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Artificial Intelligence in medicine: Potential and Application Possibilities - Comprehensive literature review

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Abstract

Artificial intelligence (AI) is transforming modern medicine by enhancing diagnostic accuracy, personalizing treatment, and streamlining clinical workflows. This literature review explores AI's potential and practical applications across five key medical domains: psychiatry, ophthalmology, radiology, emergency medicine, and dermatology. In psychiatry, generative AI models support mental health through personalized interventions and symptom tracking, while in ophthalmology, multimodal learning improves early detection of eye diseases. Radiology benefits from AI-driven imaging analysis, increasing efficiency and diagnostic precision across various specialties, including neuroradiology and breast imaging. Emergency medicine sees promise in AI's integration for rapid triage and decision support, though legal and interpretability challenges persist. In dermatology, AI enhances both aesthetic evaluations and diagnostic accuracy through advanced image recognition. Despite significant benefits, issues such as algorithmic bias, lack of transparency, and legal responsibility demand careful consideration. The review underscores the need for responsible implementation of AI systems that prioritize augmentation of human expertise rather than replacement.

Key words: AI, Medicine, Future

1. Introduction

Artificial intelligence (AI) is increasingly recognized as a transformative tool in healthcare, particularly for enhancing accessibility, affordability, and anonymity in psychiatric diagnosis and treatment. Its capacity to replicate human cognitive processes such as learning from data and making informed decisions makes it especially valuable in the realm of machine learning (ML), which forms the foundation of many AI systems by enabling them to identify patterns in large datasets [1].

In clinical practice, AI's potential expands further through multimodal applications. These systems integrate various types of patient data, including medical imaging, electronic health records, voice recordings, and genomic information, to offer a more comprehensive picture of an individual's health. By synthesizing data from multiple modalities, AI can contribute to more accurate diagnoses, more effective treatment plans, and more efficient patient monitoring [2].

Particularly around accountability for AI-driven decisions highlight the need for cautious and responsible implementation. While AI enhances healthcare by supporting a more holistic and calculated approach, it remains a tool that requires human oversight, with its effectiveness still largely dependent on the user [2].

Understanding public and professional trust in AI is another critical factor for successful integration into healthcare systems. A study by Shevtsova and colleagues aimed to explore what influences trust and acceptance of AI in medicine through a rapid review and survey. Nineteen key factors were identified and categorized into four main areas. Survey responses revealed that 84% of these factors were seen as highly relevant, with only a few such as patient age, gender, and education considered less important. These insights emphasize that most human, technological, ethical, and legal aspects are essential to earning trust in medical AI. The findings offer valuable guidance for stakeholders including hospitals, tech developers, research institutions, and policy makers looking to ensure the responsible and timely implementation of AI in healthcare [3].

The concept of AI itself dates back to the mid-20th century. It was first formally introduced by John McCarthy during the 1956 Dartmouth Conference, which is now considered the foundational event in AI's development as a scientific discipline [5]. Since then, AI has grown into a major branch of computer science dedicated to building systems capable of mimicking human intelligence. These systems are designed to analyze large volumes of data, extract insights, and make autonomous decisions paving the way for increasingly sophisticated applications across medicine and beyond [4].

2. Metodology

This review is based on a comprehensive analysis of peer-reviewed scientific literature. Inclusion criteria included articles on artificial intelligence, its applications in various fields of medicine and clinical usefulness, which are sequelae in English or Polish. Articles are available through PubMed database search and through manual search of journals.

3. The Potential and Threat of Using AI in various fields of medicine

After analyzing the available literature, we noticed significant potential of AI in many branches of medicine, which will be discussed in the following subsections.

3.1 Psychiatry and Mental Health

Advanced generative AI (GAI) technologies are increasingly recognized as powerful tools in the early identification and monitoring of mental health conditions, helping to facilitate timely interventions and more personalized support for individuals at risk [1,5]. Recent studies have shown that GAI can offer customized recommendations, including lifestyle adjustments and potential treatment strategies, to support users dealing with psychological challenges [1,6]. While counseling applications of GAI tend to focus on short-term, solution-oriented support for specific issues, therapeutic uses are broader and aim at addressing more complex, long-standing mental health problems. These therapeutic implementations include interventions rooted in traditional psychotherapy, music, visual art, and expressive writing [1,7].

Some models have been developed to generate motivational messages and positive reflections tailored to users' emotional states, while others use AI tools to deliver mindfulness-based interventions to reduce anxiety and improve overall mental health outcomes. Creative AI applications such as DeepTunes have merged emotion detection via facial recognition using convolutional neural networks with personalized music generation through LSTM models, creating music and lyrics that align with users' reported feelings. Similarly, systems like StoryWriter transform personal stories into real-time visual art, and fine-tuned models like GPT-2 have been used to compose poetry reflecting users' emotions, encouraging emotional awareness and regulation [1].

In clinical settings, advanced GAI has proven valuable for enhancing decision-making, streamlining documentation, prioritizing urgent cases, and offering nuanced treatment suggestions, thereby increasing both the speed and quality of mental health service delivery [1,5,6]. GAI has also been employed in goal-oriented applications, helping to improve diagnostic accuracy and therapeutic safety across various mental health interventions [1,21]. Nevertheless, several limitations persist, including the absence of human empathy, dependency on data volume and quality, and the unpredictability of algorithmic behavior [5].

Despite these drawbacks, AI shows substantial promise in the field of digital psychiatry. Tools like ChatGPT may support a range of mental health services from psychoeducation and emotional support to symptom tracking and behavior analysis thereby expanding the accessibility and reach of care [5]. Currently, most mental health chatbots are designed for anxiety and depression, but some address broader issues such as PTSD, autism spectrum disorders, dementia, phobias, substance use, and suicide risk. They have also been tailored to different populations, including children, adolescents, adults, older adults, and people with specific clinical needs [6,7].

Early chatbots like ELIZA laid the groundwork for conversational AI by responding to users in real time using Rogerian principles. Modern systems are more sophisticated and capable of screening users for psychiatric conditions such as depression, anxiety, psychosis, or substance misuse. They can make preliminary diagnoses, suggest treatment options, and even generate reports for users. Some advanced systems can predict psychotic episodes with notable accuracy. Chatbots now form a key part of digital mental health interventions, often using natural language processing to simulate therapeutic conversations. CBT remains the most widely used framework, as seen in platforms like Woebot [7].

3.2 Ophthalmology

In recent years, ophthalmology has become a prominent area for advancements in medical artificial intelligence, particularly through the integration of multi-modal AI approaches that have attracted substantial attention from interdisciplinary researchers. This combination of various data types and modeling techniques plays a crucial role by offering detailed and accurate insights essential for diagnosing visual and ocular disorders. By employing multi-modal AI methods in ophthalmology, healthcare professionals can improve diagnostic precision and efficiency, thereby reducing the likelihood of misdiagnosis and enhancing the overall management of eye health [8,9].

Recent findings suggest that multi-modal learning, especially in supporting the diagnosis of glaucoma and a range of fundus-related conditions, outperforms traditional unimodal methods. By merging data from different imaging sources, multi-modal models provide a more holistic and nuanced view, greatly enhancing the accuracy of diagnoses and enabling earlier detection and more tailored treatment strategies. The expansion of multi-modal deep learning in ophthalmology is therefore promising, offering reliable tools to boost both the effectiveness and accuracy of eye care [8,10].

Artificial intelligence is playing an increasingly vital role in identifying and monitoring glaucoma, one of the leading causes of irreversible blindness. While early research often focused on single data types such as retinal images or visual field analyses more recent approaches have fused diverse inputs like scans, photographs, clinical measurements, and patient profiles to achieve greater diagnostic accuracy. These comprehensive AI models have demonstrated strong performance in both glaucoma detection and progression forecasting. Nonetheless, a common drawback is that much of the training data originates from hospital settings or healthy individuals, limiting generalizability. To overcome this, new datasets have been developed using longitudinal data from real-world clinical environments. In parallel, novel AI architectures have been created to handle these complex data inputs, allowing more precise alignment and integration of information from multiple sources, thus offering enhanced tools for clinical use [8].

Another key area of AI application is in managing age-related macular degeneration (AMD), a primary cause of vision loss among the elderly, which occurs in both dry and wet forms [8,10]. Researchers have built models that successfully differentiate between healthy eyes and the two types of AMD by combining data from multiple sources. Studies have highlighted that blending imaging modalities such as optical coherence tomography (OCT) and angiography significantly boosts diagnostic effectiveness. Moreover, OCT is widely utilized in diagnosing various retinal issues including macular holes, epiretinal membranes, vitreomacular traction, macular edema, retinal detachment, retinoschisis, and choroidal tumors [8,10]. Although progress has been substantial, challenges remain, including imbalanced datasets across disease categories. AI is also being applied to forecast individual responses to drug therapies, facilitating personalized treatment planning by analyzing both imaging and clinical information. Public datasets like those from the Age-Related Eye Disease Study serve as essential resources for advancing AI-based diagnostic tools, though access is typically restricted and requires formal permission [8].

Diabetic retinopathy, a frequent complication of diabetes that can lead to serious vision impairment if untreated, has also benefited from AI advancements. Deep learning models are increasingly utilized to detect pathological features by combining multiple imaging modalities. These include merging color fundus photographs with techniques such as fluorescein angiography and OCT, significantly improving the detection and categorization of retinal abnormalities [8,11]. Multi-modal strategies have proven more effective than unimodal ones, especially in boosting diagnostic accuracy. However, some simplifications in AI methods like converting complex, multi-label classifications into isolated binary decisions may overlook the interconnected nature of eye diseases, diverging from how clinicians typically interpret such conditions. Advanced data fusion techniques, incorporating inputs like 3D imaging and widefield scans, are helping address this issue. Hierarchical fusion, in particular, has shown superior performance [8]. Still, the limited availability of extensive clinical datasets continues to pose a significant challenge [8,10]. Fortunately, publicly accessible resources like the EviRed dataset, which includes diverse scan and photographic data, are fostering further progress in using AI to improve early detection and management of diabetic retinopathy [8].

Beyond diagnostics, AI also holds promise for future applications in automated procedures such as robotic eye surgery and retinal laser treatments, signaling the expanding influence of artificial intelligence across the field of ophthalmology [10].

3.3 Radiology

Radiology has become a key area of innovation in medical AI, with major developments spanning machine learning for detecting intricate imaging patterns, deep learning to enhance image interpretation and streamline workflows, and natural language processing to support report generation and clinical decision-making [4,12]. Advanced deep learning techniques have achieved impressive results in interpreting medical images, aiding in the early identification of diseases and supporting individualized treatment planning [4].

These technologies assist radiologists by simplifying tasks such as interpreting scans, spotting anomalies, and supporting clinical decisions, which significantly reduces time spent on routine duties and allows greater focus on complex diagnoses. Furthermore, AI is reshaping the radiology workflow by boosting speed and precision at different stages, including the initiation of imaging requests, scheduling of scans, and the actual image analysis. Automating repetitive tasks improves efficiency and enables radiologists to dedicate more time to intricate clinical cases [4,12,13].

In neuroradiology, AI is extensively used to identify brain tumors, monitor neurodegenerative disorders, and detect emergencies like strokes or intracranial bleeding. Platforms like Aidoc assist by promptly flagging critical issues, enhancing diagnostic speed and accuracy in time-sensitive situations. Notably, AI has greatly improved the identification of brain tumors such as gliomas. Deep learning models can now detect serious conditions like hemorrhages, mass effects, and hydrocephalus on head CTs, forming the foundation of automated alert systems for life-threatening findings [4].

In breast imaging, AI demonstrates excellent performance in identifying subtle tissue changes that might be missed by human observers. Deep learning has significantly improved early breast cancer detection, particularly through mammography [4,12]. Studies show that AI can match or surpass experienced radiologists in identifying interval cancers those often missed in routine screenings. It is also applied to digital mammography and breast tomosynthesis data to assess breast density, estimate cancer risk, and detect aggressive tumors, even in seemingly normal cases. Moreover, AI helps forecast tumor progression, leading to more tailored and timely treatment options [4].

Chest radiology has equally benefited from AI advancements, especially in diagnosing pneumonia, lung nodules, tuberculosis, and interstitial lung disease. AI systems have reached high levels of accuracy in identifying thoracic pathologies and have even outperformed radiologists in specific scenarios [4,12]. In emergency and intensive care units, AI tools are aiding in the quick detection of pneumothorax, heart failure, and pleural effusion, thereby improving decision-making under pressure [4].

Cardiac imaging also gains from AI, particularly in diagnosing coronary artery disease, evaluating heart function, and managing aortic aneurysms. AI-powered systems automate tasks like calcium scoring, plaque analysis, coronary stenosis measurement, and myocardial tissue characterization across CT, MRI, and nuclear scans. These innovations increase both diagnostic accuracy and efficiency, allowing radiologists to focus on complex cardiac cases [4,12]. In echocardiography, AI ensures consistency in measuring cardiac volumes, ejection fractions, and wall motion, which enhances diagnostic reliability. It also improves the assessment of aortic aneurysms by automating segmentation and predicting rupture risk, allowing for more personalized treatment plans [4].

Abdominal imaging has seen the adoption of AI for organ segmentation, identifying and categorizing lesions, and predicting outcomes. In liver imaging, deep learning helps differentiate between benign and malignant growths, improving accuracy in diagnosis and treatment. AI is also pivotal in the early detection of pancreatic cancer, often challenging to diagnose due to vague imaging signs. Additionally, it proves effective in identifying and managing kidney stones using CT and ultrasound. Machine learning predicts stone makeup, the risk of recurrence, and treatment outcomes, supporting more informed care strategies [4].

AI is transforming musculoskeletal imaging as well, improving the detection of fractures, joint disorders, and bone diseases. It assists with bone age assessments and arthritis monitoring. Deep learning models have shown strong performance in identifying fractures, especially hip fractures, across various imaging types. These systems offer faster and more dependable diagnoses, enhancing patient care. In rheumatoid arthritis, AI helps with early diagnosis, tracks disease progression, and informs treatment choices by analyzing imaging and clinical data [4].

Across all radiology subspecialties, AI improves patient care by guiding clinical decisions, optimizing workflows, and minimizing unnecessary imaging. These tools assess the appropriateness of imaging requests using patient history and established guidelines like those from the American College of Radiology, promoting better resource allocation and high-quality care. AI-driven chatbots and recommendation engines also assist referring doctors in selecting the most suitable imaging exams for their patients [4,12].

However, AI does have its downsides, such as the need for sophisticated infrastructure and the risk of missing important findings. Despite these challenges, one of AI's major benefits is its cost-saving potential, with estimates suggesting up to $200 million saved annually in the U.S. healthcare system [12].

3.4 Emergency Medicine

Once AI tools in medicine have been created and verified, the next critical step is their seamless incorporation into everyday clinical routines. If adopted on a large enough scale, AI could begin to shape or even lead the entire clinical decision-making process. Over time, medical professionals may come to depend more heavily on these systems, even when the complexity of their internal mechanisms makes it difficult to fully understand the basis of their recommendations [14,15].

AI has the potential to support multiple stages in emergency care, including self-triage, triage at the emergency department (ED), registration, physician consultations, and even during patient discharge [11,15-17].

In the future, healthcare is expected to shift toward a more preventive approach, catching diseases before symptoms appear. Nevertheless, emergency medicine will still play a vital role due to unpredictable incidents like trauma, infections, or acute medical conditions. In this context, AI may become increasingly embodied, utilizing robotics, visual recognition, and natural language processing to interact directly with patients and clinical environments [14,17].

However, several significant barriers still hinder the full integration of AI into healthcare systems namely legal, regulatory, technological, and philosophical issues. For example, when an AI tool provides a faulty diagnosis that causes harm, it's unclear who would be legally accountable the software developer, the attending physician, or the hospital itself. Current legal principles often place responsibility on physicians, which may discourage them from using AI in ways that deviate from the traditional standard of care, even if such use could benefit patients. Some argue that highly autonomous AI should be subject to stricter legal accountability, akin to that of medical devices with life-altering implications [14,17].

The fast-paced environment of emergency departments presents additional implementation hurdles. Clinical decisions here must be made swiftly and accurately [7,14]. For AI to be effective under such conditions, it must be capable of rapidly processing complex inputs from various medical sensors and offering real-time guidance in life-threatening situations like sepsis or pneumothorax. These high-stakes demands are more pressing than in slower-paced fields like oncology, where professionals have time to assess AI-generated insights [14].

A key aspect of AI's potential in medicine lies in its ability to reason. While AI excels at recognizing patterns, real-world medical decision-making also requires intuitive and analytical thinking skills often referred to as "common sense." Current AI systems attempt to mimic reasoning by identifying statistical trends, but they still lack the capacity for genuine logical inference. Improvements in this area could make AI more transparent and easier for clinicians to trust and use effectively [14,16].

This challenge is closely tied to the debate on interpretability. Some believe that if AI becomes highly accurate, it may not always need to explain its decisions in detail. Since neural networks theoretically have the capacity to replicate nearly any function, they could eventually generate ideal solutions for medical dilemmas. However, both doctors and patients remain cautious about accepting critical medical advice from opaque "black box" systems, especially when those outputs go against a clinician's expectations. As AI becomes more dominant, this lack of clarity may marginalize human input and complicate decision-making processes [14,15].

Ultimately, patients are expected to continue making the final decisions about their care, guided by medical professionals and AI assistance. The concept of "augmented intelligence" emphasizes that AI should serve to enhance not replace human expertise. Yet, if AI systems begin to outperform clinicians in particular tasks, healthcare may face a tradeoff between human involvement and optimized outcomes. Similar to how autonomous driving technology may one day limit human drivers to improve safety, medicine could gradually shift towards more AI-driven processes to boost precision and efficiency [14].

3.5 Dermatology

AI-powered dermatological assessment apps, widely accessible through mobile platforms, are raising concerns among dermatologists. Experts caution against their use due to the lack of transparency in their algorithms and the risk of inaccurate diagnoses [18].

Beyond these applications, AI holds promise in reshaping how skin barrier health is evaluated during aesthetic consultations. Traditional methods, such as measuring transepidermal water loss (TEWL) which assesses water evaporation from the skin may soon be replaced by AI-driven techniques that offer comparable accuracy. This also applies to the evaluation of sebum levels [19].

Furthermore, AI can assist in personalizing treatment plans, such as predicting the number of laser sessions needed for conditions like vitiligo, estimating the volume of filler required for aesthetic procedures, or assessing the potential effectiveness and suitability of proposed treatments. It also contributes significantly to educating patients and tracking their progress over time [19-21].

One of the most useful features of AI is its ability to noninvasively measure skin hydration levels with accuracy comparable to human evaluation. This can help practitioners save time while providing an objective measure of success after cosmetic procedures or serving as a baseline during the initial consultation [19].

AI also supports the identification of skin lesions and characteristics frequently mentioned by patients during appointments, improving clinical insight and diagnostic precision [19,22]. For example, recognizing specific pigment patterns or color variations on a patient's face helps determine the most suitable laser type and wavelength for treatment [19].

Classifying skin quality is a key aspect of cosmetic assessments. While conventional evaluations often rely on subjective visual inspection, the integration of image recognition and AI-based analysis enhances both precision and efficiency. This technological support is transforming not only consultations but also treatment planning, progress monitoring, and patient communication, paving the way for major advancements in the field of cosmetic dermatology [19].

Research has also demonstrated AI's diagnostic capabilities. It has shown accuracy comparable to experienced dermatologists in distinguishing between keratinocytic carcinoma and benign seborrheic keratosis, as well as malignant melanoma and nevi [22].

Moreover, AI has matched dermatologists in analyzing dermatoscopic images, and in some cases, its sensitivity surpasses that observed when evaluating clinical photographs [22].

Even more impressively, AI has outperformed dermatopathologists in differentiating histopathological patterns of skin nevi and melanoma. This underscores its growing potential in the routine diagnosis of various skin conditions, including melanoma, nevi, and seborrheic keratosis [22].

Taken together, these capabilities highlight AI's potential as a powerful tool in dermatology, one that can enhance teledermatology practices, improve diagnostic accuracy, and accelerate the overall diagnostic process [19,22].

Conclusions

The integration of artificial intelligence into modern medicine marks one of the most significant paradigm shifts in healthcare in recent decades. Across the diverse fields examined in this review psychiatry, ophthalmology, radiology, emergency medicine, and dermatology AI has shown substantial potential to improve diagnostic precision, streamline clinical workflows, and expand access to personalized care.

In psychiatry and mental health, AI tools, particularly generative models and conversational agents, are revolutionizing mental health support. These systems offer individualized recommendations, monitor symptoms over time, and simulate therapeutic conversations, often based on cognitive-behavioral therapy frameworks. However, while these technologies improve accessibility and scalability of care, their limitations such as lack of empathy, reliance on data quality, and potential for misinterpretation highlight the need for ongoing human oversight.

In ophthalmology, the application of multimodal deep learning models has significantly enhanced the diagnosis of complex eye conditions such as glaucoma, age-related macular degeneration, and diabetic retinopathy. By integrating multiple imaging modalities and clinical data, AI systems are able to identify subtle pathological changes earlier than traditional methods, thereby enabling more timely interventions. Nonetheless, the limited generalizability of models trained on hospital-based datasets and the need for high-quality, diverse training data remain key challenges.

Radiology represents perhaps the most mature field for AI implementation, with tools already assisting in image interpretation, anomaly detection, and report generation. AI models have shown proficiency across subspecialties identifying brain tumors, pulmonary diseases, cardiac abnormalities, and musculoskeletal disorders with accuracy comparable to or exceeding that of expert radiologists. Yet, questions remain regarding false negatives, clinical accountability, and the implications of over-reliance on opaque "black-box" algorithms, especially in high-stakes diagnostics.

In emergency medicine, AI has the potential to revolutionize the speed and accuracy of triage, diagnostics, and treatment planning. Tools capable of rapid analysis of sensor data and medical imaging are being explored for use in time-sensitive conditions such as sepsis, pneumothorax, and traumatic injuries. However, the fast-paced and unpredictable nature of emergency departments poses additional implementation challenges. Legal ambiguity around responsibility for AI-driven decisions and the philosophical debate about whether clinicians should trust or question algorithmic advice are especially pronounced in this high-pressure setting.

In dermatology, AI enhances both clinical and aesthetic practices through advanced imaging, pattern recognition, and non-invasive assessment tools. It supports early diagnosis of malignant skin conditions, treatment planning, and progress monitoring. Mobile AI applications are increasingly popular, but dermatologists have expressed concern over their accuracy, lack of transparency, and risk of misdiagnosis particularly when patients use them in place of professional consultation.

Despite its clear benefits, the adoption of AI in medicine is not without risk. Ethical considerations, such as bias in training data, algorithmic fairness, and transparency, must be carefully addressed. Legal and regulatory frameworks need to evolve to define clear lines of accountability. Importantly, the concept of "augmented intelligence" in which AI supports rather than replaces human decision-making should remain a guiding principle. AI must be seen not as a replacement for the clinician, but as a sophisticated assistant that enhances, rather than diminishes, human judgment.

To realize AI's full potential, a multidisciplinary approach involving clinicians, computer scientists, ethicists, and policymakers is essential. Training healthcare professionals to understand and work alongside AI systems is just as important as improving the technology itself. Ultimately, the future of AI in medicine will depend on our ability to deploy it safely, ethically, and inclusively prioritizing patient outcomes and trust at every step.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Supplementary Materials

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