Review Article

The Role of Artificial Intelligence in Emergency Medicine: A Comprehensive Overview

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ABSTRACT

In the era of the development of information technology, artificial intelligence has become a vital part of the process of developing electronic applications and platforms. Recent years have witnessed tremendous growth in the adoption of artificial intelligence and machine learning techniques in healthcare services and helping healthcare workers to track patients and produce medicines, as well as in emergency medicine. The possibilities of artificial intelligence in the medical domain are enormous and include magnetic imaging applications, disease prediction, continuous monitoring of vital signs, and monitoring the spread of epidemics. This article will discuss the importance and role of artificial intelligence in emergency medicine while highlighting its profitable contributions to assisting healthcare workers.

1. INTRODUCTION

Artificial intelligence refers to the ability of computer systems to process data with high accuracy and learn from it to achieve specific purposes and tasks through flexible adaptation and the growth of new applications [1-4]. At the beginning of the evolution of artificial intelligence systems, they worked in a specific manner, which is the first generation, as they are organized for the purposes of face and voice recognition, and they are widely used today. On the other hand, it possesses the second generation known as (Superintelligence) with which the machine can plan, think, and solve problems independently, even in areas that are not explicitly programmed [5][6]. In the future, it is expected that the third generation of supernatural artificial intelligence will appear, which may work in place of humans in many businesses. Therefore, human resources may become disproportionate in the future. In the 1940s, the concept of artificial intelligence appeared through the science fiction novel Runaround written by Isaac Asimov (American writer). It served as an inspiration to scientists in the area of artificial intelligence. In this novel, three basic rules for robotics are identified (see Figure 1): First: A robot may not injure a human or, through inaction, allow a human being to come to harm. Second: A robot must obey the orders given to it by a human being except where such orders would conflict with the First Law. Third: A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws. Simultaneously, British mathematician Alan Turing invented the code-breaking machine known as the Enigma, the British government's first mechanical computer to break Nazi ciphers . In the 1950s, Turing posted an article titled "Computing Machinery and Intelligence", which outlines the construction of intelligent machines and proposes a method for evaluating their performance and intelligence. This method, known as the Turing test, is used as a standard for evaluating the intelligence of artificial systems and their ability to interact with their surroundings. According to the Turing test, if a person's interaction with both a person and a machine cannot distinguish the machine from the human, then the machine is considered intelligent and efficient. In 1956 the term artificial intelligence appeared at the Dartmouth Summer Research Project on Artificial

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Intelligence (DSRPAI), a roughly eight-week event organized by Stanford computer scientists Marvin Minsky and John McCarthy at Dartmouth College in New Hampshire [7-10].
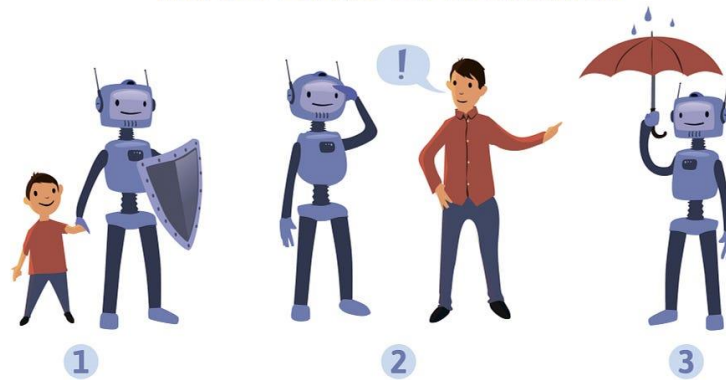

Fig. 1. Three laws of robotics [11].

A set of programs and games that operate in the manner of artificial intelligence have appeared, the most famous of which is: the famous computer program ELIZA, which was developed by Joseph Weizenbaum (German American computer scientist) at the Massachusetts Institute of Technology between 1964 and 1966. This language-processing program is designed to simulate human speech and aims to pass the Turing test for measuring the ability of intelligent machines. In 1997, IBM's Deep Blue chess program defeated world champion Garry Kasparov (Russian chess grandmaster) by analysing about 200 million possible moves per second and making perfect decisions up to 20 moves ahead using a method called Graph and tree search algorithms. In 2015, Google developed a program called AlphaGo, which stunningly beat the world champion in Go. AlphaGo's exceptional performance is enabled by a specialized neural network known as deep learning. Currently, artificial neural networks and deep learning serve as the basis for most artificial intelligence applications and technologies. These applications include image recognition algorithms used by platforms like Facebook, Netflix, smart speakers, and speech recognition algorithms in self-driving cars. In November 2022, ChatGPT designed by OpenAI is based on the GPT architecture (Generative Pre-Trained Transformers), specifically the GPT-3.5 and GPT-4 modern model [12-15]. ChatGPT engages in natural language conversations with users and generates human-like text, making it suitable for a wide range of tasks, including answering questions, providing explanations, writing creative stories, making recommendations, translating language, and more. ChatGPT is trained on a large set of text data from the Internet, which allows it to understand and generate text in a context-appropriate way [16-18]. The model's capabilities are not limited to pre-determined responses but depend on developing responses based on the learned patterns during training. The main contribution of this article is to discuss the importance of artificial intelligence in emergency medicine and how it can be employed to develop and assist healthcare workers.

2. AI IN EMERGENCY MEDICINE

Artificial intelligence techniques and applications contribute precious capabilities in the prediction and early detection of diseases [19-23]. In particular, systems based on machine learning contribute to analysing big data and assisting healthcare workers in diagnosing diseases perfectly. In addition, these systems contribute to the production of drugs and vaccines and survey the health status of patients. There are seven main factors that can benefit from artificial intelligence and machine learning in healthcare:
- Benefit from digital imaging in the interpretation of diseases.
- Digitize all medical records and share data between patients and healthcare workers.
- The ability of machine learning to analyse large, diverse, and heterogeneous data.
- The ability of machine learning to generate a hypothesis in search.
- The potential of machine learning techniques to streamline clinical workflows and empower patients.
- The prompt growth of machine learning algorithms and the possibilities of their application in interpreting many diseases and diagnosing conditions.
- Machine learning algorithms deliver improved performance while expanding datasets and contributing to decision making.

These factors contribute to the development of the healthcare environment and assist specialists in making proper decisions, which allows more accurate predictions of diseases, early diagnosis, and enhancing patient outcomes by preventing the development of diseases, reducing complications, and controlling the spread of diseases and epidemics. Nowadays, there are many applications of artificial intelligence being employed in pre-hospital emergency care. These applications have the ability to distinguish between urgent medical conditions that require immediate intervention—for instance, myocardial infarction, enzyme, stroke, acute pneumonia or coronaviruses [24]. Moreover, these applications contribute to collecting basic details about the caller's address and location in order to reach the patient and reduce the time required for the immediate dispatch of an ambulance. Artificial intelligence applications enhance the efficiency and accuracy of emergency response systems, ultimately leading to more valuable outcomes for patients in critical situations and saving lives. Artificial intelligence plays a vital role in the emergency room by quickly analysing patient data, allocating the necessary resources to perform the rescue operation, and classifying the risks resulting from the patient's condition. It is essential to make quick, informed decisions in emergency rooms, often with limited information availability, as artificial intelligence applications can provide critical data to healthcare workers. In addition, the classification of diseases into categories within the emergency room with the arrangement of patient data accurately in order to facilitate the specialists to perform the necessary first aid and save the patient's life. Machine learning techniques aim to provide systems based on artificial intelligence to classify diseases by predicting patients who need critical care or emergency procedures. In addition, specialized machine learning models have been designed to predict specific disease outcomes, such as predicting acute and late cardiac complications, predicting acute pulmonary infections, or predicting in-hospital mortality. Artificial intelligence systems contribute predictions through disease outcomes, leading to more effective emergency procedures. So, these systems work to help emergency room professionals as well as enhance patient care and resource utilization, leading to better healthcare outcomes. Artificial intelligence techniques seek to prioritize patients based on the severity of their condition, allowing healthcare workers to concentrate on those who need immediate attention. These systems are based on analysing patient data, determining vital signs, and showing medical history to predict the severity of the disease and diagnose diseased conditions. Artificial intelligence systems can analyse images and quickly and accurately interpret medical scans such as X-rays, CT scans, and MRI scans [25][26]. These systems suggest the ability to detect abnormalities, identify life-threatening conditions, and provide details promptly to help healthcare professionals make rapid and accurate diagnoses. Artificial intelligence techniques are employed to analyse patient data and determine the severity of the disease, which enables early identification of potential disease outbreaks and determines the patient's needs for treatment and care. These systems and techniques contribute to the processing and analysis of unstructured medical text data, such as clinical notes and electronic health records, that contribute to clinical decision-making. Artificial intelligence helps optimize drug dosing, prevent adverse drug interactions, and identify potential allergies, thus reducing medication errors and enhancing patient safety. It also streamlines the emergency department workflow, helping reduce wait times, improve resource allocation, enhance overall operational efficiency and make decisions with high accuracy. Also, remote monitoring devices continuously monitor patients, allowing healthcare workers to track vital signs and intervene immediately to aid the patient, whether inside or outside the hospital. Artificial intelligence applications can analyse patient data and clinical guidelines to recommend personalised treatment plans based on individual health conditions and treatment responses.
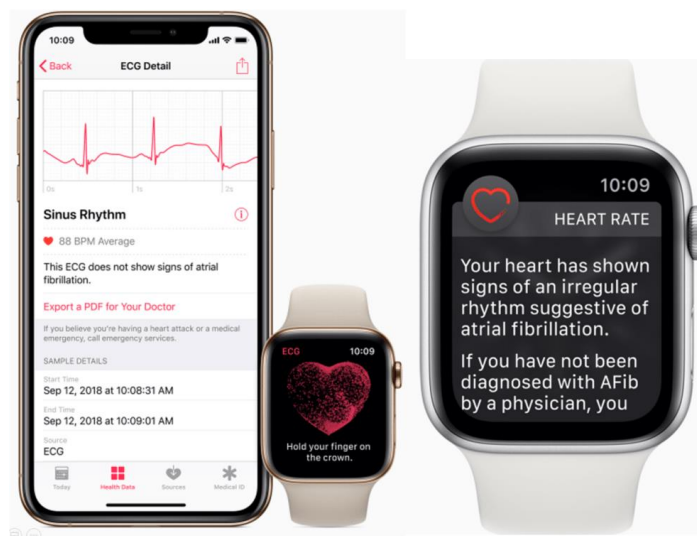

Fig. 2. An application from Apple that relies on artificial intelligence to monitor heart health [27].

The radiologist in emergency rooms is a domain in which artificial intelligence finds wide application in detecting various diseases through scans using algorithms specialized in this field. These algorithms can provide accurate details about the patient's condition, for example, bleeding, brain injuries, the spread of a particular virus in the lung, and other conditions. These algorithms can give up to 94% to 100% predictive accuracy results. These algorithms contribute to the exclusion of life-threatening conditions by providing details that require care workers to intervene quickly to save patients. Likewise, it informs specialists of delays in emergency rooms and the lack of necessary examinations. Artificial intelligence has demonstrated the ability to assist in diagnosing and detecting diseases while improving results and with high efficiency, which contributes to achieving better patient outcomes in emergencies. Artificial intelligence is employed in the documentation process, as it can be used to record all patient data from the moment of arrival and send it directly to the hospital before the arrival of the ambulance in order for the necessary action to be taken. At the same time, artificial intelligence techniques are having difficulty analysing low-quality free text input data in documentation systems. It has been observed that virtual recording systems that use artificial intelligence, speech recognition technologies, and natural language processing technologies reduce recording time by about 50% by having recordings ready while the patient is speaking. It also supports preparing prescriptions and written recommendations (without medical terms) in a way the patient can understand upon discharge from the hospital. Electronic records can more efficiently provide data suitable for statistical analysis. Artificial intelligence is employed in clinical monitoring to track the patient's health condition and estimate the possibility of heart complications or septicemia based on the patient's initial symptoms and signs. In addition, there are applications in monitoring the heart rate and predicting heart diseases, where applications have been developed that can predict adverse events to the heart, such as deaths, acute myocardial infarction, coronary intervention percutaneous and coronary artery bypass grafting. Moreover, machine learning techniques, used with wearable devices, remote monitoring, and digital consultations, can eliminate the need for the traditional model of discontinuous data collection and interpretation in the clinic or hospital setting. These applications may support patients and families to perform more effective and informed self-care (see Figure 2). It has been proven that home follow-up, which is similar to inpatient follow-up using artificial intelligence, is effective in detecting acute exacerbations of chronic obstructive pulmonary disease and has been used in the period of the COVID-19 pandemic and monitoring exacerbations of asthma a week before the onset of symptoms by analysing all data and environmental factors that affect the patient. Smartphone audio apps have been successful in detecting falls in older adults. Despite the advances in artificial intelligence applications and techniques, many technical, ethical, and technological acceptability issues are associated with utilizing artificial intelligence applications and practices in the emergency room. More studies are needed to accept the technology in the healthcare domain, as alarm algorithms have been developed employing artificial neural networks and machine learning. It is a milestone in technology where trust is placed not only in the hands of the human developer of the algorithm but also in the computer to generate the appropriate instructions regarding the patient's condition. This presents many ethical and potential challenges related to legal medicine, making the answers and explanations of artificial intelligence algorithms incomprehensible to both clinicians and patients. Also, the health data collected should be confidential but require constant updating and real-time feedback for optimal performance. Patient consent is required to prevent gross violations. Although the vast majority of artificial intelligence systems assist clinicians rather than act independently, it is important to be aware of when and where these algorithms are introduced and can lead to incorrect clinical decisions.

3. CONCLUSIONS

The primary purpose of this article is to discuss the importance of artificial intelligence in emergency medicine and how it can be used in patient care and assisting health care professionals and professionals in providing the best medical services to patients. Artificial intelligence applications and technologies in the emergency service contribute to increasing the quality of service and reducing the burden of service on healthcare workers. In addition, these applications and techniques contribute to reducing human errors and help doctors make the right and accurate decisions. But the potential for artificial intelligence systems to make wrong decisions should be noticed. In addition, medical, and legal regulations related to the use of artificial intelligence are also required. In the future, more studies will be conducted on the importance of modern artificial intelligence practices in the medical domain.

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Conflicts of Interest

The author's disclosure statement confirms the absence of any conflicts of interest.

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