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# A REVIEW ON IMPORTANCE OF ARTIFICIAL INTELLIGENCE (AI) IN COVID-19 PANDEMIC

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## ABSTRACT

**Background and Aim-** Healthcare delivery requires the support of new technologies like Artificial Intelligence (AI), Internet of Things (IoT), Big Data and Machine Learning to fight andlook ahead against the new diseases. We aim to review the role of AI as a decisive technology to analyze, prepare us for prevention and fight with COVID-19 (Coronavirus) and other pandemics.COVID-19 outbreak has put the whole world in an unprecedented difficult situation bringing life around the world to a frightening halt and claiming thousands of lives. Due to COVID-19's spread in 212 countries and territories and increasing numbers of infected cases and death tolls mounting to 5,212,172 and 334,915 (as of May 22 2020), it remains a real threat to the public health system. **Methods**: The rapid review of the literature is done on the database of Pubmed, Scopus and Google Scholar using the keyword of COVID-19 or Coronavirus and Artificial Intelligence or AI. Collected the latest information regarding AI for COVID-19, then analyzed the same to identify its possible application for this disease.

**KEYWORDS-** Artificial Intelligence, big data, machine learning, bioinformation etc.

## INTRODUCTION

Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus.Most people infected with the virus will experience mild to moderate respiratory illness and recover without requiring special treatment. However, some will become seriously ill and require medical attention. Older people and those with underlying medical conditions like cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more likely to develop serious illness.Anyone can get sick with COVID-19 and become seriously ill or die at any age. The virus can spread from an infected person's mouth or nose in small liquid particles when they cough, sneeze, speak, sing or breathe. These particles range from larger respiratory droplets to smaller aerosols. It is important to practice respiratory etiquette, for example by coughing into a flexed elbow, and to stay home and self-isolate until you recover if you feel unwell. Since the emergency of the COVID-19 pandemic at the end of 2019, 219 countries around the world affected 97,422,123 confirmed cases and 2,086,159 deaths, on the twenty- first of the January 2021 (website, worldometers.info) see. A novel coronavirus disease 19, also referred to as COVID-19, is an infectious disease caused by severe respiratory syndrome coronavirus type 2 (SARS-CoV-2) (Awasthi et al., 2020) (de Almeida et al., 2020) (Manigandan et al., 2020). The most common symptoms experienced by COVID-19 infected patients are dry cough, loss of smell and taste, fever, fatigue, and 117 respiratory illness such as shortness of breath (Ibrahim, 2020)(Jalaber et al., 2020).

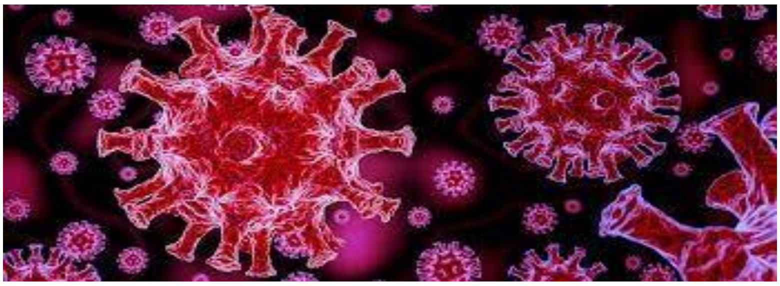

**Fig. – Coronavirus.**

The cross sectional view of SARS-CoV-2 shown in Figure 2, which is comprised of spike protein (S), nucleocapsid protein (N), hemagglutinin-esterase dimer (HE), membrane glycoprotein/ matrix (M), an envelope protein (E), and single-strand RNA, non-segmented, enveloped.

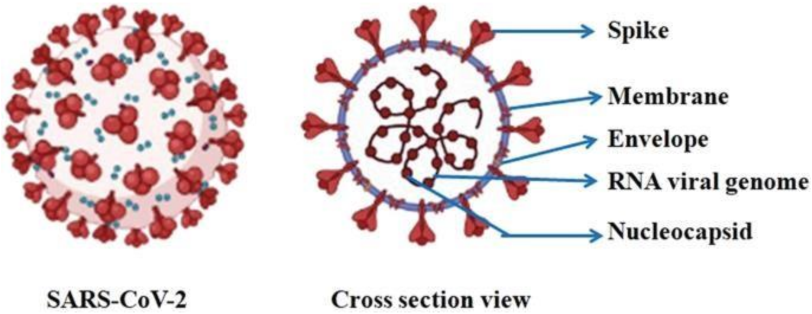


**Fig. 2: Cross-sectional View of SARS-CoV-2.**

In our opinion, the scenario is complete: the direct impact of the pandemic drives scientific research towards AI methodologies applied in COVID-19 related situations, and collaborations between different countries are strengthened by the common interest in finding effective strategies to contain the crisis in many different fields. A notable literature review of AI tools during the COVID-19 pandemic can be found in Chen et al. (2020).

Such a wave of interest confirms the importance of new strategies in accelerating the development of knowledge and solutions to the present medical and socio-economic emergency. However, some questions related to the role of AI during a pandemic remain open: for example, "Has AI proven itself ready for such a situation?"; "What is the real importance of data, i.e. the importance of their collection and quality in the application of AI techniques to real problems?"; and "Has AI been successfully applied in real COVID-19 situations and what benefit has it brought in these contexts?".

COVID-19 was initially recognized in 2019 in Wuhan, China, and since then spread globally and very fast, resulting in the 2019–2020 coronavirus pandemic. The most common symptoms of COVID-19 include cough, fever and shortness of breath. Other symptoms may include diarrhea, muscle pain, sore throat, sputum production, abdominal pain and loss of taste and smell. COVID-19 is typically spread during close contact and via respiratory droplets produced when people sneeze or cough. Respiratory droplets may be formed during breathing but it is not well- thought-out airborne. It may also spread through fomite transmission. For example, touching a fomite (contaminated surface) and then touching the body's mucous membranes, such as the mouth, nose, or eyes, could potentially introduce the pathogen into the body. Recommended measures to prevent infection include frequent hand washing, social distancing (maintaining physical distance from others, especially from those with symptoms), covering coughs and sneezes with a tissue or inner elbow, and keeping unwashed hands away from the face. The use of masks is recommended by some national health authorities for those who suspect they have the virus and their caregivers, but not for the general public, although simple cloth masks may be used by those who desire them. In this Review, we focus on AI technologies play a crucial rolein the covid -19 and there are some various applications are used in the analysis, detection, and prevention of covid-19 disease.

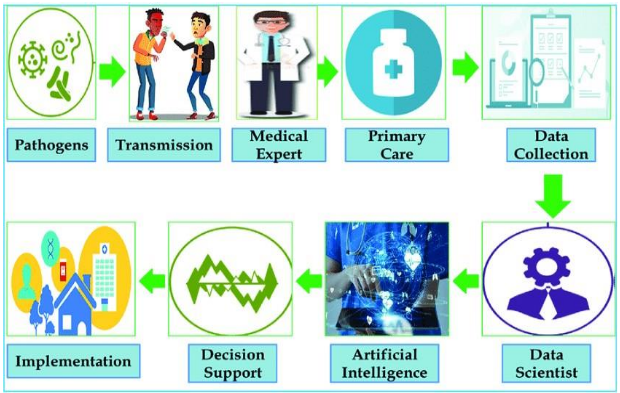


**Fig. 3: Prevention of infectious disease.**

Advances in AI are expected to represent an effective strategy to face these challenges: thanks to the massive amount of information made available through the advent of pervasive IT, and the continually increasing computational power, AI has shown an outstanding performance concerning most of the problems mentioned above. Indeed, its ability to extract patterns and relations from data has made this research area particularly attractive in tasks involving the description of complex information and dynamics. Successful applications of Deep Learning (DL) (Shorten et al. 2021) and Machine Learning (ML) (Nayak et al. 2021) techniques in image recognition and segmentation, time series forecasting, sentiment analysis, system control and dynamics simulation are widely present in the literature, as well as robotic self-operating solutions that have proven to be effective in containing social contacts.

**Applications of Artificial Intelligence in healthcare and bioscienceResearch**
- Collecting and synthesizing information.
- Molecular interaction and drug identification by data mining.
- Elucidation of disease mechanism.
- Generation and selection of drug candidate.

**Detection**
- Analysis of data and early warning for communicable/non- communicable disease.
- Disease diagnosis by pattern recognition using symptom data and medical images.

**Prevention**
- Prediction by calculating a person's probability of infection.
- Surveillance to monitor and track infectious agent in real time.
- Deciphering appropriate information by analysing personalized news and moderatingcontents to fight misinformation.

**Clinical development**
- Design of trials.
- Selection of site to conduct trials.
- Recruitment optimization.
- Prediction of toxicity and risk monitoring.
- Monitoring of drug adherence.

**Response**
- Assistance in delivery (Robots for high exposure task in hospitals and drones for transport of materials.
- Service automation by deploying virtual assistants and chatbots.

**Recovery**
Monitoring to track the economic recovery through satellites, GPS and social media.

AI-based technologies also help to identify the most susceptible individuals based on their personalized genetic, physiological and biochemical profiles. Applications of AI-basedapproaches that could assist as key components of the Covid-19 pandemic are presented in abovementioned.

**Covid-19 and AI**
AI-based approaches are being implemented in the diagnosis of Covid-19. Some of the AI-based tools have demonstrated to perform efficient classification of the level of severity of Covid-19 byusing radiologic images like X-Ray and CT-scans.For the diagnosis of Covid-19, supervised learning algorithms like convolutional neural network (CNN), linear discriminant analysis, Naive Bayes, support vector machines, decision trees, logistic regression and random forest are being used. These algorithms use different datasets to classify the images in multiple groups which help in determining the level of disease severity and also in differentiating Covid-19 from other similar diseases characterized by similar symptoms and pneumonia.[41,45]

**AI in disease diagnosis**
Chest CT based diagnosis is the fastest approach to clinically diagnose Covid-19 in suspected patients within certain limitations. A recent study implemented a deep learning based model for Covid-19 to differentiate between community-acquired pneumonia and Covid-19 separately.[18,20] With a paucity of point-of-care diagnosis, the transmission dynamics of SARS-CoV-2 among different population groups and the risk of disease spread may complemented with AI driven tools. Currently, the active learning process in AI devices is reported to increase confidence during the decision making processes.[23] Thus, protocols must be standardized for development of AI-based devices which may be used in the event of such disasters. Deep learning methods using chest CT and X-ray images are complementary in the diagnosis of Covid-19 positive cases.[7,20,28] According to recent reports, chest CT of Covid-19 patients reveal typical radiographic features like multifocal patchy consolidation, ground-glass opacities and/or interstitial changes with peripheral distribution.[8] A CNN-based approach was able to distinguish between influenza A and Covid-19 infected pneumonic lungs with an overall accuracy of 86.7%.[15] A transfer learning approach to design a CNN-based model to perform disease diagnosis from the chest anterior-posterior radiographs of patients could predict with 96.3% accuracy with a high sensitivity and specificity. A meta-analysis review on published research with independent dataset on CT scan and other imaging techniques for diagnosis of Covid-19 showed excellent prediction accuracy.

The use of AI-based algorithms, that integrate chest CT findings with laboratory testing, clinical symptoms and exposure history are as sensitive as radiological disease diagnosis.[20] Many researchers have developed AI coupled radiological image findings to distinguish between infected and non-infected individuals. Another study implemented robust 2D and 3D deep learning models for automated detection and patient monitoring. The deep learning CT image analysis including a set of 157 international patients showed an accurate measurement of disease progression with 98.2%

sensitivity and 92.2% specificity. It was also demonstrated that a high accuracy in the diagnosis of Covid-19 could be achieved in a time efficient manner when complemented with AI-based image analysis. A comprehensive machine learning was used to design a CRISPR-based nucleic acid detection of SARS-CoV-2 and symptomatically related pathogens that could be used for diagnostic and surveillance purposes.[19] The CRISPR-Cas13 detection system was experimentally tested based on lateral-flow assay to demonstrate its speed and sensitivity using synthetic targets.[19] Therefore, AI approaches that can go hand-in-hand with the existing molecular diagnostic procedures could help in diagnosis and assist in early control of disease spread. AI-based tools can impart swiftness in the healthcare set up amidst the Covid pandemic crisis through AI/ML algorithms, which are well-tested and verified in several disease outbreaks.

**AI in prediction of Covid-19 outcome**

Hitherto studies are conducted to increase the clinical skills for the identification and progression of Covid-19.[13] An AI framework having predictive analytics capabilities was built and applied to clinical data to provide support to clinical decision making. The predictive models could learn from previous health-related data of Covid-19 patients to predict which patient will develop severe symptoms that is, acute respiratory distress syndrome or who will require intensive care unit facility. The most predictive clinical features included elevated alanine aminotransferases, body aches and high haemoglobin levels. The predictive models could achieve up to 80% accuracy in predicting severe cases. In yet another study, the effect of Covid-19 pandemic was predicted by implementing recurrent neural networks on publicly available data from the WHO and the Johns Hopkins University. The results indicated that errorsbetween validated and predicted data as compared to the actual corresponding trends were low. The study concluded that repeated peaks are anticipated on the epidemic curve for Covid-19 which is a propagated source epidemic.[17]

A machine learning-based prognostic model with clinical data from Tongji hospital, in Wuhan in China predicted the survival of critically ill Covid-19 patients with almost 90% accuracy using three parameters that is, lactic dehydrogenase, lymphocyte count and high- sensitivity C-reactive protein out of more than 300 clinical and laboratory features.[29]

**AI in predicting the spread and management of Covid-19**

Addressing issues like the global viral outbreaks is often considered to be of national and global interest. Increased data sharing is a foremost necessity to better understand the pandemics and to develop highly efficient AI-based model systems. A recent study analysed Google trends (GT), particularly to understand the popular search terminologies concerning the Covid-19 outbreak in the Taiwanese population.[13] The results reveal that GT could be instrumental in predicting the exact time to react concerning risk communication among the public. In a study conducted in six cities in Taiwan based on Covid-19 searches, a high to moderate correlation was found between Google relative search volumes and Covid-19 cases. The findings based on Google activities preceded an increase in Covid-19 cases.[13] A suitable risk communication plan will help in avoiding the threat of infodemic and hoax calls. Covid-19, with a basic reproduction number (R0) was reported as exceeding 2.0, making it highly infectious to an immunological naive population.[18] The early phase risk communication could be the most important way of curtailing the spread on a global basis. This could help to create awareness not only among public health officials and scientists but also among the public about the events occurring at ground zero of the outbreak. The efforts for effective development and use of decision-making AI algorithms in literature may help in searching for the scientists/researchers as well as the medical staff attending the cases, who can seek assistance from such platforms.64 The ML-based algorithms, for improving the identifications of infected cases through mobile phone-based web surveys, may support in reducing spread among susceptible populations.

The international travel pattern was assessed from Wuhan, China, for anticipating the pattern of disease spread across different countries. The Infectious Disease Vulnerability Index (IDVI) scores on the basis of metrics like disease dynamics, demographic, public health, political (domestic/international), healthcare and economics were reported for countries receiving a large number of passengers from Wuhan. Countries are given IDVI scores between 0 and 1 with higher scores reflecting a better ability to respond to a disease outbreak. The study revealed that among the countries receiving a significant number of passengers from Tokyo (Japan), Wuhan (China), Hong Kong, Bangkok (Thailand), Taipei (Taiwan), Dubai (UAE), Sydney (Australia) and Victoria (Canada) had high IDVI scores. Further, a similar study evaluated the vulnerability and preparedness (based on IDVI) of African countries for Covid-19.

**Social control**

A fourth role for AI in fighting the COVID-19 pandemic is in social control. AI has been argued to be necessary to manage the pandemic by using thermal imaging to scan public spaces for people potentially infected, and by enforcing social distancing and lockdown measures (Rivas 2020). For example, as described by Chun (2020) “At airports and train stations across China, infrared cameras are used to scan crowds for high temperatures. They are sometimes used with a facial recognition system, which can pinpoint the individual with a high temperature and whether he or she is wearing a surgical mask.” It is reported that these cameras can scan 200 persons per minute and will recognize those whose body temperature exceeds 37.3° (Dickson 2020). Thermal imaging has, however, been criticized as being inadequate to identify from a distance a fever in people who are wearing glasses (because scanning the inner tear duct gives the most reliable indication) and because it cannot identify whether a person's temperature is raided because of COVID-19 or some other reason (Carroll 2020).

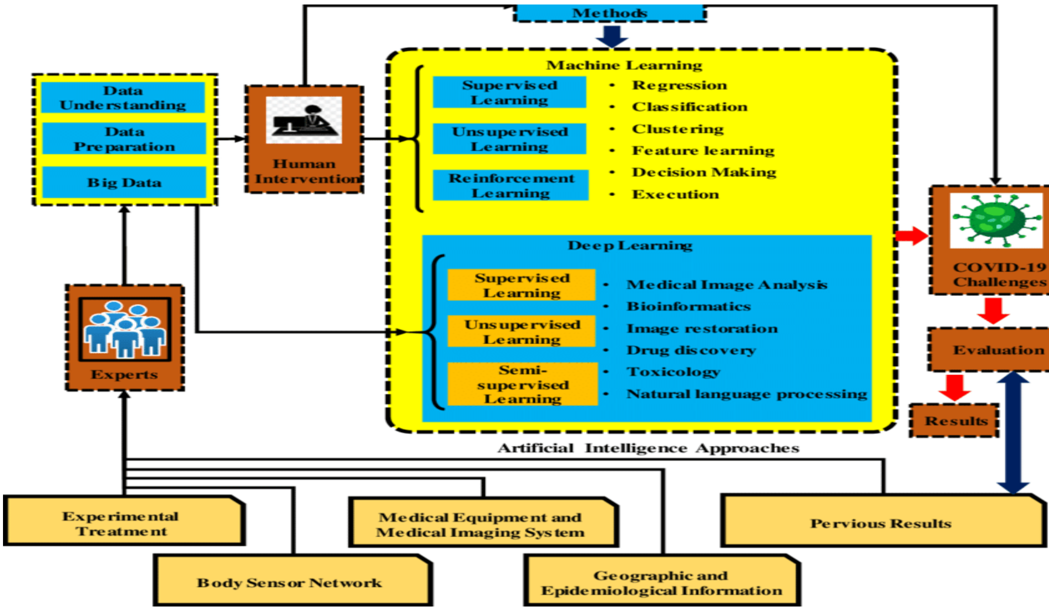


**Fig. 4: The process of application of AI-based methods to conquer challenges associated with COVID-19.**

**Treatments and vaccines**

A third area where AI can potentially make a contribution in the fight against COVID-19 is in identifying possible treatments and vaccines. Even long before the COVID-19 outbreak, AI was lauded for its potential to contribute to new drug discovery, see e.g. Coldeway (2019), Fleming (2018), Segler et al. (2018) and Smith (2018). In the case of COVID-19, a number of research labs and data centers have already indicated that they are recruiting AI to search for treatments for and a vaccine against COVID-19. The hope is that AI can accelerate both the processes of discovering new drugs as well as for repurposing existing drugs. A number of researchers have already reported discovering drugs for repurposing. These include Beck et al. (2020) who report results from using Machine Learning to identify that an existing drug, atazanavir, could potentially be repurposed to treat COVID-19, and Stebbing et al. (2020), who identifed Baricitinib, used to treat rheumatoid arthritis and myelofbrosis, as a potential treatment for COVID-19.

**AI applications against COVID-19**

Remote detection and diagnostics. The signature communicability and lethality of COVID-19 represented a physiological fortress for the medical group and scientists alike. This challenge is founded on the rapidly mutative sequelae of COVID-19. Rapidly, the alteration of COVID-19 sequelae is governed by pre-existing lung conditions. Pulmonary atelectasis, hemorrhage, edema, and lung tissue neoplasia are illustrative examples capable of altering COVID-19 diagnosis and confusing the trained medical eye (Adly et al., 2020). Public health experts state the standard diagnostics of COVID-19 as a methodology of two folds consisting of nasopharyngeal PCR swabs and diagnostic radiology (Salman et al., 2020). PCR test analysis reported a characteristic disparity in the differential diagnosis yielding a percentage of 60–71% clinical sensitivity (Adly et al., 2020). Therefore, comprising the prospectof fast and definite acquisition of essential diagnostics relevant to patient survival (Naud´e, 2020). Public health experts resorted to bio surveillance to rectify the disparity of present molecular testing kits and provide the basis for remote detection and prevention of COVID-19 (Bansal et al., 2020).Contact tracing is a mainstay public health prevention regulation that detects the exposure of a particular sample of individuals to an infectious contagion through a reverse revision of each member's activitiesand movements involved in the chain of transmission (Lalmuanawma et al., 2020). Public health epidemiology dates the application of contact tracing in instances of global pandemics like SARS, MERS, flu, Ebola, and COVID-19 (Agbehadji et al., 2020; Lin and Hou, 2020). This process is evident in COVID-19 prevention protocols that allow a stringent observation of infected cases during 14 days through cellular technologies like global positioning systems, Bluetooth, social activity maps, and network credit card transactions. In episodes of proper systematic deployment, contact tracing can provide means of real-time detection, identification, and prevention of severe COVID-19 epicenters (Lalmuanawma et al., 2020). Hence, reducing predicted causalities and augmenting the success of COVID-19 responses employed in individual localities and governments as solidified in South Korea (Lin and Hou, 2020). The antithesis of the beneficial role of contact tracing manifests in possible data security breaches, invasion of autonomous privacy, and mishandling of the heterogeneous data volume (Lalmuanawma et al., 2020).

**Challenges and future prospects**

Artificial intelligence is perceived with lauded acceptance and opposition from all scientific aisles (Allam, 2020). Intelligent AI agents opened the scientific retrospective view in terms of COVID-19 and the prospects of artificial intelligence. The majority of artificial intelligence research associations praised digitized economies, supply chains, and exports as future AI landscapes following the reduction of COVID-19 (Naud´e, 2020). Additional research findings project the construction of smart cities and the integration of robotics in human labor as anticipated artificial intelligence presentations post− COVID-19 (Bragazzi et al., 2020; Naud´e, 2020). Table 4 collects some encountered challenges and tradeoffs of artificial intelligence in consideration of COVID-19.

## CONCLUSION

AI-based methods are useful in epidemiological modelling of the ongoing Covid-19 pandemic, and to forecast need of healthcare infrastructure, medical supplies, human resource requirementin future when the disease spread, which could aid public health agencies in adopting timely prevention and control strategies. However, the accuracy of the AI based predictions are based on the input data and assumptions, we need to be aware that the real time situation may varyfrom the predictions. The AI-based technologies and methods are helpful in improving disease diagnosis and could beexplored to select the candidates for developing vaccines and drugs, understanding virus evolution and identifying potential drug candidates for repurposing against Covid-19. AI plays an important role in healthcare industry as well as public health. In this review, we highlighted the uses of AI-based approaches in healthcare during the course of the Covid-19 pandemic where AI-based technologies and methods have been deployed in modelling the virus spread and optimal utilization of resources. Availability of huge amount of high- quality data enriched with information may help the AI-based approaches effectively study the complicated real-life health related issues leading to a better management. Promising initial results have been obtained by the researchers using AI-based technology but the regulation around data exchange is the major hurdle in its implementation in real life. The AI-based approaches have helped address the key issues but a significant impact on the global healthcare industry is yet to be achieved. The capability of AI to address the challenges may make it a key player in deciding the operation of healthcare systems in future. It is agreed that AI-based tools may not totally replace human brain in terms of observations made by virologists, epidemiologists or clinicians, however the value of AI will play a significant and complementary role by reducing the burden on each stakeholder. The decision makers at each level can have a few preferred choices suggested by AI tools, which can be further scrutinized with the help of human intelligence before taking final decision for having a control on the impacts of epidemic. In the disease epidemic situation, whether AI is being used solely or in conjunction with other tools, the factors such as understanding of the epidemiological features, incubation period, transmissibility, risk populations, reproduction ratio (R0), mortality rate, natural history of the infection, ultra-details of the pathogen, stability, virulence and pathogenic potentials are key for efficient public health response.

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