Artificial Intelligence: An Eminent Tool in Healthcare Industry

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Abstract:According to WHO Artificial Intelligence (AI) holds great promise for improving the delivery of healthcare and medicine worldwide, but only if ethics and human rights are put at the heart of its design, deployment, and use. AI continues to significantly outperform humans in terms of accuracy, efficiency and timely execution of medical and related administrative processes.This article briefly discusses the incorporation of AI based technologies for Medical assistance.The use of technology has aided in offering reliable and enhanced responses.This article aims to unfolds the importance of technology assisted services in Medical field and further through light upon recent advancements of AI in amalgamation with Healthcare sector.

Keywords:Digital twin, Telesurgery, Ti Robot, Automated Defibrillator

Introduction: Artificial intelligence (AI) is reshaping healthcare, and its use is becoming a reality in many medical fields and specialties. AI, machine learning (ML), natural language processing (NLP) and deep learning (DL) enable healthcare stakeholders and medical professionals to identify healthcare needs and solutions faster with more accuracy, using data patterns to make informed medical or business decisions quickly.AI is able to analyze large amounts of data stored by healthcare organizations in the form of images, clinical research trials and medical claims, and can identify patterns and insights often undetectable by manual human skill sets.AI algorithms are “taught” to identify and label data patterns, while NLP allows these algorithms to isolate relevant data. With DL, the data is analyzed and interpreted with the help of extended knowledge by computers[1].Healthcare systems around the world face significant challenges in achieving the ‘quadruple aim’ for healthcare: improve population health, improve the patient's experience of care, enhance caregiver experience and reduce the rising cost of care[2,3.]The application of technology and artificial intelligence (AI) in healthcare has the potential to address some of these supply-and-demand challenges. The increasing availability of multi-modal data (genomics, economic, demographic, clinical and phenotypic) coupled with technology innovations in mobile, internet of things (IoT), computing power and data security herald a moment of convergence between healthcare and technology to fundamentally transform models of healthcare delivery through AI-augmented healthcare systems.

In particular, cloud computing is enabling the transition of effective and safe AI systems into mainstream healthcare delivery. Cloud computing is providing the computing capacity for the analysis of considerably large amounts of data, at higher speeds and lower costs compared with historic 'on premises' infrastructure of healthcare organizations. Indeed, we observe that many technology providers are increasingly seeking to partner with healthcare organizations to drive AI-driven medical innovation enabled by cloud computing and technology-related transformation[4,5]. Deep learning algorithms for image recognition require 'labelled data' – millions of images from patients who have received a definitive diagnosis of a particular disease, a broken bone or other pathology. AI could aid in forming an appropriate well defined repository of radiology and Histopathological data. Health care is shifting toward becoming proactive according to the concept of P5 medicine–a predictive, personalized, preventive, participatory and precision discipline (6). This patient-centered care heavily leverages the latest technologies of artificial intelligence (AI) and robotics that support diagnosis, decision making and treatment. In this paper, we present the role of AI and robotic systems in this evolution, including example use cases. (7) AI has a great potential to transform drug discovery by accelerating the research and development timeline, in an effort to make drugs more affordable and improve the probability of FDA approval.The tech can also help with the repurposing of new drugs, especially during the COVID-19 pandemic. AI and machine learning algorithms are able to identify molecules that may have failed in clinical trials and predict how the same compounds could be applied to target other diseases.(8)

Methodology:

1. Cloud computing in health:

The National Institute of Science and Technology defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction".(27) Without the requirement for conventional data storage configurations, cloud computing enables information sharing among diverse healthcare experts and simple access anytime and wherever they desire. M-Health Technologies is one such cloud computing-based solution.

In this technology, healthcare data is collected by sensors like BG and sphygmomanometers in daily activities, in the Cloud Storage which is more convenient for data management and tends to be more economical. Furthermore, the Multiple Tenants Access Control Layer increases the security and privacy of patient data. Moreover, data heterogeneity is a problem that is frequently encountered during data processing as heterogeneous data supplied by hospitals' varying technology makes automatic healthcare data sharing and comprehension between medical organizations more difficult, which is resolved by the Healthcare Data Annotation Layer. . Because similar past data are essential resources for creating a treatment plan for a similar illness case, the Healthcare Data Analysis Layer analyzes healthcare data saved in the cloud to support clinical decision making. (29)

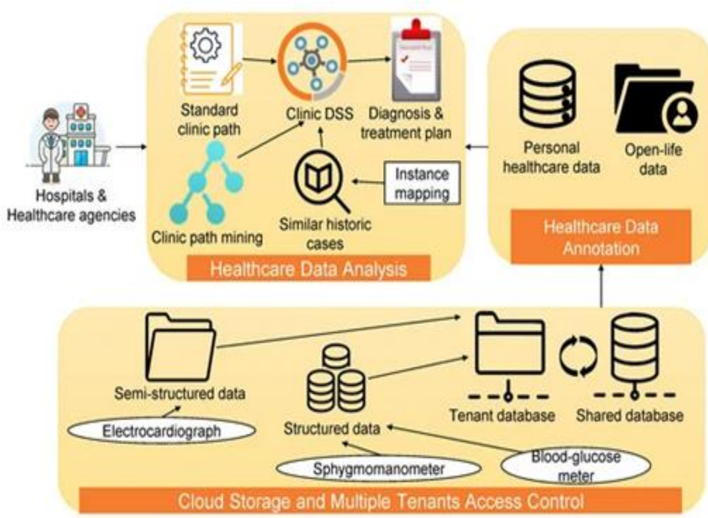


Figure 1 - M-Health Monitoring System [28]

One such application of this technology is in Pancreaticoduodenectomy (PD) (30). It is a complex procedure that is accompanied by high rates of postoperative morbidities mainly because of loss of pancreatic parenchyma and thus needs constant surveillance by medical professionals. In order to evaluate the clinical utility of this approach, the doctors retrospectively enter the data after the surgery. The data is then examined to study parameters linked to post-PD problems.

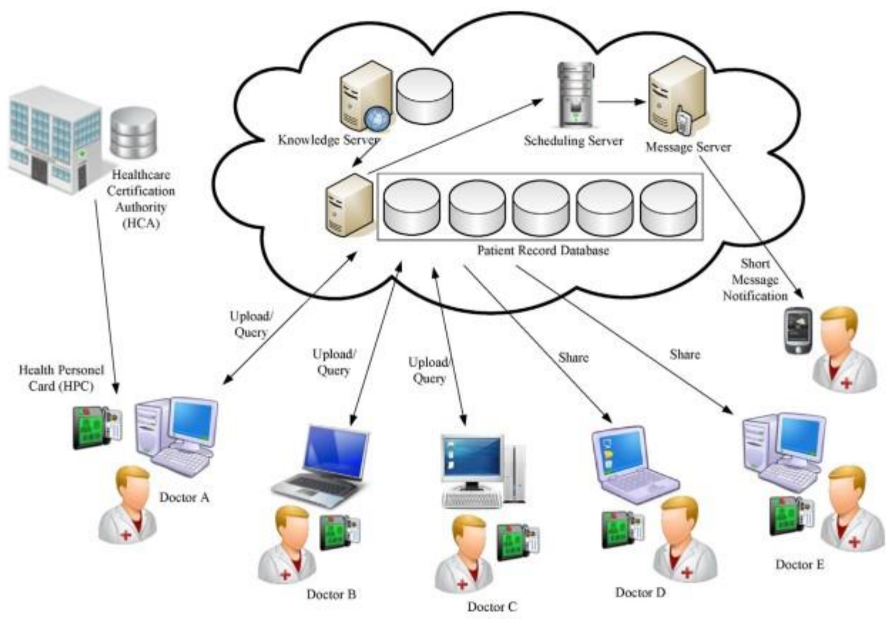


Figure 2 - Architecture of proposed system (31)

	Item	Before	After
1	Format of data	Develop the format by himself/herself	•Ready to use •With well-developed format
2	Data-sharing	Through e-mail	Through the system
3	Inter-exchangeable	Difficulty (may be different definition of data content)	Easy (same definition of disease and complication; same file format)
4	Validation of cancer staging	Two or more persons to validate the data (time- and manpower-consuming)	•Clinical rule supporting (time- and manpower-saving) •Accuracy: improved
5	Ubiquity (ubiquitous access) mobility, portability	USB flash drive (may be lost)	Network-dependent
6	Security storage	Sensitive data is not encrypted	Sensitive data are encrypted
7	Remind physicians of coming follow-up	No	Yes

Figure 3 - Comparison between before and after implementation of the technology (31)

2. Chatbots:

The application of artificial intelligence (AI) and machine learning (ML) in education is shown by chatbots, also known as conversational agents, which are pieces of software that can converse with a human user in real-time using natural language.(9) Despite the growing interest in chatbots' educational uses, traditional learning environments have yet to include them. The instance of a Conversational Virtual Patient (CVP) prototype is presented in this study to teach medical students' decision-making abilities with reference to thromboembolism. The proposed CVP uses Natural Language Processing and ML approaches to enable students to create their own utterances and communicate with the virtual patient in natural language, in contrast to standard virtual patients that rely on predetermined, multiple-choice input.This CVP prototype will serve as the foundation for co-creation sessions in order to familiarise stakeholders with chatbot technology and facilitate the requirement elicitation process with a view to implementing participatory design and co-creating open access chatbots for healthcare curriculum. The CVP prototype's next stages in co-development are explored.

There is still much to learn about chatbots' potential in the areas of cancer diagnosis and treatment, patient monitoring and support, clinical workflow efficiency, and health promotion. The rapid development of chatbots will bring up a number of problems and difficulties that need to be carefully navigated. Thus, it is crucial to critically assess the benefits vs risks. The human element in the practise of medicine is irreplaceable and will always be there, even after creating the necessary foundations for employing chatbots safely and efficiently. It is the duty of medical practitioners to be aware of the advantages and disadvantages of chatbots and to inform their patients about these issues.

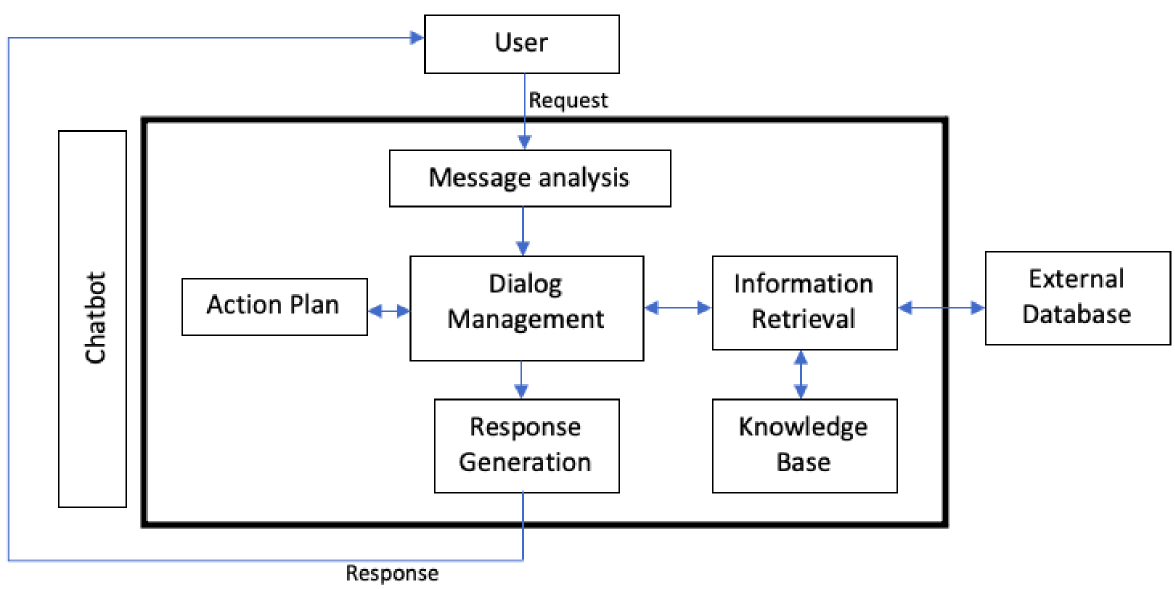


Fig 2 : Conceptual illustration of the architecture for generic chatbots (11)

3. RPA:

This technology executes organised digital administration tasks—those involving information systems—as if they were being carried out by a human user who was following a set of instructions or guidelines. They are less costly, simpler to programme, and more transparent than other types of AI. (12) Robotic process automation (RPA) mostly use server-based software rather than actual robots. To behave as a semi-intelligent user of the information systems, it depends on a mix of workflow, business rules, and 'presentation layer' integration. They are employed in the healthcare industry for routine duties including billing, prior authorization, and patient record updates. They may be used to extract data from, say, faxed photographs and feed it into transactional systems when paired with other technologies like image recognition.

Although we have only discussed these technologies individually, they are progressively being merged and integrated. For example, robots are acquiring AI-based "brains," and RPA and image recognition are being coupled. Perhaps these technologies will become so intertwined in the future that composite solutions will become more possible or practical.

RPA's potential for use in the healthcare sector(13) -

1) Using software robots to automatically acquire and integrate data from clinical applications, lab information systems, third party portals, insurance portals, radiology information systems, scheduling applications, ERPs, and HR applications, we can mitigate the challenges of the healthcare sector in terms of the complexity of processes, volume of patient & hospital data from multitude of sources, and eliminate the need for employees to perform repetitive tasks.

2) Automate tasks like eligibility requests to access information for better communication with providers and patients

3) Reduce expenditure on budget and human resources while incorporating speed, intelligence, efficiency, and quality into healthcare processes

4) Automate claims status requests and perform reviews of claims to deliver better revenue cycle

5)To increase productivity, develop a digital workforce that collaborates with the workforce as a whole.

4. Virtual reality:

A three-dimensional computer-generated environment that can be interactively explored with a range of computer peripheral devices is known as virtual reality (VR). Any system that seeks to let a user feel an experience via the use of specialised perception-altering technologies is considered virtual reality (VR). It is a simulation of reality that takes place in a virtual world where the image is constantly changing based on the user's gaze and direction. As a result, users will be able to engage with the virtual environment on a high level and navigate it as though they are a part of it, demonstrating what is referred to as "immersion" or "presence."

The first VR medical uses emerged in 1993, where they were used to treat mental health issues. Cognitive behavioural treatment (CBT) was previously used in VR used to treat certain phobias, such as a fear of heights. Due to its success rate of more than 90%, it was regarded as a first-choice therapy. Virtual reality (VR) applications in cutting-edge healthcare as of late have focused on surgical procedures. Although the simulated procedure in the virtual environment is done by a surgeon and communicated to a robotic device that duplicates the motions, remote surgery may be carried out successfully far away from the patient. Medical therapy, preventative care, database visualisation, skill improvement and rehabilitation, and medical education and training are further uses. VR is also used in psychotherapy to divert patients. Medical therapy, preventative care, database visualisation, skill development and rehabilitation, and medical education and training are further uses. VR is also useful in psychotherapy as a means of diverting patients through uncomfortable procedures or treating a wider spectrum of anxiety disorders, such as posttraumatic stress disorders [13]. Technology advancements made it possible for VR systems to run on personal computers, which reduced the cost of implementing a complex system. Also, the ability to recreate real locations in a VR system makes it easier to treat mental health illnesses (such as social anxiety and fear of public speaking) with greater success.

5. Drones in medical service:

A useful innovation that has the potential to save lives in medical emergencies is drone delivery. Drones, also known as Unmanned aircraft systems (UAS) were first used in the late 1800s and early 1900s for various military operations. Their technological prowess and usability are particularly advantageous to the healthcare sector. Drones are more efficient and quick than conventional types of transportation, which rely on a good infrastructure. They are helpful for delivering medical aids in difficult areas and in communication.

Some of the applications of drones include;

(i.).Transportation of minor medical equipment, blood, and other supplies that are urgently needed. Unicef and Matternet, are testing similar drones in Malawi for the transport of paediatric blood samples for HIV testing. Children born to HIV-positive mothers must be tested for the virus in specialised labs, and early diagnoses are frequently delayed.(32-34)

(ii.) In locations identified using GIS (Geographic Information System) models, research have shown that the use of drones for the delivery of an automated external defibrillator (AED) for out-of-hospital cardiac arrests (OHCA) may prove to be safe and practical. (35)

(iii.) A medical kit comprising emergency supplies was designed to deliver by a drone with video conferencing skills via Google Glass. This mix of technology enabled healthcare workers to guide bystanders in assisting persons in need via telemedicine. (36)

(iv.) In times of crisis management. For instance, during the 2010 Haiti earthquake, hurricane "Superstorm Sandy" in 2012, cyclone Pam in 2015, and the 2015 "Gorkha" earthquake all provided reports of the successful deployment of drones for delivering medical supplies.

6. Digital twin:

A digital replica that enables modelling the condition of a physical asset or system is called a "digital twin." They could be of both patients and medical equipment. Transferring the patient's bodily traits and physical changes to the digital world results in the creation of the patient's Digital Twin. This hastens diagnosis and treatment procedures and boosts accuracy rates. Thus, help us design the best treatment regimen for the patient as it provides novel and conclusive solutions. (37) They are used for designing models to diagnose and address specific cardiovascular diseases.(38) Not just that, digital twin could help individuals plan out their personalized and customizable workouts. The application of the Digital Twin technology can assist in providing people with a highly adaptable solution. With the help of digital twin (DT) technology, real twins' data can be collected, analysed, and given individualized feedback to enhance their quality of life and wellness. (39). In the realm of physiotherapy, this technology could be utilized to track patient muscle growth, spine cell changes, and bone movement during physical therapy. Using the patient's personal information and the treatment procedure, forecasts for its improvement can be established.

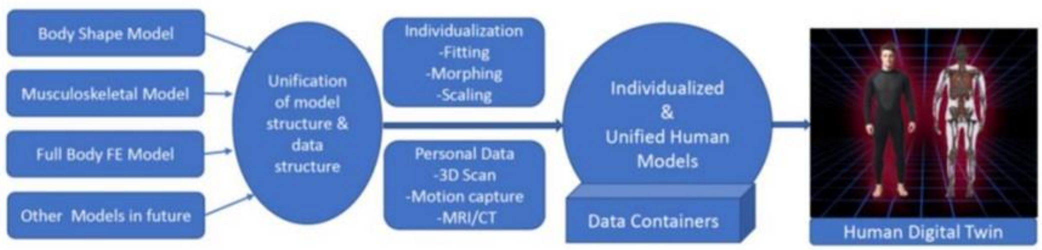


Figure - Overview of Human Digital Twin (40)

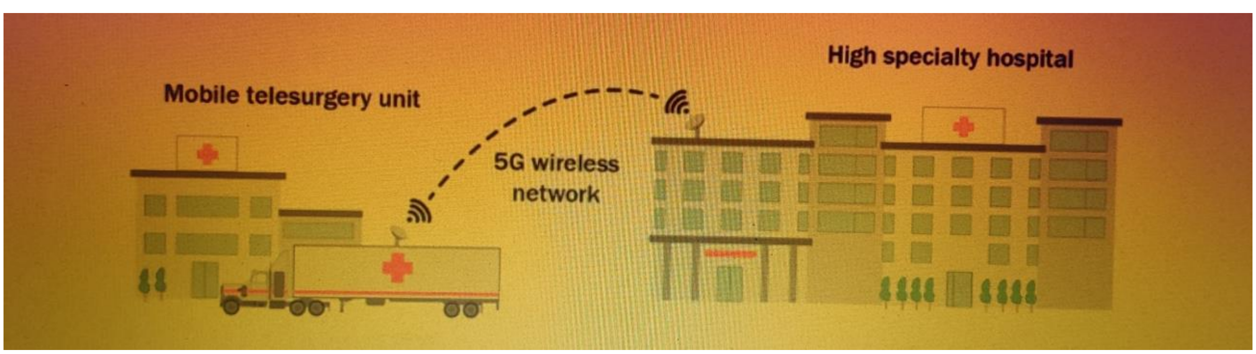
The pharmaceutical industry is on its way to make a major advancement in this domain as Atos and Siemens, the IT - pharma duo, have now joined hands to create a digital replica of the pharmaceutical manufacturing process. They aim to conduct pilot studies and create operations which would help us design economic manufacturing processes by reducing waste and saving time. The "Process Digital Twin" is a fully virtualized representation of a particular stage in the manufacturing process that is coupled to IoT sensors set up on the real plant. (41)

7. 5G opens future of telesurgery:

A long-distance laparoscopy was carried out in 1993 with the organic-material model placed in Milan, Italy, and the control console situated in Pasadena, USA. The connectivity was done via optical fibre, and two satellites, and three stations—one in New York, one in Pasadena, and the last one in Milan—mediated the communication system (one located over the Atlantic and the other over the U.S.). The signal travelled 150,000 km, while the distance between the centres in both directions was 14,000 km. The procedure's stated delay time was 1.1 s. Laparoscopic cholecystectomy in pigs was also performed in Asia, with Seoul, Korea, serving as the control site and Fukuoka, Japan, as the operating location. The bandwidth was 50 Mb/s over gigabitclass fibre, with a reaction latency of 540 ms and an image delay of 871 ms, while the direct distance between the two locations was 540 km. The surgery took 90 minutes, which is about how long a typical laparoscopic cholecystectomy takes. Throughout recent years, the expansion of mobile networks has boosted the speed and capacity of information\transmission, triggering the 4th industrial revolution, which is changing the paradigms of the way mankind lives, works, and communicates.

As comparison to the 4G LTE technology, the 5G technology enables a more reliable data transfer with a latency delay of 1-2 ms, a 100-fold increase in speed from the 4G's 10 Gb/s, and a significantly greater simultaneous connectivity capacity. This technology revolution's effects are now being seen in telesurgery, which promises to address network issues and include cutting-edge innovations like augmented reality and artificial intelligence.2020 saw China conduct four laparoscopic procedures on pig animals (left nephrectomy, partial hepatectomy, cholecystectomy, cystectomy). The first of their type, employing the MicroHand robotic system and UHD (4K) resolution in the recordings, were made in the cities of Qingdao and Anshun at a distance of almost 300 kilometres via a Wireless 5G connection. It was stated that there was a total delay of 264 milliseconds and that the operation took 2 hours in total. In order to treat 4 thoracolumbar fractures, 6 lumbar spondylolisthesis, and 2 lumbar stenoses, 12 telesurgeries were done on 7 women and 5 men with various spinal diseases. This was made possible by the development of robotic surgery equipment and 5G technology.

Six different hospitals took part in the procedures, with Shandong Yantaishan Hospital, Zhejiang Jiaxing Second Hospital, Tianjin First Central Hospital, Hebei Zhangjiakou Second Hospital, and Xinjiang Karamay Central Hospital serving as the operation sites and Beijing Jishuitan Hospital serving as the control room. The average travel distance was 895 km. The procedures were carried out using a "**TiRobot" equipment** that was connected to a 5G wireless network.



Conclusion:

A potential benefit of Artificial Intelligence could be found in Healthcare profession .The contents in this article, combined with the theoretical analysis and software's suggest the upcoming paradigm shift in the Medical field.This review lays the groundwork for further research on the protective mechanisms of medicinal plants in disease treatments and the applications of network pharmacology in drug discovery.AI adoption in healthcare continues to have challenges, such as lack of trust in the results delivered by an ML system and the need to meet specific requirements. However, the use of AI in health has already brought multiple benefits to healthcare stakeholders.By improving workflows and operations, assisting medical and nonmedical staff with repetitive tasks, supporting users in finding faster answers to inquiries, and developing innovative treatments and therapies, patients, payers, researchers and clinicians can all benefit from the use of AI in healthcare.

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