**AI in Healthcare: A survey of literature**

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**Abstract­­:** Artificial Intelligence, (AI), is increasingly being used in healthcare. Artificial Intelligence sub-fields machine learning and deep learning can be used in many ways. Artificial Intelligence models can be used for diagnostics, treatment plans, surgery, drug creation, scans, and improving practices. This survey looks at two types of AI application: virtual and physical. Virtual applications of artificial intelligence are processes that occur without immediate visible effects, such as diagnostics, imaging assistance, and drug creation. Physical applications are processes that are immediately visible, such as robotic surgeries. AI can break down live feeds of laparoscopic surgeries, surgery done with the help of a camera, to aid in diagnosis and provide real-time feedback to surgeons. AI improves medical imaging, reduces required radiation, increases scan quality, and can aid in diagnostics. AI can speed up the oncology drug development pipeline by analyzing genetic biomarkers to choose better study groupings and candidates. There is still need for improvement in the AI ecosystem before it can be best implemented in healthcare. Areas requiring improvements include dataset creation, medical school education, and diversity in diagnostic models.

**Keywords:** Artificial Intelligence, Deep-learning, Machine-learning, Medicine, Medical, Healthcare, AI, Robotics, Diagnostics

Contents

[Introduction 4](#_Toc136372073)

[Narrative 4](#_Toc136372074)

[**Artificial Intelligence, Machine Learning, Deep Learning** 4](#_Toc136372075)

[**Physical Applications** 5](#_Toc136372076)

[**Virtual Applications** 5](#_Toc136372077)

[**Issues** 9](#_Toc136372078)

[Conclusion 10](#_Toc136372079)

[References 12](#_Toc136372080)

# **Introduction**

This report focuses on Artificial Intelligence, (AI), in healthcare. Artificial Intelligence can be described as a machine being modeled to mimic intelligence (Hamet & Tremblay, 2017). Artificial intelligence is an extremely important part of the modern world and is being implemented in healthcare settings worldwide. Artificial Intelligence has a wide range of applications in the medical field, but all can be grouped into two categories: physical and virtual. The physical applications include robotic surgery. The virtual applications range from drug creation, and diagnostics, to scanning improvements.

# **Narrative**

## **Artificial Intelligence, Machine Learning, Deep Learning**

Artificial Intelligence includes the tools of deep-learning and machine-learning. Alpaydin et al. (2014) provides an understandable explanation of machine learning and other AI concepts. Machine learning takes in vast amounts of data to form conclusions from underlying patterns. Deep-Learning is a sub-field of machine learning in which neural networks, computer networks modeled after brains, are used. Data is passed into the neural network and neurons, or nodes, are activated that then pass data to the next level of nodes. These networks can be thought of like a series of filters that the data is passed through until a result is reached. Software engineers can manually change the properties of nodes within the network if the result is not what it is expected to be. Machine learning methods are useful in cases where the problem should result in a yes or no, but there is no simple way for a computer to get to the solution. An example of this would be the differentiation of spam emails from normal emails. A program designed to distinguish spam emails is expected to determine whether it is spam or not, but there is no one thing that makes an email spam. AI models, using machine learning techniques, can be trained for this task by showing them large amounts of emails with spam status marked. The AI model learns to look for similarities within the emails that differentiates spam from non-spam (Alpaydin & Bach, 2014).

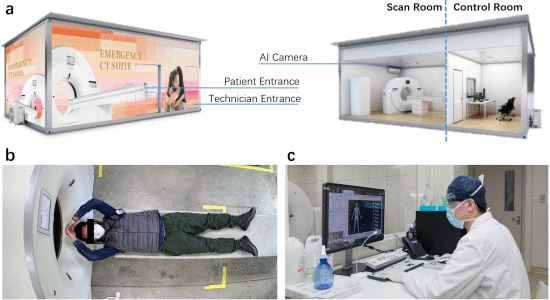
## **Physical Applications**

The physical applications of artificial intelligence include robotic surgeries, robot-assisted surgeries, and improved practices (Hamet & Tremblay, 2017).

Li et al. (2021) explains that AI brings improved practices to robot-assisted surgery. Robot-assisted surgery is less invasive because it requires less incision area to get the tools into the patient's body. This also leads to quicker patient recovery times post-surgery. AI plays a significant role in the operating room, even when it has no part in guiding the robotic instruments. AI is used to gather data from the procedures to improve medical practice and surgical methods. The live feed of laparoscopic surgery, surgery done through small incisions with the help of a camera, can be analyzed by AI algorithms to provide diagnosis even if the doctor misses it (Li et al., 2021). Laparoscopic surgery with AI also provides information such as tissue quality and size to the surgeon (Harvey & Ball, 2023).

## **Virtual Applications**

The virtual applications of artificial intelligence include diagnosing illnesses, imaging assistance, drug creation, and text generation bots (Hamet & Tremblay, 2017). Shi et al. (2020) found that AI brings improvement in medical imaging in a variety of ways ranging from radiation reductions, image quality, and image reading. During the Covid-19 pandemic, hospitals were overwhelmed with the patient load. Traditional Reverse Transcription-Polymerase Chain Reaction (RT-PCR) was inadequate for reasons ranging from lack of staff, test inaccuracies, and sample preparation. Doctors turned to the use of X-Ray and CT-Scans as an additional way to diagnosis patients. The traditional method of scanning patients exposes medical professionals to the virus; however, AI can provide a contactless workflow (see Figure 1). Once a patient is in the general scanning area, AI can align the scanner with the correct part of the patient's body by using cameras. This method limits patient-physician exposure, improves image quality, and reduces radiation needed. AI can reduce radiation and improve image quality through ISO-Centering, alignment of the scanner ISO-Center and the patient's key body parts. (Shi et al., 2020).



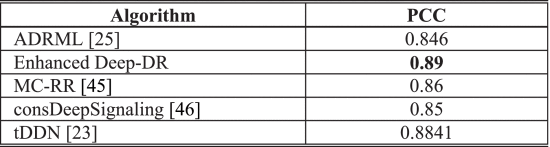
Source: (Shi et al., 2020)

Figure 1: AI assisted scanning inside a contactless scanning room.

A Bayesian Convolutional Neural network was implemented to improve the VGG16 model, a pre-existing AI used to find Covid-19 in lung X-Ray scans. The model was shown 70 lung scans of Covid-19 infected patients, scans of healthy lungs, and pneumonia infected lungs to train it to detect Covid-19. The improved model was able to detect Covid-19 in scans with 92.9% accuracy (Shi et al., 2020).

Cassidy, graduate of Cambridge University and founder of Cambridge Cancer Genomics Limited (CCGL), et al. (2020) explains the emerging benefits AI plays in oncology drug development. A large challenge in drug development and discovery is the time and money needed to maintain the “drug development pipeline.” Experimental drugs within the pipeline must go through many steps before reaching the public, such as Target Identification (2-6 years), Lead Optimization (3 years), Pre-Clinical development (1-2 years), Clinical development (3-6 years), and finally Regulatory Approval (1-2 years). There is an enormous amount of wasted time in the typical pipeline, as many drugs fail in the late stages of development; only 1 in 5000 drugs that make it to the Pre-Clinical Stage get Regulatory Approval. A large reason many drugs fail is failed patient stratification, the randomization of patients with different health characteristics into different treatment groups for more accurate data. An AI model was trained to help researchers with this problem by reading the genomes of patients involved. The model was able to detect 65% of morbid genes, and 78% of druggable genes in patients (Cassidy et al., 2020).

Ahmed et al. (2017) found that deep learning AI models are helpings with personalized cancer treatments. Within the human genome there are measurable characteristics called biomarkers that can be read to determine which drug treatment will work best. An AI model designed to improve others proposed by Ahmed et al. uses a neural network to predict the responses of 256 different drugs. The model factors in gene expression and gene mutations as inputs in the process. The new model improved mean squared error rates by 25%. The newly proposed model has a Pearson correlation coefficient (PCC) of .89, (see Figure 2); a score of one would indicate a perfect correlation between expected drug effects and actual drug effects (Ahmed et al., 2017).



Source: (Ahmed et al., 2017)

Figure 2: Comparison of different algorithms PCC scores. Expected results were compared to actual results of the drugs tested by each model.

One of the largest problems with AI in drug discovery is the need for hundreds, or even thousands of data samples to effectively train the model. The typical clinical study only requires 5 samples to be considered valid. Obtaining this amount of labeled data can be a big challenge, often requiring manual input. Large databases of labeled data exist, such as the Cancer Genome Atlas program, however, in some cases no databases with the required samples exist. (Cassidy et al., 2020).

GPT-3, (Generative Pre-Trained Transformer), is a general-purpose chat AI model released by OpenAI in 2020. Users of GPT-3 can ask it any question and the AI model will respond with a word-by-word generative response. This model has many potential applications ranging from helping students with math problems, writing, coding, and most importantly providing patients with pre-visit diagnostics. Levine et al. (2023) found that when given the symptoms of 48 separate, verified cases, GPT-3 provided the correct diagnosis within its top three responses 88% of the time. When given the same cases, a layperson was accurate only 54% of the time and a physician was 96% accurate. The information presented to the test subjects was <60 words long, and at a sixth grade reading level. This concludes that the GPT-3 model was able to diagnose better than the average person, but still worse than a professional (Levine et al., 2023). This is relevant because it shows that AI could be a valuable tool for the average person to have in their pocket. The diagnosis of GPT-3 could lead to a hospital visit from those who are weary of going to the doctor. GPT-4 was released late 2022 and has potential to improve the diagnostic scores of its previous iteration, however, public data has not been released at this time.

## **Issues**

Harvey & Ball (2023) explains the current issues that AI has in relation to robot assisted surgery. “Accurate tracking of tissue deformation is vital in intraoperative guidance and navigation in minimally invasive surgery. It currently could not be accurately modelled” (Harvey & Ball, 2023, p. 202-203). AI has not yet reached the point where it can execute operations without the oversight of a surgeon (Harvey & Ball, 2023).

Kasperbauer (2020) examines the conflicts between a current Learning Health System and an AI based health system. The adoption of AI into the medical field is difficult because of the large amount of data needed, along with the specificity of many AI algorithms. An AI algorithm designed to diagnose colonic polyps would not detect other illnesses, this leads to a need to mass adopt AI models for many different illnesses. This could be a problem because of the need to find accurate models for various illnesses and find a way to implement them all. Another issue is the lack of transparency in the methods many AI models use to diagnose patients. “The problem is that the factors influencing decisions made by algorithms are not always readily ascertainable. We do not always know how AI comes to its conclusions. This is a problem for researchers and patient understanding but not necessarily for improved treatment” (Kasperbauer, 2020, p. 539). AI mistakes could lead to patients losing trust in the healthcare system if their doctors aren't able to explain why the model chose the wrong drug to treat them (Kasperbauer, 2020).

Liaw et al. (2022) explains that healthcare workers must understand AI and use it as a tool, not a complete replacement to the traditional system. This article proposes that ethical use of AI requires doctors to understand what the tool is, why it should be used, when it should be used, how it should be used, and what side it effects it may cause (Liaw et al., 2022). In a study done in Ireland, 66% of medical students reported receiving zero training in AI and over 40% reported to have never heard of machine learning. Training is required to recognize when AI tools need to be overridden in diagnosis (Liaw et al., 2022).

# **Conclusion**

More methods need to be introduced to solve the current issues that AI experiences in the medical field. Methods of creating datasets for AI to be trained to detect different ailments must be discovered or advanced from what they currently are. More resources need to be put into the education of AI in medical school to make the adoption of AI more accepted.

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