


Chapter 5

Relevance of Artificial Intelligence in Modern Healthcare


Dhanabalan Thangam

 <https://orcid.org/0000-0003-1253-3587>
Acharya Institute of Graduate Studies, India

Anil B. Malali

Acharya Institute of Graduate Studies, India

Gopalakrishanan Subramaniyan

 <https://orcid.org/0000-0002-2158-7483>
Acharya Institute of Graduate Studies, India

Sudha Mariappan

Acharya Institute of Graduate Studies, India

Sumathy Mohan

Bharathiar University, India

Jin Yong Park

Konkuk University, South Korea

ABSTRACT

Artificial intelligence (AI) and machine learning (ML) are playing a major role in addressing and understanding better the COVID-19 crisis in recent days. These technologies are simulating human intelligence into the machines and consume large amounts of data for identifying and understanding the patterns and insights quickly than a human and preparing us with new kinds of technologies for preventing and fighting with COVID-19 and other pandemics. It helps a lot to notice the people who got infected by the virus and to forecast the infection rate in the upcoming days with the earlier data. Healthcare and medical sectors are in requirement of advanced technologies for taking accurate decision to manage this virus spread. AI-enabled technologies are working in a talented way to do things intelligently like human intelligence. Thus, the AI-enabled technologies are employed for attaining accurate health results by examining, forecasting, and checking present infected and possibly future cases.

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INTRODUCTION

Due to the worldwide pandemic called Coronavirus (Covid-19), the healthcare industry is in need of well-equipped technologies for the multipurpose usage and also for analysing and controlling the spread of Covid-19 pandemic. Artificial Intelligence (AI) is an advanced technology, which is having the capability of tracking the pattern of increasing Covid-19, and it also diagnoses the patients who are at high risk and it is helping to manage this disease in real-time. It is also forecasting the fatality risk by assessing patients' previous data thoroughly. Moreover, AI looks as if a crucial technology in searching and preparing preventive measures to manage the Covid-19 and other possible diseases. AI is a technology that simulates human intelligence into the machine and thereby it processes the real-time data for the necessary purpose. AI-enabled technologies are evolving quickly in the recent years, because of its advancement in the data processing, yes, AI processes millions of million data within few minutes with much faster and smarter, thus it predicts the happening more exactly than human. Since the present pandemic has collapsed the entire world, all the countries are trying to come up with sophisticated technologies such as AI, and Machine Learning (ML), to develop new and ground-breaking ideas to fight against Covid-19 (Vaishya, Javaid, Khan, and Haleem, 2020). AI and ML offer numerous advantages than conventional analytics and moreover they are supporting a lot in taking decisions with more accuracy and reliability. Learning algorithms can be converted into more accurate and precise as they mesh with training data, letting humans attain extraordinary insights into diagnostics, treatment variability, patient care processes, and patient outcomes (Chen, Yang, Yang, Wang, and Barnighausen, 2020). The worldwide medical field also needs well-equipped technologies for taking appropriate decision immediately, to deal with this pandemic and to save the society from the spread in real-time. AI and ML technology work in a brilliant way to mimic human intelligence. It may also play an imperative role in understanding and suggesting ways and means for the developing vaccine for Covid-19. Such a wonderful result-driven real-time technology is utilized for screening, evaluating, predicting, and tracking of existing patients and expected future patients properly (Dialani, 2021).

Covid-19 pandemic has damaged the whole world drastically and slowdown the medical and systems healthcare sector. Still all countries are trying to find out the root cause for this pandemic, but unfortunately, it is getting delay and thus it leaves room for the development of advanced healthcare technologies to deal with various harms related to this pandemic. In this juncture, industry 4.0 enabled AI and ML technologies have given a tremendous support to eradicate this pandemic issue by establishing wireless technologies. These technologies are helping to improve process automation in across the industries including health sector. Thus, These technologies are linked with various stakeholders of the healthcare industry and to communicate with each other for the developing various health related products and services such as healthcare equipment, drugs, and vaccines, check-up instruments, patient care applications and so on. All these products and services are made safely, smartly, accurately, and with the lesser human contribution (Alloghani et al., 2018). As a consequence, AI enabled smart manufacturing system ensures the availability of necessary healthcare items on time, to face the Covid-19 pandemic issues. This technology also helps to design and develop healthcare necessities rapidly. Further the AI enabled digital health instruments like pressure testing kits, contact tracing applications, response systems, health rings, and so on are contributing a lot to this sector (Javaid et al., 2018). Against this backdrop, the present chapter has made an attempt to demonstrate the relevance of AI and enabled technologies in this perilous pandemic.

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The present chapter is purely based on secondary data sources and it has written by reviewing the scientific journals, from the major sources, such as Google Scholar, Wiley Online Library, Science Direct, and Springer Link. Apart from these sources internet sources also have been used with the keyword of Corona virus pandemic, Covid-19, AI, and ML. from the search the latest information has been collected pertaining to the application AI enabled technologies in controlling the pandemic, the collected information filtered further to discover the application potential of AI to this epidemic. Thus there are ten possible ways have been identified where the AI enabled technologies functioning effectively to safeguard the public from the adverse of Covid-19. Table 1 explains the relevance of AI to control the Covid-19.

RELEVANCE OF ARTIFICIAL INTELLIGENCE IN THE MODERN HEALTHCARE

As the Covid-19 has malformed, the whole world has been experiencing a new situation called lockdown, to avoid or minimize the spread of Covid-19 as possible as, to control the infectivity, and to increase the recovered rate. Moreover, we can understand the pain of the doctors, nurses, health workers, cleaning workers, police personals, and other people who have been working for safeguarding society. Thus their sweat, blood, pain, and tears can be understood by even a common man and their efforts should also be appreciated. However, most people never realize the role of technologies in supporting Covid-19, especially, the role of AI-powered technologies have been functioning alongside human beings, to avoid the augment of covid-19. AI and its enabling technologies are contributing a lot in controlling the covid-19 (Pirouz, Shaffiee Haghshenas and Piro, 2020). The contributions made by AI and its enabling technologies are explained in the following areas.

Tracking the Spread of the Virus

AI-powered technologies have supported a lot to analyze how fast the infection cases increase and cases having the possibility to get infection. BlueDot is a Canada based institute developed one programme along with AI to predict spread of Covid -19 and its locality. That institute also has published its AI based forecast results followed by the first case diagnosed in china on 31 December 2019. This programme has treated as a well designed one that work with permutations of different cryptograms and it consider more than 1, 00,000 reports in a day from various hospices by cracking the communication fence and it alert all its clients including different government agencies, business houses, and other health care agencies (Gupta, Ghosh, Singh, and Misra, 2020). Smart glasses are the one of the outcomes of the AI-powered technologies and it is very much useful to the security guards to safeguard themselves from the infected

Table 1. Relevance of artificial intelligence in the modern healthcare

10. Other ways	1. Tracking the Pattern and Spread of the Virus	2. Reduces the Workload of Healthcare Employees	3. Controlling Spread through Contact Tracing Application
9. Sensor Enabled Self Monitoring Technologies	Role of Artificial Intelligence in Controlling Covid-19 Pandemic		4. Vaccine Development Through Smart Technologies
8. Decoding and Processing Images	7. Controlling Disease with Video Processing	6. Voice data support in collecting Patients details	5. Developing Response System through Chatbots

Source: Based on the Secondary Data

persons. This could be assisted the security personnel to look into the people with no physical contact, if people are looking abnormal with lofty body heat; it means it is a warning signs of the Covid-19. This smart glass technology could save the time and effort of checking every person manually. Moreover, it keeps the guards away from the risk of get in touch with of the people. This smart glass technology was in use throughout China at different public transports such as bus, train and other communal places, to test higher body temperatures without personal contact. AI-powered technologies being a critical part of integrating two technologies along with the optical vision to measure the body heat (Mufareh, 2021).

Reducing Workload of Healthcare Employees

Testing infection is one of the necessary aspects while diagnosing contaminated patients for identifying the exact reason for the contagion. Diagnosing the covid infected persons through manual tests such as blood and Swab Tests, Nasal and Tracheal aspirates and Sputum tests are ideal ways carried out worldwide. These techniques have the risk of spreading the infections from the infected person. This technique also has a limit on the number of patients confirmed in a day (Catrin, 2021). Thus it is significant to instill AI-powered technologies in hospices with an instant result. Even though the health care establishments of several countries desire to raise the tests in a day, the constraint will forever stay due to the high effort utilization in the form of manual labor, and time. By using AI-enabled technologies such as X-Ray and scanning at the present check for definite patterns such as patient's lungs and assess Covid-19 cases sooner and with no risk of virus spread (Harshita Singh, 2021).

Avoids Contact between the Infected Persons and Healthcare Employees

AI is software by using this we can develop robots with the targeted programming, and these robots can be helped us to face the outbreak. The most significant help that these AI-enabled robotics lessening contact between the contaminated and the people annoying to heal them. As robotics cannot be contaminated by the virus it can be used in healing activities, and thereby reduce infections. It has been administered in numerous hospitals to distribute foodstuff, linctus to the patients, moreover to clean and disinfect the rooms, toilets, and close surroundings often. Robots can also be used to spray cleansers on public places such as roads, parks, hospices, malls, and other common places where there is a high possibility for the crowd (Nguyen, Waurin, and Campus, 2021). Many countries have already built-in robots to check people who are in a fever and even have installed for spraying disinfectants and sanitizers and squirt gel when needed. Boston Dynamics a United States-based IT company has shaped a robotic dog that is being used in hospices. Where, the robotic dogs used to examine patients and collect health-related data, thus it reduces the contact between medical practitioners and the infected cases. In another place, Drones are used to transport medical emergency things to the people who are in quarantine (Manghnani, 2021).

Controlling the Spread of Covid-19 through Contact Tracing Applications

AI-powered Contact Tracing Applications (CTAs) are supporting a lot in controlling the spread of Covid-19. The CTAs have collected the information as the name indicates an incursion of the solitude. Characteristically, this would have for no reason been established, but this is being re-examined relating to the present situation. AI has achieved a lot through CTAs as it assists to decide the transporter of a particular mobile phone number and identifies the spot and meantime it alarms others staying nearby.

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The CTAs have already been put into practice in different nations such as India, China, Italy, and Israel, and the same kind of application is in Trial in the UK. Where this application declared using Bluetooth modus operandi to identify the infected people and their place and make aware of others also in the same area (Maghdid, Asaad, Ghafoor, Sadiq, Mirjalili, and Khan, 2021,).

Developing Vaccine through Smart Technologies

Developing or preparing a vaccine is a lengthy process with all combinations and amalgamations it should design to develop an ideal medication that suits all despite the trivial variation in our genera. This process would be done with different data sources that might be cloud-based, and the computations may have more competencies than the computers. Researchers and research institutes have already begun using AI-powered supercomputers to accelerate calculations and develop different model solutions for a vaccine likely to be finalized. Many research laboratories are using various supercomputers such as Tencent, Alibaba, and Huawei (Hu, Ge, Jin, and Xiong, 2020).

Helping People through Chatbot Response Systems

Aiding the contaminated recuperate and diminish the virus contamination is an important job of the medical practitioners in the outbreak. Creating awareness among the public along with genuine information about the virus would be the best way to reduce the impact of the outbreak. The Centre for infection control and preclusion has developed a chatbot and named Clara. This chatbot has developed to direct the public to recognize signs related to the outbreak and what to suggest actions need to take. Thus, different types of Chatbots have been created, and even the World Health Organization (WHO) has its chatbot on the Whatsapp platform. Since these chatbots are designed with AI-enabled technologies, they are always smart, fast, and accurate in collecting and examining the data related to the outbreak. The responses obtained through the chatbots are based on the unique data inputs, and it is also called ML (Maghdid, Ghafoor, Sadiq, Curran, and Rabie, 2020).

Collecting and Processing Data Through Voice Data

AI plays an indispensable role in crafting a voice assistant to lend a hand to the medical practitioners' to issue the medical notes to the needy instantly because of the time limitations. 'Suki' is an application developed with the AI and ML components to understand the mode of healing and the choices of a doctor. This gadget also recognizes the background of the treatment followed by a doctor and describes their intention also. In such cases collecting and storing a patient's data is a receptive process and it is done safely with cryptographic actions to maintain its security. At present, using "Suki" is free for doctors, health care professionals, doctors, and other crucial care units until the controlling of the outbreak. "Kara" is one of the similar products to "Suki" which is purposively crafted for high-end mobile phones such as iPhone, blackberry and it is a voice-enabled technology that can direct the persons who are working for and who are affected by the outbreak. It also can be used as tone to text application, thus it saves the doctors' time to inform reports manually and it also can be used as an interface with several charting methods. In the case of telemedicine, charting directs to get perfect and regularity of data, accessible for fresh and regular medicine. At present Kara is available free of cost, and it can be accessed with proper permission from the developed organization (Varshney, 2021).

Capturing and Analyzing Data Through Video

In the recent days using videos as data at the necessary times is being a common one. Since it is simple to capture video with the digital camera, and it is available in all places. However, with the help of AI, the cameras could be activated with the visual sensors and notice irregularities as well. The same kinds of gadgets are available with the tag called “Care.ai” and it can be utilized to notice the face reactions, feelings, and it’s some of the features that help to discover health issues too. These gadgets or the systems enhancing the physical readings and examining them to take decisions related to fever, allergies, discoloration, and agitations. Even though, this technique has its limitation that it has to be always on to observe the patient’s situation and behavior in connection with the patient’s history and other clinical details (Maghdid, Ghafoor, Sadiq, Curran, and Rabie, 2020).

Decoding and Processing Images

Images are played important role in the health sector in different ways. Images include Computed Topography, X-Rays, MRI scans, CT scan, PET scans, etc., and doctors are analyzing these images physically even now for normal cases. However, personal involvement is a threat in the present pandemic; moreover, it consumes more time as well as a human endeavor. However, the same data can be assessed by the AI-enabled gadgets it would examine the metaphors by the fraction of time, as well as it would present the reports accurately, thus it reduces the workload of the doctor either endorse otherwise make a decision subsequently. Hence, it is necessary to implement the AI-enabled gadgets in the medical field as soon as possible to collect and process thereby it can be utilized to recognize the consequences of an outbreak and to suggest precautionary to be approved and utilize (Karthikeyan, and Pandian, 2021). Behold.ai is a company that has introduced a new system called diagnostic imaging. This technology can be used to study the upper body C-Rays for patients by using the deep learning technique to generate an algorithm instead of establishing Heat Maps on the patient’s upper body.

Sensor Enabled Self-Monitoring Technologies

Admitting patients into the hospital is a preliminary task of the medical staff, whether the patients infecting less or high. The abrupt increase of Covid-19 affects thousands of people every day, on the other side hospitals facing issues in admitting patients into their hospital due to the shortage of beds. Owing to this issue a new practice called Quarantine has been brought into practice, as per these quarantine patients have to separate themselves in their own houses by maintaining physical distance with others. Further, it needs to observe the patients who are in quarantine whether the health of those bettering or worsening. Due to this, a Hong Kong-based organization called Biofourmis brought some changes in its premise Biovitals Sentinel as well as Everton biosensor to ensure patients who are in house quarantine. Moreover, these gadgets can find out electro dermal, high temperature optically, and some other dimensions, followed by it collect and analyze the data by an AI-powered computer in the health center itself. At the same time as most of the medical centers are operating on AI sensors to observe patients, a digital platform called Oura ring can sense Covid-19 signs before three days they show up. This application has been designed by researchers by employing AI technology to envisage the Covid-19 outbreak and its warning signs such as high fever, continuous and rough cough, gasp problems, and drowsiness, with more precision. Moreover, this technology can be used to monitor the wellbeing of the hospice staff and

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doctors. This software collects biometric data from Covid-19 symptoms and identifies patterns of the start, progressing, and recovery (Neelima, Amit, and Mangamoori, 2020).

Other Ways

EKO is one of the few technologies that use AI, and it is used as an AI-enabled stethoscope to observe and identify various resonances in the body and recognize anomalies. The major benefit of this gadget is that it is wi-fi enabled one and thus it allows keep of a stretch between the physician and patients, by eradicating the possibilities of virus transmission. Further, abnormal heartbeats would be detected by EKO cardiology and monitor cardiopulmonary functions using telemedicine operations (The Economic Times, 2021).

APPLICATION OF ARTIFICIAL INTELLIGENCE IN MODERN MEDICINE

The application of AI in the modern health sector is a hot subject matter in current years. Even though there is the acumen of extreme potential in the application of AI and its enabling technologies in the contemporary medical sector, there are also qualms about the overwhelm of the human touch in such significant and human-motivated jobs. AI indicates that the use of AI and its enabling technologies, programs, and its procedures play a crucial role in the modern health sector by identifying and curing patients with utmost care at affordable cost. Moreover, several other incidental procedures also come to pass in the requirement for a patients' delegate accurately taken to attention on collecting and storing patients' data during doctor's consultation and health checks. Once it collects the data it also examining those data and produces the outcomes of the result. Thereby it applies numerous reasons of information data to obtain precise problem recognition and suggests appropriate curing techniques and treatments, and also it controls the selected technique whenever necessary (Sengupta, 2021). Divergence for engorged use of AI and its enabling technologies in the contemporary medicine is rationally planned and automated the health services frequently and thereby the jobs are completed more rapidly, and it also assists to reduce the time of a doctor, while they could be performing other errands, which cannot be automated and helps to reach more exquisite practice of human wealth. As the application of modern techniques are being occupied and helps to improve our day to life. Nowadays, there are incredible technologies, tools and robotics join hands with AI thereby they have redesigned the modern health and medicine sector by digitalizing the medical data, managing doctors' appointments online, and along with the healthcare applications installed in the smartphone, and it also helps the patients to identify the nearest clinics and health centers. Further, the AI-enabled medical evaluation systems help to analyze various health-related issues, indications, marks, lab files, etc. to build a hierarchical list of recognition and it can be used to illustrate the health and medicine indices. AI-enabled health systems are used to observe, and inspect infects of the patients accurately (Satheesh Pandian, 2020). Further, AI-powered healthcare robotics supports a lot in the surgery with required movement along with the robotic arms, and magnetized hallucination supports surgeons to carry out surgery that is impossible by manual and expertise. Thus the AI-enabled health technologies support a lot to diminish the physical involvement of the health personals in various health services, saves doctors' time, it also enables expertise service and positive service output, and thus it ensures prospect for health and medical sector, thereby it transforms the modern health sector.

IMPACT OF AI ON VARIOUS STAKEHOLDERS

On Patients

Like a self-service hotel, patient self-service is the latest health service model that ensures the option and expediency by letting patients complete the health-related activities such as appointment scheduling, hospital bill payment, entering or updating patients' details quickly and with no trouble all and also with their expediency. Patients can also be utilizing various information and communication devices such as Smartphones, tablets, and laptops to fulfill these activities at their convenient times and locations. Executing self-service health and medical programs enable hospitals to recognize various advantages such as cost reduction, patient waiting time reduction, minimizing medical errors as much as possible, make payment easy, and thereby these technologies also helps the hospitals to augment patients' satisfaction and to promote the hospitals' goodwill among the public (Bai et al., 2020). Such a wonderful self-service can be ensured in the hospitals with the help of ML and Natural Language Processing (NLP) by collecting, storing, analyzing patients health-related data, and it is also made possible to provide customized health services to the patients by accelerating health service processes to augment expediency and competence of the hospitals further. Progressively, service-providing organizations including hospitals nowadays are developing and using internet-enabled interactive platforms, along with chatbots for helping patients to complete various hospital-related services such as medication refills and simple directorial tasks. Alike to virtual health assistants (VHAs), chatbots use NLP to extract concepts and to analyze sentiments and thus a well-structured interactive can be experienced. Apart from this, image sensing is also being used in some cases to sense photos, read bar codes as well as handwritten notes. Thus the automatic interface systems enable a customized incident to the patients and it is also accessed at any time round the clock. As health service providers are trying to mounting patients' experience and satisfaction towards their services, concentrating more on the intelligent interface systems to make a distinction. By authorizing patients to do some tasks at their expediency with round-the-clock access to gain familiarity with the various functions of the chatbots, along with the health systems, the ability of the interface systems will also be representing to boost up patients' satisfaction. With patient's self-service model the health service providers can streamline the hospital operations by steering the patients to get an appointment or straight them to visit help or registration desk, according to the predefined rules, thus it facilitates the registration team to concentrate more on the select group of patients who require greater value-added services. The managerial and operational advantages of the hospital self-service model using ML and NLP ensures well-organized documentation of current and real-world scenarios as well (Li, 2020). With the help of the self-service technology model, patients' traffic in the hospitals can be reduced considerably and free healthcare staff to do their work without any disturbance. Afterward, as schedules are ended, point of service (POS) will be exposed to augment payment collection. Though hospitals integrated with various payer systems, the use of POS systems helps to speed up the payment process and more responsible for the patients. If in case of any problems arising in the collection and remittance of the payments, the ML technology will be used to remove those problems, by analyzing the payment patterns along with the interface system, thereby it will come up with the finest way to receive the payments from patients without any delay. A personal health assistant is yet another health application that leverages the experience of the patients in various ways. These personal health assistant applications collect information from the users and provide the same to the hospitals or the doctors about the intensity of diseases, vari-

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ous symptoms through chatbots with NLP and ML (Tim Wilson, 2020). Some types of personal health assistant applications raising questions towards the patients to build a user profile and thereby perform custom-made evaluations when the patient is not feeling well. Thus personal health assistant applications also use AI to present health-related advice based on queries raised by the patient and also provides technical support through video consultation with doctors. Further, than personal health assistants, NLP and ML are also used in various patient-oriented functions. Personal health assistant applications use optical images to confirm whether the patients have taken medicines, at the right time or not. AI plays a major role in this process for analyzing the images of both facial and medication identification and to authenticate that the medicine has been ingested.

On Clinicians

AI acts like a kit for diagnosing patients more effectively with precise treatment plans with the help of ML and NLP. There are numerous clinician-oriented applications which are using NLP and ML to collect and process the data. AI-enabled technologies are at present being used in computer-aided detection (CAD) systems to gain knowledge of how various clinical deformities become visible and it can be studied by assessing the data collected through imaging and clinic. Thus by reviewing an extremely more number of images and along with clinical data, would facilitate achieving a sufficient level of knowledge, further CAD systems are talented to use the information they have erudite to recognize areas of deformity by studying the images and produce various possible analyses for the results. CAD is the latest method that is being used largely in several imaging studies, especially in mammography to recognize areas doubtful for breast cancer for the radiologist to assess further, and high-resolution CT scans to evaluate the chest related issues by using the number of images taken during the study to spot suspicious areas which are having the possibilities for the lung cancer and thus it suggests further review from the radiologist (GGVA, 2019). Progresses in AI and its enabling technologies are expected to produce additional as well as the extraordinary potential to the solutions produced by the CAD. Over time, it would not be astonishing to see the precision of CAD technology for several images sensing studies and it surpasses that of radiologists, further along with CAD technology radiologists become the principal interpreters of various image sensing studies and radiologists only reassess the image sensing studies that go beyond a certain point of doubt of the CAD or AI technologies. Apart from the radiology application, CAD technology is also applied in dermatology to identify skin-related issues or diseases. CAD technology in the dermatology field helps to learn a lot about dermatological issues by analyzing huge numbers of images of lesions along with the dermatological-related opinions connected with them. Representing how CAD technologies are functioning in the radiology field, this CAD technology can also be helped to use the knowledge they have obtained to identify the possible dermatological lesions that are at risk for being wicked. Even though the results of these technologies are usually re-evaluated by a skin specialist, these dermatology CAD technologies can make it convenient for non-dermatologist major care doctors to screen various skin lesions (Forsee, 2020). At last, a company, further than spoken, has designed software to recognize the vocal samples to categorize the feelings for uses further than the health sector. Fascinatingly, some of the health-related researchers have established the precise relations between several patterns of voice and several diseases. At the same time as more researches need to be conducted in this field to excel the health benefits, further the initial results direct to voice analysis possibly used this method as a marker for various non-invasive sickness processes (oucks, Davenport, and Schatsky, 2018).

On Pharmaceutical Industry

The role of AI in the pharmaceutical industry is a fortunate thing, as it condenses the time and cost for discovering new drugs and developing new formulas as fast as possible. In olden times developments of pharmaceutical products were expensive and time-consuming lengthy process. Since the biological field is a multifaceted one, this AI-enabled technology inserts many layers in the drug development process within a short span with more precision. A particle that is recognized to adapt an exact step in a biochemical process and to do so efficiently, the rest of the biological process needs to be understood thoroughly. Though many formulas are reacting extremely well in the laboratories they cannot be processed further in biological setup as they have unfavourable effects. The different mix of the biomolecular configure the number of new molecules with new possibilities to become restorative drugs is overwhelming. Further, the more tests that must be lead to high costs and lengthy as well as a slow process. AI and ML together with NLP are a tremendous technology that would facilitate to process of numerous research outputs to make the progression more competent and resourceful (Kechit, 2021). Thus the AI and its enabling technologies then decide the shortest connections among various relevant data points and thus it narrows down the number of molecules by an order of enormity. Further, the objective of drug development is to discover diminutive particles that modulate the process towards the target proteins. From the olden times, guidance has been provided from generation to generation to prepare the compounds naturally. Moreover, nature has supplied a huge number of molecules and they are facilitated to develop various modern drugs, but not in recent times, as many drugs are developed through the laboratory. And while unearthing new drug formula has a chaotic process, the modern pharmaceutical industry developing various methods and strategies to evaluate a huge number of molecules for exact desired targets (Kathleen, 2020). Yet even with contemporary techniques of high-throughput selection of molecules recognized for exact targets, and the results are frequently sub-optimal because genetic systems are multifaceted, and molecules that functioning well for transforming one pace in a process may have unfavorable relations in other branches of the biological network or the process. These concerns may not become obvious until later in the development of the drug come across several tests, and requiring more time and money for the same but results are not viable. In such cases, the modern techniques in molecular testing, called machine-vision and image sensing allow AI and enabled technologies to envisage the right number of molecules for effective results, and thus speed up the drug discovery and development process. Likewise, replications of chemical relations can be carried out to assess the efficacy of the drugs in the disease treatment (Alyssa DelPrete, 2019). The potential application of AI and its enabling technology is ensuring speedy and precise discovery of vaccines for a certain pandemic like covid-19. In such times this technology can ensure huge and immediate benefits for diseases that are spreading immediately such as Ebola or Zika, or even the rapidly transmuted HIV. While some of the drug manufacturing companies have started to use AI technology to study the drug interactions deeply, thus this technology may pave the way forward to use AI to investigate whole biological systems to observe how the drugs might influence the tissues of a patient. Through this technology requires a huge volume of data and image sensing outputs, AI technologies are the promising technology; they are helping to trim down the time as well as the cost in the drug development process by spotting the right number of molecules. Even though the brunt of ML and NLP has yet to be decided in successive stages of drug development, researchers have lots of optimism for making use of the outcome of these technologies (Laura Craft, 2017).

AI FOR DESIGNING EFFECTIVE TREATMENT PLAN AND DELIVERY

AI is contributing a lot to oncology treatment design and it is considered to be a major advantage of AI in this sector. Because treatment patterns will differ often while treating cancerous cells and it is important to consider various factors of treatment such as treatment modalities availability and the preservation of healthy tissue. As a result, this process seems to be a challenging one as well as time-consuming. However, in the field of subspecialties of oncology number of clinical tests and trials are being carried out around the globe. While understanding and assimilating all the data would be a colossal job for one oncology practice and it is not possible by a single doctor, but this job can be processed easily and precisely by computer-facilitated with ML and NLP (John Edwards, 2019). These two technologies can make this job as easy as possible by reading and understanding thousands of data and compare the same with the data of a particular patient's case, and thus a doctor can take an appropriate decision. Deciding and providing treatment is yet another complex issue and as it is a time-consuming one in oncology because treatment has to target only the cancerous cells and safely treat the area of the healthy tissue. Thus it is a difficult job, further while treating the cancerous cells spotted in the neck, and head, countless important structures are in located closeness, that too they are small spaces comparatively (Aunt Minnie.com, 2019). Charting the anatomical structures, and measuring radiation combinations at different viewpoints and beam strengths, is a time-consuming process for radiation oncologists and their employees, as they decide the right way to providing therapy. Here yet again, the ML along with NLP demonstrated medical value consistently. Further, the ML-enabled systems can process the way of treatment in less than a minute, but for the same, even the days need to spend by the manual oncology team, and it also delays the treatment process. In the cancer clinical trials, the ML-based medication plans have been compared with the plans prepared by the experts, where the ML-based medication plans have equal accuracy. Furthermore, the majority of the respondents found difficulty in distinguishing between the plans produced by experts and the ML system. In such a manner the ML-enabled systems created an accurate treatment plan.

HOW AI CAN IMPROVE OUTCOMES AND EFFICIENCY IN THE HEALTH SECTOR

From the ancient days to till today the health sector has been moving with huge volumes of data, and which have been maintained through recording and keeping the data including observation details and analyzing the same during the patient care if required. Nowadays AI-enabled systems have made these kinds of jobs including collecting, classifying, storing, retrieving, and exploring the large structured and unstructured data sets to expose veiled patterns, compare the same with past cases, and take medication decisions based on that. As mentioned earlier, ML is playing a significant role in AI-enabled health activities and it enables the quicker and more precise examination of the huge volume of data. Yet another role of AI in the health sector is health and medical proof mining and recognition of concealed tendency of the disease. AI can be applied to inspect the data for drawing the health trends of the patients or to match up with an individual patient with similar histories. Data science technologies are very much useful in examining various medical data from numerous medical records, and they can help to improve patient care during an emergency through clinical forecasting based on patterns recognized among similar cases. With the help of AI-enabled technologies patients' risks can be segregated more

accurately by processing huge volumes of data with lesser resource requirements, but this facility was a tough job before the arrival of AI. In the same way, AI can be used to improve the outcomes of the pharmaceutical industry (Daniela Hernandez, 2017). AI leverages itself as an essential tool for clinicians in charting interventions and improves patient outcomes. One more area that receives significant benefits from AI is genomics. Genome examination and disease tendency forecast are keystones of accuracy health service, which is a promising move focusing towards individual's health improvement by analyzing, avoiding, and treating potential sickness through well-planned preventive techniques. AI-enabled integrated technologies ensured exact health analysis by combining the AI-powered technologies in genomics medicine with improved data compilation through electronic health records, sensors, digital wearables, and other digital devices. Thus the AI-enabled technologies not only diagnose the disease pattern but also assess the clinical information, by analyzing the data collected from a patients' biometric access, lifestyle, heredity, and current environment situation includes workplace, residence, tension, and so on. For several diseases, a patient's genomic data is used already to plan a custom-made treatment to maximize the clinical outcome. In the years to come, the accuracy of the health sector can be balanced by merging the genomic analysis with ML and AI. These technologies will ensure the suitable treatment to trim down the occurrence of certain illnesses (Nicolae et al., 2019). Thus the capacity to identify potential health risks and arbitrate with precautionary measures will alter the concept of health care. In the present disease management process, health service providers let the individuals become ill and present with symptoms, to know exactly what the disease is. But in the future, the health sector and health service providers will focus more and more to provide true and reliable health service by observing the individual health proactively, performing precautionary measures in advance, and managing people with preventive medicine. Thus the exactitude health models will have the possibility to implement using ML, and NLP. Apart from medical, AI helps to gain managerial and operational benefits, as AI will prolong to play an important role in providing a competent and gainful administration of the health sector (Cohen and Mello, 2018). Thus it enables operational effectiveness; reduce the treatment cost, data processing, speedup office automation from reception to back-end offices, and all over the place in between. Further, the systematic appraisal of medical credentials and coding hospital operations based on data analytics having the potential to raise the annual income to 80 million USD, depending upon the dimension of the health care organization.

THE FUTURE OF AI IN HEALTH CARE

The future of healthcare will depend upon AI in its operations, as it has been operating with hybrid models. With these hybrid models, health service providers can diagnose the patients accurately with less time along with less cost; these models will also guide them to charting the treatment plans, analyze and identify the health risk factors shortly, thus this technology itself is having the responsibility for the patient's care. Its result influences the health service providers to adopt this technology faster for justifying perceived risk and begin to deliver quantifiable developments in patients' outcomes and working efficiency at scale. The existing AI-enabled modern technologies and the technologies in the developmental process are leveraging themselves through ML and NLP as these technologies having their values (Atul, Ken, David, and Bill, 2019). As these technologies having the capacity to deliver potential output to the health sector, the future will be expected to obtain a synergy through the power of AI and its related technologies on patients' journeys. Though we cannot forecast the happenings in the future

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with the fullest accuracy, we may judge upcoming scenarios that would likely happen. Because in the upcoming days, all the patients would have access to various wearable digital devices to track different health issues right from monitoring glucose levels in the blood, heartbeat rates and rhythms, and levels of exercise over time. Thus all this monitored information will be synchronized to a centralized monitoring system installed in the hospitals. All those monitored information will be processed through ML to identify irregular or undesired change patterns. If the monitored devices found an abnormal health pattern in the patient's body, those monitoring devices will notify that information to the doctors or hospitals through messages or warning signs, and it also intimates the patients to plan an scheduled time to meet or consult with health service providers. Once the patient reaches the health center, they can check-in by themselves through voice chat-enabled biometric machines powered by the NLP to attain patients' registration data. Suppose the patient has no bill due on his hospital account, the patient need not pay at the machines or expect anyone to discuss an account balance. The doctor before checking the patient, will review the data sent by the digital wearable devices of the patients along with the causes why the alert was produced and a list of possible diagnoses will be produced by the monitoring systems with the help of AI capabilities. Once the doctor inspects the patient, he /she will then provide the treatment reminder (Simon Marshall, 2021).

After the treatment reminder note has been provided, the ML and NLP will convert the text in that treatment note into codified data behind the scenes, by using those codified data patients' medical records will be updated electronically, and thus it would generate appropriate billing details automatically and will send the same to the patients' insurance company for reimbursing the medical expenses. Furthermore, based on the data collected by the digital wearables as well as the electronic medical record generated by the systems, a treatment plan will be decided with the combination of ML and NLP to suggest possible changes to the patient's present treatment plan including medicine dosages and times to consume as well as diet and exercise schedule. Thus it also reveals the patients' precise clinical condition up-to-date. For example, a patient approaches a doctor and mentions that he feels tired and having a continuous cough in the last two months, so the doctor will dictate necessary lab tests along with a chest CT scan (Codrin Arsene, 2021). Once the lab test results come both the patient and doctor will be notified through the patient and doctor portal. Based on the results of abnormal heartbeats and chest CT scans found by the CAD it would mention the probability of the particular health issue. As a result, the patient is again impelled by the NLP-enabled chatbots to schedule and follow-up the appointment with the doctor, oncologist, and biopsy for confirming the state of the disease, and to consider the results to go for the next stage of treatment. The oncologist will check the patients' e-medical records and imaging findings before meeting the patients and will re-examine evidence-based medical treatment literature for deciding possible treatment options by using NLP and ML. If the treatment type is finalized, then the ML will be used to customize the treatment plan according to the patients' health conditions (Micah Castelo, 2020).

Both while the patient is undergoing treatment and after treatment, wearable devices will monitor the patient and again notify both the patient and provider should the AI-enabled monitoring system determine that intervention is needed. ML can then also suggest the best course of action based on the patient's clinical condition and prescriptive analytics, and monitor patient behavior in order to provide incentives for appropriate behavior. At last, data of a particular patient will be compared with the health data of other patients, and the results will be stored into the master health database. That database, with new information being added daily, is continuously being mined using NLP and ML for potential associations across a broad set of data in an effort to identify previously undiscovered causes and treatments of diseases. This situation demonstrates the possible advantages available to the patients, doctors, and

other stakeholders like laboratory experts, pharmaceutical experts by increasing the use of AI throughout the medical journey the patients (analyticsindiamag.com, 2021).

Proactive oversight of the patient's health using NLP and ML to monitor data from wearable devices can mean quicker interventions and changes to treatment plans, potentially resulting in patients health state while they are coming to the treatment, and it will support doctors by making their job more easy, fast and take care of patients with affordable cost. Kiosks with NLP and ML for registration and check-in can save patients time, reduce front-desk resource costs, and increase the accuracy of information for the provider office and insurers. Using NLP and ML to codify a provider's dictated note saves the provider time because dictation is much quicker than other forms of data entry but benefits the patient, the provider, and the insurer by codifying information dictated in the visit note and generating a more accurate and complete bill to send to the insurer in a more timely fashion. Application of CAD systems into the examination of the image studies, it will help a lot to the radiologists to get better output with precision, and applying AI and ML in the treatment based on the unusual physical condition of the patients, inducing patients to make appointments means that patients can be proactively treated earlier in the process when they are less ill. The use of NLP and ML to review the literature for treatments specific to a particular patient's clinical situation helps providers and patients by making a positive outcome more likely and helps reduce costs for insurers by avoiding treatments with lower likelihoods of success. It can also benefit the pharmaceutical industry by allowing their products to be used in clinical situations where they are more likely to be successful in treating the patient. The application of NLP and ML in the public health data mining produces various benefits to various stakeholders such as patients, doctors, other healthcare service providers, and pharma industry people by discovering the diseases have not explored previously and having the possibility to the novel treatments (analyticsindiamag.com, 2021).

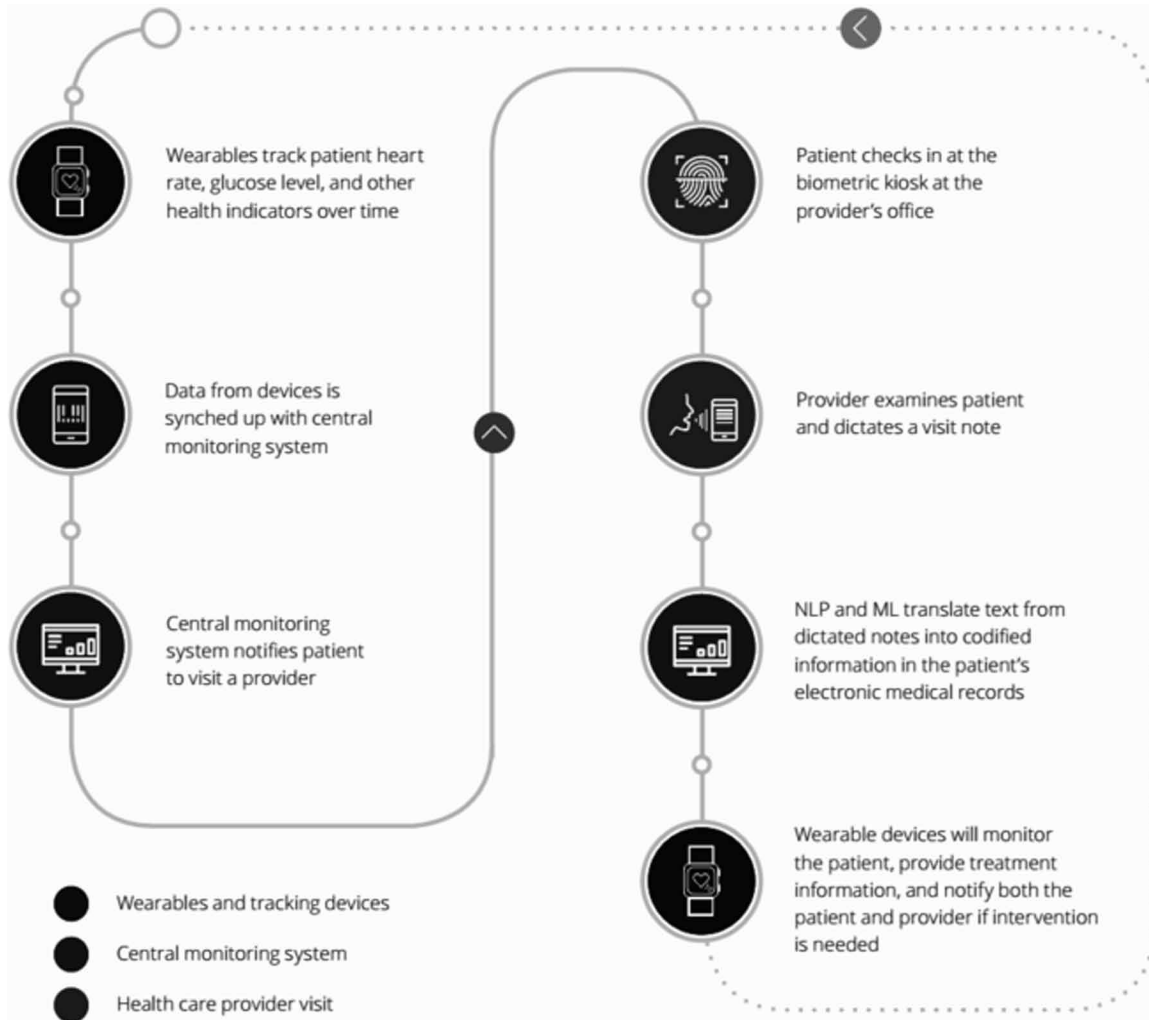
Patients will be monitoring during and after treatment with the digital wearable gadgets, and these gadgets will be watching patients by observing the physical condition and it will alert both the patient and doctors by the AI-powered supervising systems to decide the type of intercession is required. Meantime ML can also recommend the best course of treatment based on the patients' medical stat, analyzing prescriptive and observing patients' behavior. On the other side, patients' health data will be de-identifying with other patients' health data, and thus it will be entered into the centralized healthcare database. Such a manner database will be updated daily with new patients' data and is incessantly analyzed with the help of ML and NLP to find out the possible relations across the large set of data to discover reasons and treatments to cure the diseases. This situation demonstrates a lot of the possible positive outcomes to various stakeholders such as patients, doctors, and pharmaceutical people by augmenting the power of AI throughout the patients' medical journey (G7, 2018).

AI-enabled smart wearables induce the patients to oversees their health proactively by themselves using ML and NLP to observe and collect the data from the wearable devices, thereby it alerts the patients to go for the treatment at the earlier stage of the disease and thus it reminds the quicker intervention of the doctors either to choose or change the plan of treatment, its result patients will be checking at the initial stage of the ill and immediately will be presenting for the treatment, thereby the workload of the doctors will be reducing, and also reducing the costs for insurers. Machines powered with ML and NLP are used in the hospitals nowadays for registering patients and check-in, thus patients' time can be saved considerably on one side, on the other side it will minimize the costs of front-desk resources, and augment the correctness of data for the doctors and insurers (Geng, Daniel and Rishi 2018). ML and NLP will be used to coding the doctor's dictated notes, thus this technology banks the time of the doctor, by this way the dictation can be done much faster than different forms of data entry, meantime it also helps the

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Figure 1. Patient journey

Source: Deloitte, 2021



patient, doctor, and the insurance company by coding the information stated in the appointment note and producing a more precise and absolute medical bill, and the same will be sent to the insurance company in a further appropriate method. Using CAD systems in reviewing the images of the various scans, will assist radiologists to get better output and accurateness, and applying AI and ML to hold unusual health outcomes activating patients to schedule an appointment with the doctors to treat themselves as early as possible in the course while the patients are in the ill. ML and NLP will be used to re-examine the medical literature for fixing specific patterns of treatment to a patient based on their clinical condition, and thus these systems will help doctors and patients for making possible positive outcomes and assists to diminish reimbursement costs for insurers by evading treatments with lesser likelihoods. AI-enabled technologies also supporting the pharmaceutical companies by permitting the drugs and tablets to be utilized in various medical situations where they are having more possibility to treat patients successfully. Ultimately, ML and NLP help a lot to manage mass health data in a short time with high accuracy,

thereby it helps patients, doctors, insurance companies, and the pharmaceutical industry by recognizing the unfamiliar relationships and ensures new possible treatments (Pandey, 2018).

AI AND THE DELIVERY OF HEALTH SERVICE

The application of AI in the health sector will impact all the new players who are entering into the health sector along with the doctors, health service providers, clinicians, and some other stakeholders who will engage in the future. New players who are entering into the health sector such as doctors, nurses, laboratory experts, and pharmaceutical specialists, healthcare-oriented technology manufacturing companies are expected to incorporate modern healthcare technologies such as AI, ML, and NLP in their everyday medical routine, and it would be an essential requisite to build and competitive advantage on their health care servicing and to attain sustainability. To attain sustainability in the health sector, hospitals and other health-related service providers will try to offer precise and cost-effective services to the patients by automating healthcare practices and permitting doctors, clinicians, and other health sector staff to focus on their time, skills sets, and other pertinent activities that make added value to their sector. Doctors, nurses, and other health service providers may spend more time looking after the patients than the time used to enter the data into the electronic health records. In this way, health care staff can spend more time addressing the physical conditions of the patients than checking them at the first sight (Sandeep, 2018). By saving time, doctors, health service providers, nurses, and staff may intermingle with systems which are relied on AI, ML, and NLP, and found a way to improve their potentials, by adjusting the work structure. Thereby they are working with these systems comfortably and use the same in the day-to-day healthcare practices. The application of AI in the health sector ensures better, flexibility, and accurate health service from the beginning. The mounting capability of the medical types of equipment starts to use AI, ML, and NLP to monitor the patients remotely and proactively by conveying alerts as early as possible when the health condition becomes unusual. By sensing the physical condition of the patients it reminds the doctors and patients to avail themselves of the appropriate treatment at home, with lesser cost, though patients are away from health centers. It means the doctors will likely carry out their day-to-day activities away from the emblematic health care setting where they are working. Further, this remote treatment also ensuring personal visits by the doctors, nurses, and other health care service providers to take care of the patients, thus it is lowering the cost of patient care on one side and also augments satisfaction (mckinsey.com, 2020). In addition, assessing where and how the health sector will be working

Figure 2. Various considerations of AI, ML, and NLP

Source: Deloitte, 2021



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better with the application of ML and NLP will possibly shock the health sector's talents. Because, these technologies to be expected to perform better by extending the doctors' service by combining with ML and NLP, to trim down costs and saving doctors time. It is also expected that the new developments and new forms of talent models to occur in the days to come. Thus it will be changing the traditional health service from the hospital to the home environment, and it would not be astonishing to see local health care by allowing the licensed health professionals and allow them to serve as local and home extended services on behalf of the health care institutions (Sandeep, John Fox, and Maulik, 2019). Health service providers hereafter should be deemed the inevitable shifts related to NLP and ML and prepare themselves to be ready for dealing with various considerations, such as process and governance, Organizational and culture, and financial considerations (Deloitte, 2021).

Consideration of Process and Governance

The basic ideology of identifying new forms of functioning is depending upon the solid structure of the governance, process, and reliable teams. Hence every organization especially service organizations like health care centers needs to deem the development of an innovative steering commission. The commission should conduct regular conventions to discuss the things that need to be automated, modernized, and enhanced by applying the latest technology developments like AI, ML, and NLP. In this way, organizations can radically augment the output or service quality by investing capital, time, and other resources to build a solid structure of governance and process. Further, the organizations need to connect with the steering committee to innovate and recognize places where the latest digital technologies such as the Internet of Things, blockchain technology, big data can be applied to promote organizational efficiency. Cloud storage is a technology that augments the value and diminishes the cost thereby it promotes cloud-based third-party data storage structures, and ML and NLP help to build a faster, smarter, competent, and sustainable business. Thus measurable data storage can be offered by the third-party vendors that would usually be prohibitively costly, and offer a Software-as-a-Service (SaaS) move towards attaining ML and NLP resolutions that diminishes the charge and intricacy of having and keeping hardware on-site (Chelvachandran, 2020).

Consideration of Organization and Culture

While thinking about the human capital and organizational resource aspect of this revolution, organizations need to raise data analytics groups to be capable to collect data from the patients, doctors, and the public as likely to augment health care services and operations. Spawning fresh data from the patients is a tricky job for doctors due to the multifaceted and complex nature of healthcare data. On the other hand, many decisions will be made based on these data and will be used in clinical and business, it is an indispensable process to generate a culture and its related processes to endorse the formation of fresh, whole, and appropriate data from domestic sources. From the cultural point of view, health care service providing organizations should look into other businesses for motivation, as numerous companies are in a superior place to take perils coupled with modernization of business than health service providing organizations, as patients' survival would be at stake and attractive unacquainted perils are excessively risky (Tim, Brian, and Tamim, 2019).

Financial Considerations

From financial considerations, any business must be ready to do the investment in the information center sufficiently, as the IT-enabled solutions will be allowing the technologies to function as planned and fabricate the required results. Though some of the models, like SaaS, involve the development of lesser infrastructure to be built and managed by a company, and thus every data need to be analyzed thoroughly and independently.

NEW RISKS TO ADDRESS

It is time to understand that, though the technologies providing lots of benefits there are latent risks also associated with the major use of technology advancements like ML and NLP. Coding the collected data using NLP builds it easier to disseminate that data such as organizational policies and procedures throughout the organizations, as well as de-identifying the information that is disbursed in several circumstances, and these are the things that need to be industrialized to look after the privacy of the patients. Moreover, data safety against the third party or the hackers or some other unauthorized admission also requires be executing and sustaining at various levels to avoid unofficial use of the secluded individual and health care data. Though the data security issues are existing in the usage of AI, users or the service providers need to understand that AI is used in the day to day health care activities to augment the quality of service provided, increase productivity; however, all these things are indenting to provide utmost service not to reinstate healthcare and its allied activities personals (Nicholson Price, 2019). Though the AI, ML, and NLP technologies are having lots of advancement in their operations, they require some amount of human effort, without human effort it is not possible by those technologies. As far as the present situation of technologies is concerned, though the AI and its enabling technologies are suggesting suitable treatment patterns for various diseases, those treatment suggestions should be appraised suitably by the approved clinical experts to confirm the suitability of the recommendations for a particular patient's health situation. Correspondingly, doctors or health service providers should not be more reliant on the use of technologies operating with the support of AI, because it may lead to the loss of medical expertise that they were skilled in training and extended through practice (Michael Walter, 2019). Though modern technologies are come up with several noteworthy paradigm shifts, the progression towards AI in the various operations will take some time to work. While there are major technological challenges that need to be addressed from the back and front ends. Moreover, the progress towards the self-service obtained by the patients indicates progress away from the status quo, changing control over some functions may create unnecessary problems for both doctors and patients. To recompense for the control greater than before by patients, effective governance policies and procedures need to be developed to make sure the sufficient number of staff and the resource are utilized properly, and effectively (Upendra, 2020).

CONCLUSION

AI is a fortunate technology that has been serving humankind a lot to deal with this pandemic. It is a future and constructive technology to recognize the Covid infections early and assists in managing the infectious. With all the new advancements and developments explained in the earlier part of the article,

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thus one can think about Covid-19 is an ignition for all the modernism and it makes the researchers and scientists work smarter, faster, and reliable. Thus it develops the medicinal firmness by taking decisions with well-developed algorithms. As a result this technology taking care of affected cases with the appropriate and timely monitoring. This technology also tracks the pandemic situations with various yardsticks like medicinal, biological, molecular, and epidemiological significance, and hence, it is treated as a contributive technology. Moreover, it researches the severity of the pandemic, with the available data and comes with reliable and constructive results. It also ensures world-class treatment by establishing different treatment methods and approaches for preventing disease, developing medicines, and vaccines. Exclusive of AI, the Covid-19 battle would have been harder to fight, and the potential uses of AI and its enabling technologies in the medical sector are never-ending. The further range for the advancements and developments of the healthcare industry with AI and creates an important brunt in overcoming the Covid-19 pandemic (Alloghani et al., 2018). The planet may never be similar as we know it, but it can be improved more than earlier.

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