A Review for Artificial Intelligence Proving to Fight Against COVID-19 Pandemic And Prefatory Health Policy

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Abstract

The aim of the present study is to discuss the various aspects of modern technology used to fight against COVID-19 outbreak crisis at different scales, including medical image processing, disease tracking, prediction outcomes, computational biology and medicines. A progressive search of the database related to modern technology towards COVID-19 pandemic is made. Further, a brief review is done on the extracted information by assessing the various aspects of modern technologies for tackling COVID-19 pandemic. We provide a window of thoughts on review of the technology advances used to decrease and smother the substantial impact of the outburst. However, there are still constrained applications and contributions of technology in this fight although different studies relating to modern technology towards COVID-19 pandemic have come up yet. The modern technology ongoing progress has contributed in improving people’s lives. Hence, there is a solid conviction that validated research plans including artificial intelligence will be of significant advantage in helping people to fight this infection.

Keywords: COVID-19 pandemic, artificial intelligence (AI), molecular modeling, drug repurposing, vaccines, health infrastructure systems (HIS)

1 INTRODUCTION

The COVID-19 pandemic has created unprecedented challenges for the medical and clinical diagnostic community (1–5). The technology sectors constituting of data science, machine learning and artificial intelligence are contributing towards COVID-19 pandemic (6–9). The fight against COVID-19 is being supported by a number of databases and artificial intelligence (AI)-based initiatives aimed at assessing dissemination of the disease, aiding in detection and diagnosis, minimizing the spread of the disease, and facilitating and accelerating research globally (7). Additionally, COVID-19 outbreak has created havoc and a quick cure for the disease will be a therapeutic medicine that has usage history in patients to resolve the current pandemic. With technological advancements in artificial intelligence (AI) coupled with increased computational power, the Alem powered drug repurposing can prove beneficial in the COVID-19 scenario (10, 11). AI is implemented...
in the field design through the generation of the learning-prediction model and performs a quick virtual screening to accurately display the output. With a drug-repositioning strategy, AI can quickly detect drugs that can fight against emerging diseases such as COVID-19 (12, 13). This technology has the potential to improve the drug discovery, planning, treatment, and reported outcomes of the COVID-19 patient, being an evidence-based medical tool (14). Technology refers to techniques, frameworks and devices which are the after effect of scientific information being utilized for practical purposes. Thus, there are chances that the application of the AI approach in drug discovery is feasible. With prior usage experiences in patients, few of the old drugs, if shown active against SARS-CoV-2, can be readily applied to treat the COVID-19 patients. With the collaboration of AI with pharmacology, the efficiency of drug repurposing can improve significantly (13, 15). Artificial intelligence (AI) uses personified knowledge and learns from the solutions it produces to address not only specific but also complex problems. Remarkable improvements in computational power coupled with advancements in AI technology could be utilized to revolution-wise the drug development process. At present, the pharmaceutical industry is facing challenges in sustaining their drug development programs because of increased R&D costs and reduced efficiency. In this review, we discuss the major causes of attrition rates in new drug approvals, the possible ways that AI can improve the efficiency of the drug development process and collaboration of pharmaceutical industry giants with AI-powered drug discovery firms. Consequently, the global COVID-19 pandemic has left health and social care systems facing the challenge of supporting large numbers of bereaved people in difficult and unprecedented social conditions (16). Despite the limitations in the quantity and quality of the evidence base, consistent messages are identified for bereavement support provision during the pandemic. High quality primary studies are needed to ensure service improvement in the current crisis and to guide future disaster response efforts.

2 | METHODS

Publications in the collection are sourced from PubMed Central, the bioRxiv and medRxiv pre-print servers, the WHO COVID-19 Database, and CORD-19 which is freely available, downloadable and it is updated weekly.

2.1 | Data sources for health policy

MEDLINE, Global Health, PsycINFO and Scopus databases were searched for studies published between 2000 and 2020. Reference lists were screened for further relevant publications, and citation tracking was performed.

3 | RESULTS

Emerging technologies are set to play an important role in our response to the COVID-19 pandemic. This paper explores the prominent initiatives: COVID-19 focused datasets (e.g., CORD-19); artificial intelligence-powered search tools (e.g., WellAI, SciSight); and contact tracing based on mobile communication technology (17–19). As shown in Figure 1, SciSight is one of tools for exploring evolved science network with COVID-19 in terms of itself and infection respectively. We believe that increasing awareness of these tools will be important in future research into the disease, COVID-19, and the virus, SARS-CoV-2. Easily accessible AI-powered tools and databases are valuable in all types of research, but especially in the context of the urgent diagnostic and therapeutic challenges presented by the COVID-19 pandemic. It is hoped that the new AI-powered search tools will accelerate research and development in COVID-19 as the world strives to develop

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efficient and timely testing and effective therapies to combat this disastrous pandemic. Another important part of our fight against COVID-19 will be efficient digital contact tracing enabled by mobile communication technology linked with massively scaled-up testing as outlined in the recent road map to pandemic resilience. Artificial intelligence can be characterized as Machine Learning (ML), Natural Language Processing (NLP), and Computer Vision applications. These abilities instruct computers to use huge information based models to design, depict, and predict. We discussed various applications of modern technology in the COVID-19 epidemic in Table 1 (20–32).

AI majorly focuses on diagnosis of the patients and virus, medical imaging process, disease tracking and its prediction in order to combat corona virus. On the other hand, it also covers alerting, creating awareness and social control through the internet. Following are some ways where technology is being used in the fight against COVID-19.

3.1 Proposed AI techniques for drug repurposing

A few associations have begun to use these advancements to quicken COVID-19 medication disclosure and better fathom how the resistant framework battles the infection. Therapeutic agent development point, some pharmaceutical organizations and biotechnology ventures joined forces to progress coronavirus treatment advancement utilizing computerized reasoning and CRISPR (33). Furthermore, in the scholarly area as of late united with the Human Vaccines Project to dispatch the Human Immunomics Initiative, which uses man-made reasoning models to quicken antibodies for a scope of infections, including COVID-19, as of late built up an information representation device that uses GPS data to show users the locations of known COVID-19 cases. These methods may prove effective in the data collection in a great and accurate amount. Organizations are running experimentation explores different avenues regarding effectively approved drugs, having built up wellbeing profiles in people, based on fundamental comprehension of the infection. With regards to COVID-19, hydroxychloroquine (endorsed to treat Malaria) (34) and remdesivir (for Ebola) (35, 36) are the two most popular instances of this up until now. Therefore, the data set of the effectiveness of these medicines may be a good input for an AI model. The organizations which are utilizing AI for repurposing existing medications for COVID-19 are listed in Table 2 (37–53).

3.2 Mathematical modeling and computational simulation procedures

Computational biology includes the development and use of data analytics, mathematical modeling and computational simulation procedures to study biology. Computational biologists are assisting with battling coronavirus through disease modeling and finding another medication for this pandemic. Disease dynamics modeling contributes in understanding the effect of parameters that rules the spread of the infection, and the impact that mediations can have in controlling this spread. As soon as virus advances in the deceased body, both lungs start showing ground glass and infiltrates (26–29). Numerous data driven drug repurposing (drug repositioning) approaches have been proposed with
TABLE 1: Applications of modern technology during COVID-19 pandemic

<table>
<thead>
<tr>
<th>Technology</th>
<th>Description</th>
<th>Application</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNN-Net</td>
<td>extract radiological features</td>
<td>Diagnosis using radiology image</td>
<td>(21)</td>
</tr>
<tr>
<td>DAMO</td>
<td>CT images features</td>
<td>Diagnosis</td>
<td>(22)</td>
</tr>
<tr>
<td>SEIR</td>
<td>forecast the trajectory of the outbreak</td>
<td>Disease tracking</td>
<td>(23)</td>
</tr>
<tr>
<td>CIDRAP</td>
<td>analysing rapidly evolving coronavirus</td>
<td>Disease tracking</td>
<td>(24)</td>
</tr>
<tr>
<td>COVNet</td>
<td>machine learning-based CT radiomics models</td>
<td>Prediction outcome</td>
<td>(25)</td>
</tr>
<tr>
<td>GRU</td>
<td>Medicines perspective</td>
<td>Computational biology</td>
<td>(26)</td>
</tr>
<tr>
<td>NVIDIA</td>
<td>Natural language processing AI</td>
<td>New class of biology tool</td>
<td>(27)</td>
</tr>
<tr>
<td>COV-IRT</td>
<td>Identify potential therapeutic targets</td>
<td>Computational biology</td>
<td>(28)</td>
</tr>
<tr>
<td>CURIAL</td>
<td>Rapid analysis with high confidence</td>
<td>Computational biology</td>
<td>(29)</td>
</tr>
<tr>
<td>CASP</td>
<td>predict properties of the protein from its genetic sequence</td>
<td>Protein structure</td>
<td>(30)</td>
</tr>
<tr>
<td>CCD</td>
<td>AI-based drug discovery pipeline</td>
<td>Drug discovery</td>
<td>(31)</td>
</tr>
<tr>
<td>BenevolentAI</td>
<td>AI medicate revelation</td>
<td>Drug repurposing</td>
<td>(32)</td>
</tr>
</tbody>
</table>

the point of identifying illnesses, conditions or groups of patients that could be treated with existing medications not known for this disease (31, 32).

3.3 Prediction of protein structure and drug discovery

When virus RNA genome first enters a cell, it mingles with the host’s protein-production, utilizing it to make proteins that can duplicate RNA molecules. These RNA-replicating proteins, polymerases make a target for treatments (47, 50). Proteins have a 3D structure, which is evaluated by their genetically encoded amino acid sequence, and this structure impacts the role and purpose of the protein (48). There are two primary ways to deal with the forecast task: template modeling, which predicts structure utilizing similar proteins as a template sequence, and the other is template free modeling, which predicts structure for proteins that have unknown related structure. The AlphaFold model depends on an enlarged ResNet architecture and uses amino acid sequences, and also features taken out from parallel amino acid sequences using several sequence arrangements, to foresee the distance and the dispersal of angles between amino acid residues (54, 55). This framework has been applied to anticipate the structures of six proteins identified with SARS-CoV-2 (SARS-CoV-2 membrane protein, protein 3a, Nsp2, Nsp4, Nsp6, and papain-like proteinase) (56, 57). It is projected that these predictions will help to see coronavirus capacities and possibly lead to future improvement of cures against COVID-19. Researchers are investigating each possible choice for fighting the coronavirus pandemic, and modern technology represents a captivating road. While technology advances have entered into our day by day lives with numerous victories, they have additionally added to helping people in the very intense battle against COVID-19.

3.4 Development of drugs and vaccines

AI is used for drug research by analyzing the available data on COVID-19. It is useful for drug delivery design and development (58, 59). This technology is used in speeding up drug testing in realtime, where standard testing takes plenty of time and hence helps to accelerate this process significantly, which may not be possible by a human.
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### TABLE 2: Various kinds of technologies using AI for drug repurposing.

<table>
<thead>
<tr>
<th>AI Property</th>
<th>Implication for drug repurposing</th>
<th>Company Name</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>baricitinib</td>
<td>BenevolentAI</td>
<td>(38, 39)</td>
</tr>
<tr>
<td>Indo-German</td>
<td>Hydroxychloroquine and Remdesivir</td>
<td>Innoplexus</td>
<td>(39, 40)</td>
</tr>
<tr>
<td>Korean</td>
<td>atazanavir</td>
<td>Deargen</td>
<td>(41)</td>
</tr>
<tr>
<td>Singaporean</td>
<td>niclosamide and nitazoxanide</td>
<td>Gero</td>
<td>(42)</td>
</tr>
<tr>
<td>Canadian</td>
<td>Phase I human preliminaries</td>
<td>Cyclica</td>
<td>(43)</td>
</tr>
<tr>
<td>UK</td>
<td>bi-and tri-mixes of affirmed drugs</td>
<td>Healx</td>
<td>(44)</td>
</tr>
<tr>
<td>New York</td>
<td>US</td>
<td>Golgi contraption (a viral re- bundling framework in the human cell)</td>
<td>VantAI</td>
</tr>
<tr>
<td>China</td>
<td>Big data, natural language processing and machine learning to cull data</td>
<td>BlueDot</td>
<td>(46)</td>
</tr>
<tr>
<td>US</td>
<td>significantly faster RNA folding algorithms at predicting a virus’s secondary RNA structure</td>
<td>Baidu</td>
<td>(47)</td>
</tr>
<tr>
<td>Rockville, US</td>
<td>new molecular structures</td>
<td>Insilico Medicine</td>
<td>(48)</td>
</tr>
<tr>
<td>China</td>
<td>Diagnosis and solutions</td>
<td>Alibaba Cloud, DAMO Academy, and DingTalk</td>
<td>(49)</td>
</tr>
<tr>
<td>US</td>
<td>novel drug design: SRI's SynFin®™</td>
<td>SRI Biosciences and Iktos</td>
<td>(50)</td>
</tr>
<tr>
<td>China</td>
<td>novel antiviral therapies</td>
<td>EndoAngel Medical Technology Company</td>
<td>(51)</td>
</tr>
<tr>
<td>US</td>
<td>AlphaFold system to create structure predictions</td>
<td>Google's DeepMind</td>
<td>(48)</td>
</tr>
<tr>
<td>Israel</td>
<td>a mobile digital X-ray system</td>
<td>Nano</td>
<td>(52, 53)</td>
</tr>
</tbody>
</table>

It can help to identify useful drugs for the treatment of COVID-19 patients. It has become a powerful tool for diagnostic test designs and vaccination development. AI helps in developing vaccines and treatments at much of faster rate than usual and is also helpful for clinical trials during the development of the vaccine (60–64). Vaccines play a crucial role in improving global public health, with the ability to stem the spread of infectious diseases and the potential to eradicate them completely. Compared with pharmaceuticals that treat disease, however, preventative vaccines have received less attention from both biomedical researchers and innovation scholars. This neglect has substantial human and financial costs, as vividly illustrated by the COVID-19 pandemic. In this article, we argue that the large number of “missing” vaccines is likely due to more than lack of scientific opportunities. Two key aspects of vaccines help account for their anemic development pipeline. Firstly, they are preventatives rather than treatments; and secondly, they are generally durable goods with long-term effects rather than products purchased repeatedly. We explain how both aspects make vaccines less profitable than repeat-purchase treatments, even given comparable IP protection. We conclude by arguing that innovation policy should address these market distortions by experimenting with larger government-set rewards for vaccine production and use. Most modestly, policymakers should increase
direct funding—including no grants and public-private partnerships—and insurance-based market subsidies for vaccine development. We also make the case for a large cash prize for any new vaccine made available at low or zero cost.

3.5 | Awareness and social control through an internet

Though national and worldwide associations have utilized social media platforms to communicate with the general population, but apparently this is leading to a crisis in which populaces can become overwhelmed with information, and the propagation of misinformation is progressively common. As shown in Figure 2, global infection cases and deaths were presented and the most affective countries has been taken into consideration highly Figure 3.

![Figure 2: COVID-19 pandemic total infection cases and deaths per 100,000 population from March to July reported by WHO.](image)

![Figure 3: COVID-19 pandemic active infection cases zoomed at the most affective countries in the world per 100,000 population from March to July reported by WHO.](image)

FIGURE 2: COVID-19 pandemic total infection cases and deaths per 100,000 population from March to July reported by WHO.

These information is updated at real time through an internet by reporting COVID-19 pandemic infection cases with deaths as well as recovered cases Figure 4. Furthermore, every and each single days updated new cases in the world by WHO and in South Korea reported by KCDC respectively Figure 5.

WHO’s reaction to fighting this infodemic is using its Information Network for Epidemics (EPIWIN) stage for imparting data to key partners. (65) This information is significant for AI calculations to learn and foresee the contamination threat of every being, subsequently helping in early identification of high-risk cases for quarantine purpose, thus diminishing the spread of the infection to the helpless populations. Small-Multi-Copter, a Shenzhen-based innovation, has assisted with decreasing the infection transmission hazard in city-wide transport of clinical supplies and quarantine.
The previous reviews have not comprehensively synthesized the evidence on the response of health and social care systems to mass outbreak events. For the purpose of synthesis, the evidence regarding system-level responses to mass crisis events, including natural and human-made disasters as well as pandemics, to inform service provision and policy during the COVID-19 pandemic and beyond (67). A rapid systematic review was conducted, with narrative synthesis. The review studies were included reporting on system responses to mass bereavement following human-made and natural disasters, involving a range of individual and group-based support initiatives. Positive impacts were reported, but study quality was generally low and reliant on data from retrospective evaluation designs (68). The key features of service delivery were identified: a proactive outreach approach, centrally organized but locally delivered interventions, event-specific professional competencies and an emphasis on psycho-educational content (69). Specially, large-scale events such as COVID-19 pandemic show that there are situations that can lead to huge stress on health infrastructure systems (HIS). The scheme Figure 6 of COVID-19 pandemic control system is hypothesized based on the impact of protection measures regarding COVID-19 pandemic (www.Sciencenews.org).

The pandemic reveals that it is very difficult to protect HIS from all kinds of possible hazards. They can be unpredictable and spread rapidly; hence, it is hard to find an effective mitigation strategy to completely protect society and its important HIS as shown in Figure 7.

It was illustrated that COVID-19 pandemic scenario analysis tool is introduced at the point of peak tailing and it will be continuously sustained probably. An often raised central question is what we should do if we cannot protect HIS from these types of hazards. To answer this question, the focus should move from HIS protection to HIS resilience. Therefore, in this paper, the critical infrastructure resilience index (CIRI) is used to estimate the resilience of health infrastructure systems (70). Unfortunately, COVID-19 pandemic conceptional explanation focusing on viral resurgence as multiple transmission is suggested and we have to be aware of coming diffusion again Figure 8.

The results of the case study show that HIS resilience was enhanced significantly after the implementation
of measures. The results indicate that among the resilience phases the learning phase of resilience is the weakest part. This requires a root cause analysis, which should be prioritized by HIS managers and stakeholders. This paper discusses how the resilience concept will help decision and policy-makers to have a clear view of HIS performance before, during, and after the disaster.

An easy-to-use and applicable methodology for HIS assessment and evaluation was employed. It can be concluded that resilience and its identified phases can help HIS managers to allocate available resources accordingly in the phases during and post-crisis.

4 | CONCLUSION

It can be conclude that there is a wide scope of potential utilizations of modern technologies covering clinical and cultural difficulties made by the coronavirus pandemic; but not many of them are right now develop enough to show operational effect. The papers talk about the troubles while using these algorithms in real world clinical practices. Likewise, there is an interest for a future work on building up a benchmark framework to assess and look at the current techniques. The present models acquired extraordinary accuracy in recognizing COVID-19 symptoms with different kinds of viral pneumonia utilizing radiology pictures but lacks transparency and interpretability. In addition to it, health policy-makers to have a clear view of health infrastructure systems performance and they can lead to huge stress on HIS.

5 | DISCUSSION

Molecular modeling, artificial intelligence and machine learning techniques are proving to be crucial role players in fight against COVID-19 (71). It’s time to upgrade our skills and make use of the latest technologies to help speed up the design, discovery and develop novel drug such as molecules and vaccines. Furthermore, we address how to the holistic resilience concept will help healthcare governors as well as health policy-makers to have decisive vision of HIS performance on COVID-19 pandemic.
6 | CONFLICT OF INTEREST

All authors declare no competing interests. In compliance with the uniform disclosure form, all authors declare the following:
Payment/services information: All authors have declared that no financial support was received from any organization for the submitted work.
Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

REFERENCES


52. Narin A, Kaya C, P Z;.


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