DOI: 10.7860/JCDR/2020/45341.13919

Review Article

Others Section

Utility of Digital Technology in Tackling the COVID-19 Pandemic: A Current Review

PRASHANTH KULKARNI[1], SHRUTHI KODAD[2], MANJAPPA MAHADEVAPPA[3], SUSHANTH KULKARNI[4]

ABSTRACT

The Coronavirus Disease (COVID-19) pandemic has rampaged across the globe, creating a major public health emergency and economic crisis. In this pandemic, digital technology tools such as Artificial Intelligence (AI), big-data analytics, block chain technology, robotics and drone technology are playing a vital role and are increasingly being utilised by many countries for devising major public health strategies. This article discusses the utility of digital technology in combating coronavirus infection and also highlights the current limitations and future prospects of these tools.

Keywords: Artificial intelligence, Coronavirus, Robotics

INTRODUCTION

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), the causative agent of COVID-19, has emerged as one of the biggest health crisis of the 21st century, impacting lives, health care resources and economy across continents. A single centre study emerging from China revealed that the majority of COVID-19 patients were older, with a median age of 56 years. Approximately, 81% had mild pneumonia, 14% had severe infection, 5% were critical requiring mechanical ventilation and the mortality was 4.3% [1]. The World Health Organisation (WHO) advocates early detection, containment, surveillance and preventive measures to stall the progress of the COVID-19 pandemic [2]. In this context, digital technology has emerged as a pivotal tool in tackling this pandemic. Indeed, in late December 2019, using AI, a Canadian health monitoring firm was one of the first to spot the rapid spurt of atypical pneumonia cases in Wuhan, China and alerted the world of an impending outbreak [3]. Many countries have harnessed the potential of digital technology for infection control and implementing public health and administrative measures to halt the spread of SARS-CoV-2. AI is a concept which incorporates human-like intelligence into a machine. It utilises deep and machine learning tools and block chain technological algorithms to analyse data. This intelligence is synthesised by the machine to arrive at a decision-making process and take action like a human would do. Other advancements in AI applications like natural language processing, speech recognition, chatbots and facial recognition are increasingly being utilised to accomplish a vast array of tasks [4]. AI along with other digital tools like big-data analytics, robotics, and drone technology have revolutionised the major public health strategies in the context of the COVID-19 pandemic [5,6].

DIGITAL TOOLS FOR IMPLEMENTING PUBLIC-HEALTH MEASURES

Across the world, many governments enforced lockdown, curbed non-essential travel and advocated social distancing along with standard policies like infection control and public awareness to control the spread of COVID-19 infection. Digital technology tools have helped augment these efforts and aided in disease surveillance and containment. Human travel across continents has been one of the main factors responsible for the exponential spread of the virus. AI-enabled face-recognising cameras are being installed in public areas like hospitals, airports and train stations to detect fever in individuals and track their movements [7]. AI is being leveraged to track and recognise individuals landing at airports from locations with a high volume of COVID-19 infection. These tools are also being used for contact tracing of COVID-19 patients, family and friends, and thus supports the rapid containment of cases in specific localities.

The social media sources are analysed to study an individual's travel history, personal habits, visits to the hospital and the data obtained are utilised to predict risk profiles and devise policies to prevent the spread of the infection. Law enforcing agencies have increasingly deployed drones to implement lockdown measures. Drones are being used to monitor individuals violating the rules and to identify those not wearing facial masks and for broadcasting awareness messages and disinfecting public spaces like roads, parks. These machines have been used in China to deliver essential items and medicines to those in quarantine and helped prevent virus exposure to transportation personnel [7]. Many state governments in India have developed a corona watch application for real-time monitoring and implementation of self-quarantining measures for individuals with suspected exposure to a COVID-19 patient [8].

The National Informatics Centre of the Government of India's Ministry of Electronics and Information Technology, has developed a bluetooth enabled smartphone application called "Aarogya Setu", which alerts an individual of the presence of a COVID-19 patient within a six feet radius. This app, using an encrypted social graph and data analytics, monitors an individual's travel history to a COVID-19 contaminated hotspot zone and thus helps in contact tracing. At present, this application is the world's most downloaded app with more than 90 million individuals in India using this application [9]. An Indian technology-driven company has developed a lockdown platform, which uses big data technology that provides an optimum plan for lockdowns, down to the village level that can be extrapolated to larger areas [10].

Robotic technology is being explored in this pandemic to aid sanitary workers and healthcare professionals to reduce their risk of exposure to the virus. They are being deployed to handle and dispose waste that are generated in hospitals. Robot-controlled, non-contact Ultraviolet (UV) surface disinfection is being used in high-touch areas in hospitals to prevent spread of the infection [11]. AI technology can be utilised to disseminate public health education and queries about COVID-19 infection can be effectively communicated. Virtual healthcare chatbots have been created in social media platforms to provide guidelines, advice on infection prevention and protective measures. These are used to recommend individuals with symptoms suggestive of the infection to seek doctor consultation and also provide information about self-isolation [7].

The Singapore government has partnered with Facebook-owned platform 'WhatsApp' to circulate correct and updated information about COVID-19 and to apprise citizens about the initiatives taken

by the government to address this pandemic [12]. In India, AI algorithms have been used to develop 'video-bots' in collaboration with hospitals. This platform will enable people to seek information on COVID-19 directly with a doctor through video interface [13].

DIGITAL TECHNOLOGY IN COVID-19 DIAGNOSIS AND RESEARCH

The burgeoning COVID-19 cases have overwhelmed and stretched healthcare resources worldwide. It is important that rapid diagnostic tests are available to identify the positive cases and immediate measures like isolation and quarantine can be employed to restrict the spread of the virus. A major hindrance to early diagnosis is an acute shortage of resources and the high volume of cases requiring more adept healthcare professionals. AI has helped to overcome these problems by improving the time taken to diagnose COVID-19 infection. AI-enabled medical analysis platform developed in China can detect coronavirus-infection associated with pneumonia on Computed Tomography (CT) scans with high accuracy of 96%. This was facilitated by an open-source AI model that analysed CT images of COVID-19 pneumonia in less than 60 seconds and identified the lesion pattern in terms of volume, number and proportion [14]. This analysis of CT chest correlated and complemented with the Reverse-Transcription Polymerase Chain Reaction (RT-PCR) COVID-19 diagnostic tests and was demonstrated in a study done in China [15].

The University of Tor Vergata in Rome, Italy, has conducted a pilot run for a patented AI-based tool developed by three biotechnology students from Mumbai, India, which was designed to test COVID-19 through voice-based diagnosis using a smartphone application. This testing platform has already been successfully tested in 300 COVID-19 patients with 98% accuracy [16]. AI-based triage systems in the hospitals for COVID-19 cases can be implemented and this could alleviate the clinical burden of health care professionals [17]. A Bengaluru based robotics start-up company is providing city hospitals with screening and diagnostic robots. The screening robot in a contactless manner initially helps with data collection such as the name of the patient, symptoms exhibited of coronavirus infection and later checks the temperature. The symptomatic patients will then be directed towards the diagnostics robot, which enables a video conversation with a doctor sitting in a remote location and who in turn directs them to appropriate areas in the hospital for further management [18].

In contrast to SARS-CoV-1, the genome sequence of SARS-CoV-2 was deciphered within a month, using AI technology [19]. With international collaborative efforts, scientists have successfully identified an underlying genomic signature for 29 different DNA sequences of SARS-CoV-2, providing an important tool for vaccine and drug development. The researchers utilised AI and machine learning tools to achieve 100% accurate classification of the viral sequences [20]. Many biotech companies worldwide, both in the private and government enterprises are using AI tools to expedite drug discovery against the coronavirus [21]. Scientists have identified several promising molecules that inhibit SARS-CoV-2 protease, thus stalling viral replication. AI has helped to considerably shorten the initial drug design process from several months to only a few days now [22].

CURRENT LIMITATIONS OF DIGITAL TECHNOLOGY AND FUTURE PROSPECTS

Digital technologies like AI have made a promising start in aiding the fight against COVID-19. The use of these tools is constrained by enormous data that has to be adequately harnessed by a proper mechanism of human-AI interaction. Lack of rapidly available authentic data is hampering the full utilisation of technology in the present pandemic. Also, there are ethical and data privacy issues that need to be adequately addressed before implementation of these tools for public health measures [23]. Digital technology tools are expensive to implement and require skilled manpower which might not be adequately accomplished in this current pandemic [24]. Digital technologies have a great potential to fight future outbreaks if current enormous data on the pandemic is gathered and utilised to train and be better prepared for future calamities.

CONCLUSION(S)

Many countries are overwhelmed by the rapid and relentless spread of coronavirus infection across the globe. Technology has come to the aid of policymakers and health care systems to combat the COVID-19 pandemic. Digital tools have shown enormous potential in this outbreak, but have inherent limitations that need to be addressed adequately. Nonetheless, AI and other tools can help to keep track of the data generated from patterns of the cases in this crisis and this data can be analysed to predict future outbreaks and aid in mounting an effective response against future pandemics.

REFERENCES

[1] Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020;323(11):1061-69. doi:10.1001/jama.2020.1585.

[2] Severe acute respiratory infections treatment centre: Practical manual to set up and manage a SARI treatment centre and a SARI screening facility in health care facilities. Geneva: World Health Organisation, March 2020. https://apps.who.int/iris/handle/10665/331603. Accessed May 20, 2020.

[3] McCall B. COVID-19 and artificial intelligence: Protecting health-care workers and curbing the spread. Lancet Digital Health; February 20, 2020. https://doi.org/10.1016/S2589-7500(20)30054-6.

[4] Sammut C, Webb GI (eds). Encyclopedia of machine learning and data mining. Springer, 2017. https://doi.org/10.1007/978-1-4899-7687-1.

[5] Shilo S, Rossman H, Segal E. Axes of a revolution: Challenges and promises of big data in healthcare. Nat Med. 2020;26:29-38. https://doi.org/10.1038/s41591-019-0727-5.

[6] Heaven D. Bitcoin for the biological literature. Nature. 2019;566:141-42. doi: 10.1038/d41586-019-00447-9.

[7] Obeidat S. How artificial intelligence is helping fight the COVID-19 pandemic. March 30, 2020. https://www.entrepreneur.com/article/348368. Accessed May 20, 2020.

[8] How different states in India are using AI-powered tools to combat COVID-19. https://analyticsindiamag.com/how-states-in-india-are-using-ai-powered-tools-to-combat-covid-19/. Accessed May 30, 2020.

[9] Aarogya setu & other apps: how bluetooth and data analytics lead contact tracing for COVID-19. https://analyticsindiamag.com/how-bluetooth-and-data-analytics-are-leading-contact-tracing-for-covid-19/. Accessed May 30, 2020.

[10] In the back-end of the Covid-19 fight, big data works silently. May 08, 2020. https://www.hindustantimes.com/india-news/in-the-back-end-of-the-covid-fight-big-data-works-silently/story-Pzzl8szh3T5ztIMW9JoDoJ.html. Accessed May 29, 2020.

[11] Yang GZ, Nelson BJ, Murphy RR, Choset H, Christensen H, Collins SH, et al. Combating COVID-19- The role of robotics in managing public health and infectious diseases. Science Robotics. 2020;5(40):eabb5589. doi:10.1126/scirobotics.abb.5589.

[12] Govt. Sg WhatsApp subscription. https://mci.form.gov.sg/#!/5e33fa3709f80b00113b6891. Accessed May 20, 2020.

[13] Role of AI soars in tackling Covid-19 pandemic. March 29, 2020. https://www.thehindubusinessline.com/info-tech/role-of-ai-soars-in-tackling-covid-19-pandemic/article31197098.ece. Accessed May 28, 2020.

[14] Technology Org. AI algorithm detects coronavirus infections in patients from CT scans with 96% accuracy. https://www.technology.org/2020/03/01/ai-algorithm-detects-coronavirus-infections-in-patients-from-ct-scans-with-96-accuracy/Accessed on May 28, 2020.

[15] Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, et al. Correlation of chest CT and RT-PCR testing in coronavirus disease 2019 (COVID-19) in China: A report of 1014 cases. Radiology. 2020;200642. https://doi.org/10.1148/radiol.2020200642.

[16] Mumbai students develop AI-based voice tool to detect COVID-19. April 16, 2020. https://www.thehindu.com/sci-tech/technology/mumbai-students-develop-ai-based-voice-tool-to-detect-covid-19/article31360091.ece. Accessed May 30, 2020.

[17] Ting DSW, Carin L, Dzau V, Wong TY. Digital technology and COVID-19. Nat Med. 2020;26:459-61. https://doi.org/10.1038/s41591-020-0824-5.

[18] AI, robotics start-ups leverage tools to combat Covid-19. Published on April 16, 2020. https://www.thehindubusinessline.com/news/science/ai-robotics-start-ups-leverage- tools-to-combat-covid-19/article31358732.ece#. Accessed May 27, 2020.

[19] Song Z, Xu Y, Bao L, Zhang L, Yu P, Qu Y, et al. From SARS to MERS, thrusting coronaviruses into the spotlight. Viruses. 2019;11(1):59. Published 2019 Jan 14. doi:10.3390/v11010059.

[20] Randhawa GS, Soltysiak MPM, El Roz H, de Souza CPE, Hill KA, Kari L. Machine learning using intrinsic genomic signatures for rapid classification of novel pathogens: COVID-19 case study. PLoS ONE. 2020;15(4):e0232391. https://doi.org/10.1371/journal.pone.0232391.

[21] Jun Wu., How artificial intelligence can help fight Coronavirus, March 19, 2020. https://www.forbes.com/sites/cognitiveworld/2020/03/19/how-artificial-intelligence-can-help-fight-coronavirus/#7b2c780e4d3a. Accessed May 20, 2020.
[22] Bung N, Krishnan SR, Bulusu G, Roy A. De novo design of new chemical entities (NCEs) for SARS-CoV-2 using artificial intelligence. 2020. ChemRxiv. Preprint. https://doi.org/10.26434/chemrxiv.11998347.v2.
[23] Naudé W. Artificial intelligence vs COVID-19: Limitations, constraints and pitfalls. AI Soc. 2020;28:01-05. https://pubmed.ncbi.nlm.nih.gov/32346223/.
[24] AI can help with the COVID-19 crisis-but the right human input is key, 30 March, 2020. https://www.weforum.org/agenda/2020/03/covid-19-crisis-artificial-intelligence-creativity/. Accessed May 30, 2020.

PARTICULARS OF CONTRIBUTORS:
1. Consultant, Department of Cardiology, Care Hospitals Hi-tech City, Hyderabad, Telangana, India.
2. Clinical Associate, Department of Haematology, Saskatoon Cancer Centre, Saskatoon, Saskatchewan, Canada.
3. Assistant Professor, Department of Cardiology, JSS Medical College and Hospital, Mysuru, Karnataka, India.
4. Consultant, Department of Urology, RK Health Care Centre, Bidar, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Prashanth Kulkarni,
Care Hospitals Hi-tech City, Old Mumbai Highway,
Hyderabad-500032, Telangana, India.
E-mail: docpk77@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jun 06, 2020
- Manual Googling: Jul 06, 2020
- iThenticate Software: Jul 24, 2020 (9%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jun 05, 2020**
Date of Peer Review: **Jun 17, 2020**
Date of Acceptance: **Jul 07, 2020**
Date of Publishing: **Aug 01, 2020**