diagnosis and allied health sciences. This technology helps in detecting diseases, analyzing medical data, and improving the accuracy and efficiency of clinical decision-making. The aim of this review is to study recent research, current applications, and future possibilities of AI in allied health sciences. Technologies like machine learning, deep learning, and image recognition are now widely used in radiology, pathology, and laboratory diagnosis, leading to more reliable and accurate reports. However, issues such as data privacy, ethical concerns, and lack of trained professionals remain major challenges. If AI is used safely and ethically, it can greatly improve and advance the future of diagnostic and allied health sciences.

Keywords: Machine Learning, Deep Learning, Expert System, Automation, Recognition Algorithm, Quality control etc.

1. Introduction

The growing global demand for better healthcare, an aging population, and a shortage of trained medical staff have increased the need for modern technology in medicine. One of the most important technologies is **Artificial Intelligence (AI)**, which helps improve the accuracy, speed, and availability of healthcare services.

AI is a branch of computer science that allows machines to think, learn, and make decisions like humans. In diagnostics and allied health sciences, AI is used to automate routine tasks, analyse complex medical data, and support clinical decisions [1].

Machine Learning (ML) and **Deep Learning (DL)** are the main parts of AI. They can study large amounts of data to find hidden patterns and relationships.

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These methods are now widely used in **radiology**, **pathology**, and **laboratory diagnosis** to help in disease prediction, image interpretation, and patient record management. *By learning from new data, AI systems can increase diagnostic accuracy, reduce human errors, and improve treatment results* [2]. **Expert systems** are computer programs designed to store and apply the knowledge and experience of human experts in a specific area. They use a structured knowledge base and a reasoning process to reach logical conclusions and provide useful recommendations. Although the earlier versions of expert systems had limited ability to learn from new data, they laid the foundation for today's advanced, self-learning AI models. Modern expert systems are now more efficient, capable of improving their performance continuously, and play an important role in delivering accurate and personalized healthcare solutions [3].

2. Current Trends of Al in Diagnosis

Artificial Intelligence (AI) is rapidly transforming the way diseases are diagnosed and treated. *Today, AI tools are used in almost every area of healthcare to improve accuracy, save time, and reduce human error*. The current trend of AI in diagnosis focuses on early disease detection, automation of routine laboratory work, and personalized patient care. With continuous technological development, AI has become an essential part of modern diagnostic healthcare [4].

3. AI Microscopy in Various Medical Laboratory (pathology)

Artificial Intelligence (AI) is transforming diagnostic laboratory practices across **microbiology**, **hematopathology**, **histopathology**, and **cytopathology**.

- ***In hematopathology-*** AI-assisted **digital microscopy** can identify abnormal blood cells, detect anemia, leukemia, and other hematological disorders quickly and accurately. In microbiology, AI helps in the **automatic detection** and classification of bacteria, fungi, and parasites through image recognition and colony pattern analysis. It also supports antimicrobial resistance prediction, improving infection control.

- **In histopathology-** AI-powered image analysis systems can examine tissue slides to detect tumors, grade cancers, and differentiate between benign and malignant lesions with **high precision**. Similarly, in cytopathology, AI models assist in screening cytology smears such as Pap tests and fine-needle aspiration Cytology (**FNAC**) samples, identifying abnormal cells that may indicate early stages of cancer [5,6].

4. AI with Automation in Clinical Microbiology Diagnostic Techniques

Artificial Intelligence (AI) combined with laboratory automation is transforming the workflow of clinical microbiology by improving **accuracy**, **speed**, and **reproducibility**. *Automated culture systems integrated with AI can monitor bacterial growth in real time and analyze colony morphology based on size, color, texture, and hemolysis patterns* **(Fig.1).** Deep learning algorithms interpret digital plate images to identify common bacterial species such as E. coli, Staphylococcus aureus, and Klebsiella pneumoniae without manual observation [7].

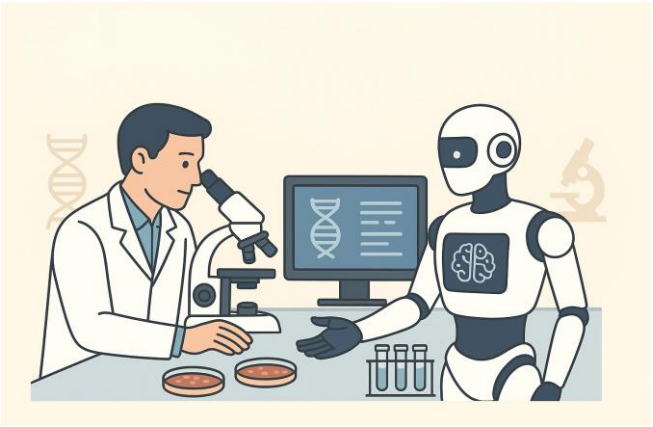

Fig. 1. AI in Microbiological Diagnostic Field

In antibiotic sensitivity testing, AI-driven systems like **Alfred60AST** and **BacterioScan** use automated optical sensors and predictive algorithms to detect antimicrobial resistance and generate susceptibility profiles much faster than conventional methods.

For biochemical identification, automated analyzers integrated with AI interpret multiple biochemical reactions simultaneously, reducing manual errors and standardizing results.

These systems can rapidly recognize enzyme activity, sugar fermentation, and other metabolic characteristics essential for bacterial differentiation [8].

AI also enhances **antigenic identification** by processing immunological data from **automated ELISA** and **lateral flow assays**. It helps detect microbial antigens or antibodies accurately, allowing early diagnosis of infections such as **malaria, dengue, hepatitis,** and **tuberculosis** [9].

AI-driven automation in microbiology enables continuous monitoring, faster reporting, and **higher diagnostic precision**. It minimizes human error, improves workflow efficiency, and supports data-driven decision-making in infection management.[10]

5. AI in Molecular Biology

Molecular biology deals with the study of **DNA**, **RNA**, and **proteins** to understand disease mechanisms. Traditional techniques such as PCR, RT-PCR, DNA sequencing, and microarray analysis are now being supported by AI systems [11].

- AI analyzes genomic data to detect **mutations**, **gene expression changes**, and identify the cause of infections.
  For example, AI-based **Next Generation Sequencing (NGS)** platforms can process and analyze millions of DNA sequences within hours, which earlier took several days [12].

- With the help of **bioinformatics**, AI predicts the structure and function of proteins.
  Tools like **AlphaFold** use deep learning to accurately predict how proteins fold — an important step in understanding diseases and drug design [13].

AI also helps in genome tracking of bacteria and viruses.During the **COVID-19** pandemic, AI systems analyzed **viral genomic data** to detect new variants and track the spread of infection [14].

6. AI in Biochemistry

Artificial Intelligence (**AI**) is helping laboratories make biochemical testing more accurate and reliable. By using special **computer programs** and **learning models**, AI can

study large sets of test results to find patterns linked to diseases. It improves the specificity and precision of reports by checking results with many existing data samples (**cross-validation**).

AI also supports *Point-of-Care Testing* (**POCT**) by providing rapid and accurate data interpretation directly at the patient's bedside. Through deep analytical processing, AI systems can differentiate minute chemical analytes that are difficult to detect manually. These systems minimize human error, enhance result consistency and provide early alerts for conditions such as diabetes, liver, and kidney disorders.*AI contributes to faster, smarter, and more dependable biochemical diagnosis* [15].

AI is also used in advanced instruments like **Mass Spectrometry (MS)** and H**igh-Performance Liquid Chromatography (HPLC) [**16].

These machines produce large amounts of chemical data, and AI helps to classify and interpret this data faster and more precisely.

7. AI and Automation Integration

The combination of AI and automation has completely changed the workflow in laboratories.From sample collection to final reporting, AI systems minimize manual errors and improve efficiency. Smart reporting systems highlight abnormal findings automatically. AI-based **decision support systems (DSS)** help doctors interpret lab reports. Predictive AI models track disease progression and support patient monitoring [17].

8. Future Directions

In the future, AI will lead to precision medicine, where diagnosis and treatment will be based on an individual's genetic and biochemical profile [18].
AI, combined with **robotics** and **cloud computing**, will create smart diagnostic laboratories that deliver faster, more reliable, and patient-centered results [19].

9. AI in Radiological Diagnosis

Artificial Intelligence (AI) has become a powerful assistant in **radiological diagnosis**, especially in the interpretation of **X-rays**, **CT scans**, **MRI, EEG, ECG,** and **ECHO** films. In some cases, early or subtle disease markers are not easily visible to the human eye, even for experienced radiologists. AI uses deep learning and **image-recognition algorithms** to study these medical films in detail and detect patterns that indicate the early onset of disease [20].

AI systems can identify minute lesions, soft tissue changes, abnormal waveforms, and structural variations that may be overlooked during routine interpretation. For example, AI can detect tiny lung nodules in chest X-rays, small infarcts in brain CT or MRI scans, and subtle changes in ECG or EEG wave patterns that suggest early cardiac or neurological disorders [21]

By comparing new images with vast digital databases, AI provides **cross-validation** and suggests probable diagnoses with high accuracy. These systems also mark suspicious regions, assisting radiologists in making faster and more confident clinical decisions.

***AI** acts as a second observer, enhancing the precision, sensitivity, and early detection capability of radiological investigations, while ensuring that the final judgment remains in the hands of trained specialists* **(Fig 2).**

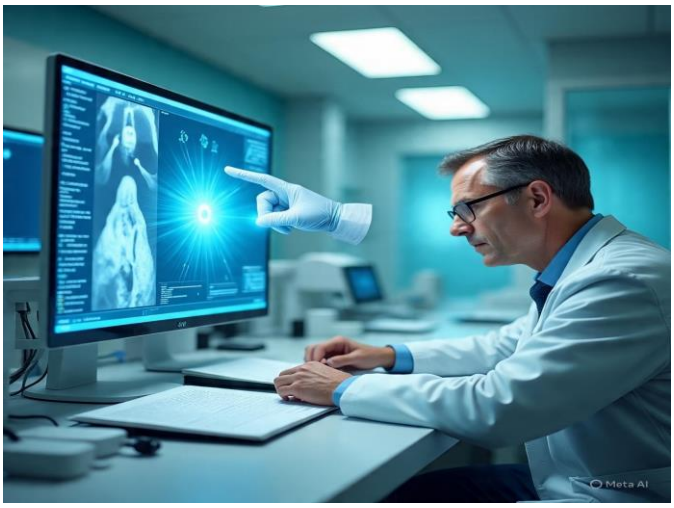

Fig.2 AI in Radiolgy Diagnosis

10. AI in Optometry Diagnosis

Artificial Intelligence (AI) is transforming diagnostic practices in **optometry** and **ophthalmic sciences**. Eye diseases such as **diabetic retinopathy**, **glaucoma**, **age-related macular degeneration (AMD)** and **cataract** often show early microscopic changes that may not be visible during routine eye examinations. AI-based systems use retinal imaging, fundus photography, and **optical coherence tomography (OCT)** to automatically detect and classify these subtle abnormalities [22].

Using deep learning and image analysis algorithms, AI can identify small lesions, blood vessel changes, or optic nerve damage from **high-resolution retinal images**. It can also measure parameters like **cup-to-disc ratio** or retinal thickness to support glaucoma and macular disease diagnosis.

AI tools assist optometrists in screening large populations, reducing manual workload, and ensuring early detection of sight-threatening disorders. These systems also compare

current eye scans with large image databases for cross-validation, improving diagnostic accuracy and consistency [23] **(Fig.3).**

Fig.3 AI in Optometric Diagnosis

11. AI vs Diagnostic Professionals: Career

The rise of Artificial Intelligence (AI) in diagnostics has created both progress and concern. AI-driven systems now perform complex image analysis and lab interpretation with remarkable speed and precision, reducing dependence on human expertise. For many diagnostic professionals, this shift brings an emotional challenge — the fear of being replaced by machines they once operated [24].

Routine tasks once handled by skilled technologists are now automated, leading to uncertainty in career stability and reduced opportunities for manual expertise. Yet, no algorithm can replace the intuition, empathy, and clinical reasoning that come from human experience. The future of diagnostics depends not on competition between AI and professionals, but on their collaboration — where human intelligence guides artificial precision [25].

12. Conclusion

Artificial Intelligence (AI) should be used as a supportive tool under the guidance of skilled professionals and technologists, not as a complete replacement for human expertise. *The goal of AI in healthcare must be to assist, not to dominate — ensuring that decision-making remains in human hands* **(Fig.4).** AI should be developed in a way that connects modern technology with natural and human values, promoting harmony between innovation and life. The future of medical science must integrate AI's precision with human compassion and **NATURE'S** balance, creating a healthcare system that is both advanced and humane.

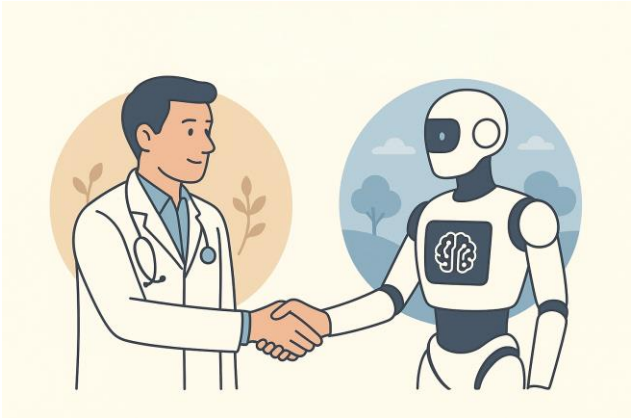

Fig. 4. Mutual Understanding between Nature and Artificial Health Care.

Conflict of interest: Author declares that there is no conflict of interest.

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