International Journal of Computer (IJC)
ISSN 2307-4523 (Print & Online)
http://ijcjournal.org/

# Emergence of Major Pandemics: Examining the Use of AI for the Fight Against Covid-19

Jean-Marie Kuate Fotso[a]*, Styve Arnol Kayo[b], Pélagie Flore Temgoua Nanfack[c], Guy Phares Fotso Fotso[d]

[a,b,c,d]*National Committee for Development of Technologies, Ministry of Scientific Research and Innovation, Yaoundé, Cameroon*

[a]*Email: jeanmarie.kuatefotso@gmail.com* , [b]*Email: kayokayoask@gmail.com*

[c]*Email: pelagietemgoua@gmail.com* , [d]*Email: guyphares@gmail.com*

**Abstract**

Covid-19 is an infectious disease caused by the SARS-CoV-2 virus and which is considered today as a global health emergency. Long before this pandemic, several others such as the plague of Athens, the plague of Antonine, the black plague, the Spanish flu, cholera, the Asian flu, AIDS raged, with consequences as fatal, even more serious than covid-19. The emergence of AI over the past ten years has brought it to the forefront of the response to this disease. The objective of this work is to present the significant contribution of AI in the fight against the new coronavirus, comparing it to previous large pandemics. A preliminary search of information related to past pandemics and covid-19 has been carried out. Next, the contribution of AI following the WHO framework for combating pandemics was presented. Finally, the discussion part resulted in the conclusion that if AI had already been fundamentally implemented during the time of the other major pandemics, the damage to human losses would have been less.

***Keywords:*** Artificial intelligence; COVID-19; treatment; tracking; sars-cov-2; great pandemic.

## 1. Introduction

A pandemic is a disease spread to the entire population of a continent, or even the whole world [1]. The world has experienced several pandemics over the centuries. Among others, the plague of Athens, the plague of Antonine, the black plague, the Spanish flu, cholera, the Asian flu, AIDS and now the coronavirus. Table 1 below presents a brief history of these different pandemics [2,3].

---

* Corresponding author.

**Table 1:** chronology of the Great historical pandemics.

| Diseases | Periods | Large homes | Number of deaths | Observations |
|---|---|---|---|---|
| **Plague of Athens** | 430 - 426 BC | Ethiopia, Egypt, Libya, Athens | 200,000 | 200,000 is equivalent to 1/3 of the city of Athens |
| **Plague of Antonine** | 165 - 166 | Rome, Romania | 10,000,000 | Eradicated in 1980 |
| **Black Plague** | 1347 - 1352 | China, North Africa, Italy, France | 200,000,000 | Between 1/3 and half of the population of Europe and has led to an alarming drop in the European population [4, 2] |
| **Cholera** | 1826 - 1832 | India, Russia, Poland, Berlin, France, Quebec | 1,000,000 | 100,000 dead in France [2] |
| **Spanish flu** | 1918 - 1919 | Asia, USA, France, Spain | 50,000,000 | 1/3 of the world's population [2] |
| **Asian flu** | 1956 - 1957 | China, Hongkong, Australia, North America, Europe, Africa | 3,000,000 | Starts in China [2] |
| **AIDS** | 1983 to today | India, Ethiopia, Nigeria, Uganda | 40,000,000 | 2 million deaths / year worldwide [2, 3] |
| **COVID-19** | December 2019 to today | Russia, Iran, India, USA, Italy, Brazil, Argentina, United kingdom, Spain | 559 2266 As of January , 2022 [5] | 349,641,119 confirmed cases [5] |

A pandemic has the particularity of spreading quickly and causing a high death rate. Several historical approaches have been used to fight epidemics and pandemics, most of them dispersed and confined to the action of municipal and provincial authorities [4]. However, there is a need to automate existing measures through artificial intelligence techniques in order to extend the exploitation of existing solutions to other epidemics. Unlike other major pandemics, Covid-19 has specific aspects. He presents a virus with a regular mutation for a period of seven (07) months at most. Table 2 above presents the most worrying variants of COVID-19, their scientific names, the countries of origin and especially the frequencies of occurrence.

The WHO in its global response strategy to fight against COVID-19, presents its control objectives on 5 axes: mobilization for compliance with barrier measures, control of sporadic cases and clusters, elimination of cases of local transmission, mortality reduction and vaccine development [6].

The aim of this work is to carry out a similarity study between COVID-19 and other major pandemics in order to orient the contribution of AI on the anticipated proposal of medical solutions. After presenting the role played by Artificial Intelligence to achieve the eradication of this disease, the discussion part will lay out a critical

analysis as well as the proposal of new axes for future work.

**Table 1:** SARS-CoV-2 variants of concern [8].

| WHO name | Scientific name | Native country | Designation date |
|---|---|---|---|
| **Alpha** | B.1.1.7 | United Kingdom, September 2020 | December 18, 2020 |
| **Beta** | B.1.351 | South Africa, May 2020 | December 18, 2020 |
| **Gamma** | Gamma | Brazil, November 2020 | January 11, 2021 |
| **Delta** | B.1.617.2 | India, October 2020 | May 11, 2021 |
| | | | |
| **Omicron** | B.1.1.529 | South Africa November 2021 | November 24, 2021 |

## 2. AI in COVID-19 medical technology

The advent of covid-19 in December 2019 and its rapid spread forced all researchers and scientists around the world to implement potential solutions for the detection, prevention, treatment and monitoring of the spread of the disease.[6]. WHO, governments and local health facilities urgently need decision support technologies to manage this virus and help obtain appropriate real-time suggestions to limit its spread [6]. Considering the importance and role of AI in healthcare and the future of medicine, there is a need to study and explore the solutions that AI brings in healthcare while examining its applicability in the fight against this pandemic. In the context of big data and correct optimization algorithms, successful implementation of AI can unlock clinical models hidden in healthcare big data. The AI will eventually be able to recommend successful treatments that have already been given and in doing so, this reduces the time required for diagnosis [7,2].

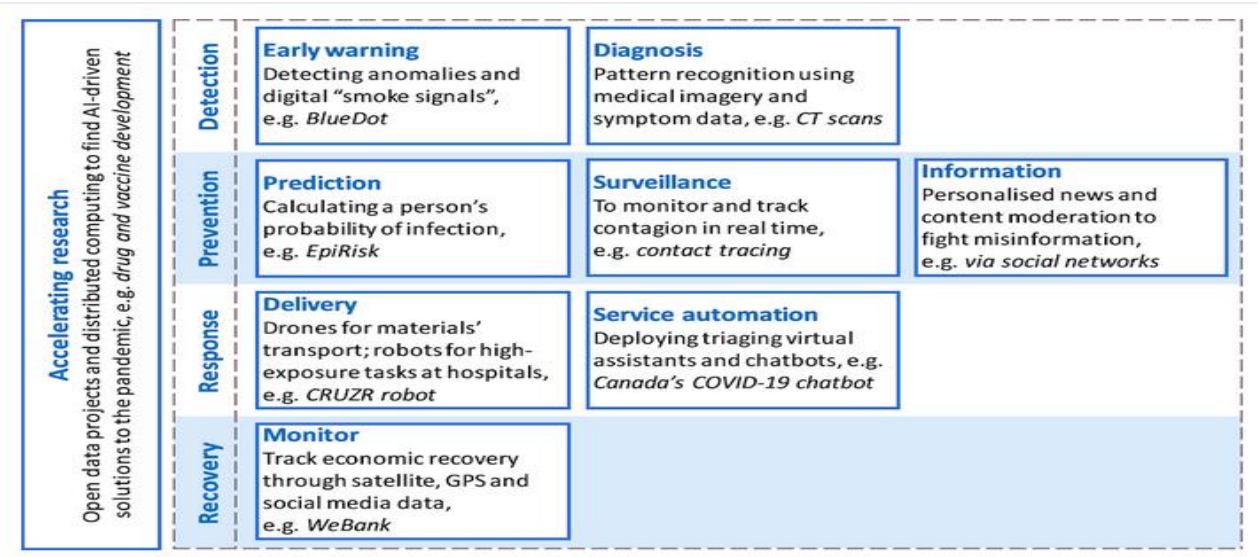


**Figure 1:** AI in the medical field [7].

The figure above presents the different aspects where AI has contributed significantly during the crisis through its techniques which are: Machine Learning (ML), Artificial Natural Language Processing (NLP), Support Vector Machine (SVM), Heuristics Analysis (HA), Artificial Neural Networks (ANN), data analysis using machine learning algorithms and clinical decision making based on the results obtained from the models. This figure also reports on work that made available data to facilitate drug discovery and vaccine improvement. [9] [10].

### *2.1 IA and detection during the pandemic*

One of the most promising areas where the application of artificial intelligence is expected with the most revolutionary results remains health [11]. Rapidly Rising Healthcare Costs, Fewer Staff Capable of Making a Diagnosis, leads to AI Gaining a Deeper Foothold in Medical Technology [12]. Thus, the rate of spread, the very high death rate due to the new coronavirus, confirm the need for AI by specifically registering it on early diagnosis [2,3,13]. The use cases of intelligent diagnostic technologies (linearFold, covitwo, covid-19 Exam CT / XR image by IA, CoughVid, infervision, Deepwise Healthcare Ping An Smart Healthcare, Cloud Computing platform, Alipay, Taobao) presented up to 'here have a beneficial contribution [11,12,14,15]. Through the symptoms of covid-19 and its target parts, which are the cerebral nervous system with its propagation model and the lungs, detection of the new virus by AI remains possible even with its classic tools (algorithms and software) [16,17]. Several technologies can be used to highlight important factors in the diagnosis. We have among others: Sparse Rescaled Linear Square Regression (SRLSR), evolutionary non-dominated radial slots based, algorithm, Attribute Reduction with Multi-objective Decomposition-Ensemble optimizer (ARMED), Gradient boosted Feature Selection (GFS), Recursive Feature Elimination ( RFE). RT-PCR (Reverse-Transcription Polymerase Chain Reaction) and CT scan (Computed Tomography Scan), Deep Neural Network (DNN), Hand-Crafted Feature Learning (HCFL) and hybrid approaches are the two most widely used detection tools in diagnostics at the moment[18] [19] [7]. RT-PCR: this tool based on the nasopharyngeal swab is currently the reference for COVID-19. It allows the virus genome (RNA) to be multiplied to make it easily detectable. During the test, checks are carried out to avoid technical faults as well as contamination of the test.[20]. CT scanis a tool based on the scanner of the lungs and useful in imaging for diagnosis. The system for its training in unsupervised learning generally operates in two stages. The first is the digitization, standardization and measurement of all pulmonary images. Then he uses deep learning algorithms to distinguish the lesions caused by Covid-19 from those due to other potential pathologies [21].

In most of the work on detection, we see among Artificial Intelligence algorithms that the Deep Neural Network (DNN), Hand-Crafted Feature Learning (HCFL) and Hybrid Approaches Have High Impact on Predicting COVID-19 [22]. However, these algorithms can be used for the other areas of AI addressed by figure 1 [7].

### *2.2 AI and Monitoring during the pandemic*

Leveraging digital tools is a central element of East Asia's response to the Covid-19 pandemic, the epicenter of the pandemic. Three main uses have dominated: digital tracing, which is used to identify past transmission chains; digital tracking, which allows real-time monitoring of individuals placed in quarantine and control of

other forms of forced isolation and contamination mapping [23]. AI can also be used to predict chances of recovery or death from COVID-19 [24]. All of this has been implemented through AI applications that have been developed in East Asia, to remotely monitor the movements of quarantined individuals and ensure they stay at home. [23]. These applications are capable of providing the doctors and families of patients with day-to-day up-to-date patient information. AI can also help analyze the level of infection of this virus by identifying clusters and "hot spots". She can successfully track individuals through their contacts and also monitor them. It also helps predict the future course of this disease and its likely recurrence [25,26]. As applications, there are among others:

- **TraceTogether** Using Bluetooth, this app tracks people who have been exposed to the virus. This information is used to identify close contacts based on the proximity and duration of a meeting between two users. It then alerts those who come in contact with someone who tests positive or who is at high risk of carrying the coronavirus.
- **Pan-European Privacy-Preserving Proximity Tracing** (PEPP-PT): this application makes it possible to quickly and efficiently interrupt new chains of transmission of covid-19 by informing potentially exposed people[27, 23].
- **Korea's Tracking App** this is a public database that helps prevent possible violations of self-quarantine orders. It keeps track of people who test positive for COVID-19, including their movements [23].
- **C-19 COVID Symptom Tracker** This application has the role of slowing the outbreak of COVID-19 by helping researchers to identify the speed of spread of the virus in different areas, high-risk areas and better understand the symptoms related to the underlying health problems [28].
- **Johns Hopkins University COVID-19 Dashboard** this interactive geoportal developed in web and mobile versions, counts the cases of people with Covid-19, those who have died but also cured thanks to data from around the world [29,30].

Besides these applications, several other platforms have been developed such as Bluedot which used AI to predict the outbreak and the geographic location of the outbreak. HealthMap collects the data and makes it available to facilitate effective monitoring of the spread of covid 19 [19].

### *2.3 AI and prevention during the pandemic*

Over the past twenty years, several viral epidemics such as' Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) (2002-2003), H1N1 Influenza (2009) and Middle Eastern Respiratory Syndrome Coronavirus (MERS-CoV) (2012) have been identified around the world[31]. All regions of the world are currently threatened by the new SARS-CoV-2 virus. The World Health Organization despite the peculiarities seen in Table 2, has launched a global clinical trial called Solidarity to test antiviral treatment options for the corona virus [8,32]. Several companies and research teams around the world are reporting possible success in the development of SARS-CoV-2 vaccines to fight this new coronavirus pandemic. Some of the SARS-CoV and MERS-CoV vaccines developed so far have followed the more traditional approaches based on inactive whole virus vaccines, subunit vaccines and nucleic acid vaccines [33]. Although a putative epitope that binds to antibodies against SARS-CoV-2 has been reported [34], more epitopes with high affinity need to be identified.

In the absence of in vivo and in vitro data, the researchers used in silico data such as the Immune Epitope Database (IEDB) and the Protein Database [35], or other online epitope prediction algorithms [36,37,38,39,40,41]. Artificial intelligence and data science applied to these epitopes would be useful, in particular with regard to human immunological bias and immuno dominance (ID), which could limit the immune response. It is developed to predict genetic and antigenic evolution, as well as statistical and phylogenetic methods to infer changes in amino acids, protein sites or regions associated with antigenic variations.

Another effective way to prevent this pandemic is to inform the general public about everything related to the disease such as the means of transmission, prevention and especially misinformation which can sometimes kill more than the pathology itself. The World Health Organization (WHO) has launched a chatbot on Facebook (Messenger and WhatsApp) to help provide accurate information on COVID-19. This app provides updates on COVID-19, like latest figures, travel advice, precautionary measures. It is accessible from the official WHO page on Facebook [42]. Likewise, Google Cloud has launched an AI sculpin to provide faster responses to queries regarding COVID-19 to its customers. Google also offers an AI Contact Center Chabot for 24/7 self-service assistance on COVID-19 issues via a Chabot or over the phone.[43, 44]. Cobot-19 is also a robot developed to help the population access information about COVID-19. Data collected comes from WHO, Centers for Disease Control and Prevention (CDC) and Johns Hopkins University [45].

### *2.4 AI and Treatment during the pandemic*

AI is also deployed in the search for treatments of patients with the novel coronavirus [11,13,46]. Microbiology laboratories like the Spiez laboratory and the Federal Institute for ABC Protection within the OFPP were among the first to use AI algorithms for chromogenic detection as well as pathogen identification [47]. The Digital headquarters found that bringing a new drug to market can take up to 10 years and cost $ 2.6 billion. By the way, the startup GENTLR with around $ 150 million spent in 46 days has finalized these AI-based lab tests. Organizations such as: Deepmind, SRI International and Itkos [46,48], focused their research on the discovery of antiviral drugs based on generative modeling technology and the computer definition of the protein structure of the novel coronavirus. Huawei and SenseTime also made superpowered computing resources available for COVID-19 drug screening [11]. To allow scientists to exploit all the knowledge of drugs in the clinical space, algorithms (LinerFold) based on deep learning have made it possible to create applications [49,50]:

Insilico medicine and its artificial intelligence GENTLR (Generative Tensorial Reinforcement Learning) used deep learning to offer a drug against this pandemic [46]. With GENTLR during the first 21 days, 30,000 molecules targeting DDR1 (fibrosis-related molecule) were created using a system of general antagonist networks. GENTLR uses a well-known technique of artificial intelligence which is the GAN (Generative Antagonist Network). The GAN is a kind of exam that works with two AI agents (generator and discriminator). The generator from a database it has learned, offers solutions to the discriminator. This examines them and if they do not match the database sufficiently, they reject them. It is for the generator to redo the process until one or more of these solutions pass the control of the discriminator [46,50].

VolunteerAI [51]: The BenevolentAI algorithm allows, thanks to the link created between data on molecular structure and biomedical information with receptors and relevant diseases, to identify potential drug targets. This novel approach to precision medicine suitable for multifactorial diseases enables AI solutions to be extended at every stage of drug discovery, from target identification to molecular design, through clinical development.

### 3. Results and discussions

We present here the results of our study which focuses on the evaluation of Artificial Intelligence as an appropriate and effective medical technology in the fight against COVID-19. It is about doing an analysis first of covid-19 and other historical pandemics and then an analysis of the medical tools of AI.

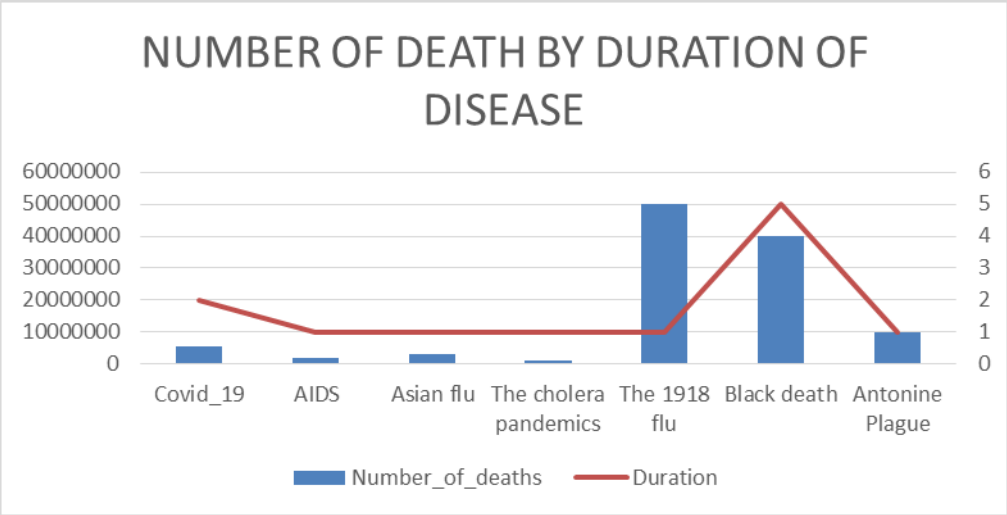


**Figure 2:** Number of death by duration of pandemics.

In Figure 2, the duration of the disease is shown in orange, while the number of deaths is shown in blue. It allows us to see that over a period of only one year, the 1918 flu killed about fifty million (50 000 000) people. Over the same period of time, Antonine plague caused the death of more than ten million (10,000,000) people. Cholera and AIDS, which are still with us today, have decimated a very small number of people. Asian flu, on the other hand, was quickly brought under control by a means that remains unknown despite our research. Black death caused the death of forty million (40,000,000) souls over a period of five (05) years.

It was noted that AIDS and cholera are now under control through sensitization on the methods of transmission and the facilitation of follow-up of affected persons.

Covid-19, has been rapidly defeated through the use of AI both in awareness, prevention, treatment and monitoring. This has significantly reduced the number of global deaths due to this disease. However, the persistence of the pandemic today is due to the multiple variants of the virus that appear every day. AI continues to work, as it can anticipate new variants and possible new treatments.

The countries of East Asia, in particular China, managed to bring this pandemic under control in less than three months, in particular using AI methods. Table 1 presents the seven (07) major pandemics that preceded COVID-19. It indicates the number of deaths related to each disease according to its duration as well as the exact location where the first cases were recorded. From this table, observations are also made to indicate the distribution of deaths around the world. Covid-19 killed around 333,398 deaths in less than 6 months[5]. Cholera killed 1,000,000 around the world with more than 100,000 deaths in France in less than six months. Regarding the Asian Flu, the 1918 flu and Antonine Plague which lasted 1 year, there were respectively 3,000,000, 50,000,000, 10,000,000 deaths. Which is quite high over a period of only one year. AIDS, on the other hand, kills around 2,000,000 people a year. This figure shows that covid-19 has so far killed fewer people than other major historical pandemics. While it is true that this latest pandemic did not begin until December 2019, the fact remains that cholera killed more than 100,000 people in less than 6 months in France alone. Thus, it would not be pretentious to conclude that AI played a fundamental role in the global response to covid-19.

The diagram in Figure 3 below shows an analysis of data from two studies investigating the diagnosis of COVID-19 patients [53,54,55]. Study E1 presents analysis results on 568 patients while study E2 involves a sample of 1014 patients [53,54]. This analysis highlights the percentages of detection through three methods of our choice: CT-scan, RT-PRC and the RT-PCR / CT-scan pair. Despite the size of the data, the first study E1 presents a better percentage of detection of CT-scan on the RT-PRC method, which is contradictory with the study E2. In addition, the RT-PCR / CT-scan detection pair presents in study E2 an average detection surplus of 19.45% on the two other tools and of 36.5% in study E1. From this figure we can see that we cannot rely on only one diagnostic tool to decide on the condition of a patient. Although the data from both are not equal, we observe a very high accuracy in cases where the diagnostic tools are mixed. Thus, in both cases the mixed solution has a very large surplus in terms of accuracy.

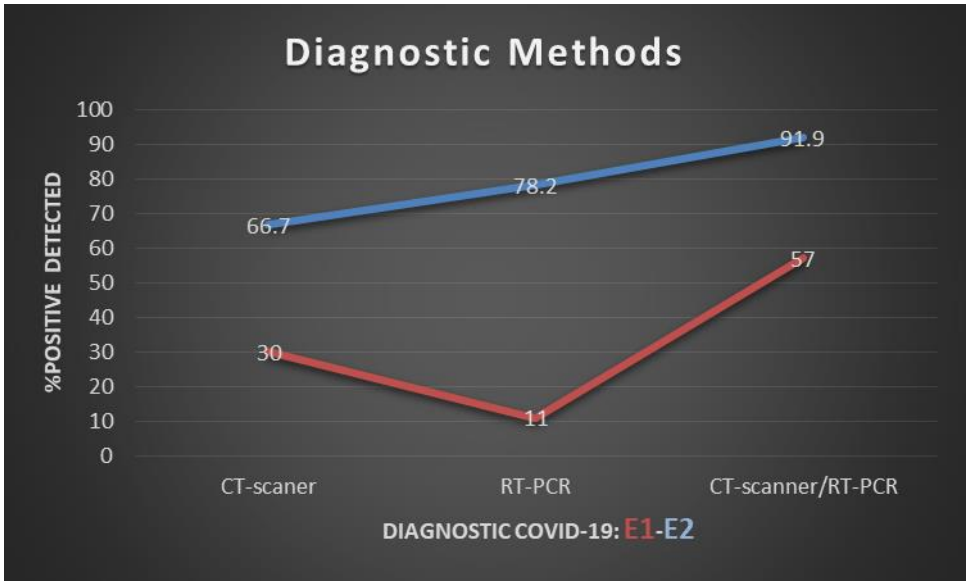


**Figure 3:** Diagnostic Methods.

The Covid-19 case has more to exploit medical imaging solutions to offer effective diagnostic solutions. Most of

the work has suggested hybrid AI solutions for diagnostics. Thus, from our study we find that the RT-PCR / CT-scan coupling allows for better diagnosis.

The AI solution for the treatment of Coronavirus remains the best way for a lasting solution because the various vaccines which until now seemed to be the solution are ineffective against the new variant called Omicron. Table 2 lists all the variants of covid-19 and shows the difficulty of a lasting solution due to permanent mutations. Corona virus. In the space of 02 years this pandemic has affected 05 mutations. It is therefore not excluded to observe in the next 06 months another variant so thinks of another vaccine. WHO also notes that the vaccine solution is not without side effects, which indicates the severity in case of an inappropriate vaccine. No scientific work has ruled on the duration of protection of vaccines and their influence will depend on 05 factors: effectiveness, the approval process, the speed of manufacture, the distribution system and the number of people vaccinated. However, the management and monitoring of the coronavirus via AI is efficient, but also requires the provision by telecommunications operators of means for designing and implementing AI applications, also and above all seriousness and reliability. contribution of the population through the provision of correct information, in case forms are made available to them. However, data collection and use should respect privacy. On the other hand, it would be imperative to add trick questions in the event that forms have to be completed in order to detect inconsistencies.

## 4. Conclusion

To create a healthy world, it is important to bet on precision medicine. However, it is important that the development of the global and national response strategy is based on the principle of Artificial Intelligence of health systems. If AI is not yet able to accurately and proactively prevent the production of a disaster or other infectious pandemic, it nevertheless presents a very promising future with the recent appearance called Omicron which makes vaccines ineffective. which heretofore concerned about the long-term protection as well as the observed side effects. It would be wise to also pay attention to the other major pandemics that preceded covid-19, because they could also have other variants that would still kill the world population. At the very least, we are sure that COVID-19 is not a first and will not be a last either. Since the onset of this pandemic, the maximum duration of the variants is 06 months. Thus, only Artificial Intelligence can allow us to have a historical record of all the variants and other major pandemics in order to help in the planning of a control program based on the correlation of old pandemics.

## Reference

[1] Laousse, «https://www.larousse.fr/dictionnaires/francais/pand%C3%A9mie/57587,» 07 Mai 2020. [En ligne]. Available: https://www.larousse.fr/dictionnaires/francais/pand%C3%A9mie/57587.

[2] France24, «https://graphics.france24.com/grandes-pandemies-histoire-peste-noire-cholera-grippe-espagnole-sida/,» avril 2020. [En ligne]. Available: https://graphics.france24.com/grandes-pandemies-histoire-peste-noire-cholera-grippe-espagnole-sida/. [Accès le 07 mai 2020].

[3] ONU, «https://www.un.org/press/fr/2001/AIDS18.doc.htm,» 11 juin 2001. [En ligne]. Available: https://www.un.org/press/fr/2001/AIDS18.doc.htm. [Accès le 07 mai 2020].

[4] F. Vialla, «Approche historique de la lutte contre les épidémies et les pandémies par les « pouvoirs publics »,» ScienceDirect, 2020.

[5] J. Hopkins, «https://coronavirus.jhu.edu/map.html,» 22 05 2020. [En ligne].

[6] WHO, «COVID 19 strategy update,» WEEKLY EPIDEMIOLOGICAL RECORD, 14 April 2020.

[7] K. R. B. M. Vaid S, «Deep learning COVID-19 detection bias: accuracy through artificial intelligence,» Int Orthop, vol. 44, 2020.

[8] O.-. O. M. d. l. Santé, «Suivi des variants du SARS-CoV-2,» 2021 WHO, 10 11 2021.

[9] A. H. R. V. a. Mohd Javaid, «Industry 4.0 technologies and their applications in fighting COVID-19 pandemic,» Elsevier, 21 April 2020.

[10] Y. Z. W. a. Lian Wang, «Artificial Intelligence for COVID-19: A systematic reviews,» Frontiers in Medecine, vol. 8, n° %1 704256., 30 September 2021.

[11] E. B.-L. C. ,. a. a. Marion BERTAGNA, «COVID-19 Accélérateur de l'Innovation,» 18 mars 2020.

[12] ITU News magazine, l'intelligence artificielle au service du bien social: la voie à suivre, No. 3, 2019 éd., UIT, Éd., Génève: Union internationale des télécommunications, 2019.

[13] M. J. I. H. K. H. Raju Vaishya, «Artificial Intelligence (AI) applications for COVID-19 pandemic,» 14 April 2020.

[14] «A new app can help detect the coronavirus,» 2 Ajune 2020.

[15] Innovation COVID-19 special EDITION, 2020.

[16] M. Gagnon, Mécanisme de propagation descorona au cerveau, u. d. Québec, Éd., Québec: Institut Armand Frappier, 2003.

[17] Z. Z. e. a. Xie X, Chest CT for Typical 2019-nCoV Pneumonia: Relationship to Negative RT-PCR Testing.

[18] A. O. N. K. M. K. A. A.-J. A. I. C. A. R. Sohrabi C, «World Health Organization declares global emergency: a review of the 2019,» Int J Surg, 26 Feb 2020.

[19] B. S. a. R. S, «Going viraleCOVID-19 impact assessment: a perspective,» J Mar Med Soc, p. 22(1):9., 01 Jan 2020 .

[20] C. Mouton, «Diagnostic du Covid-19,» 24 Avril 2020.

[21] M. GMIRA, «La contribution de l'Intelligence Artificielle (IA),» RIEMAS THINK TANK, 15 05 2020.

[22] R. N. Anjan Gudigar, «Role of Artificial Intelligence in COVID-19 Detection,» SENSORS, vol. 21, n° %18045, 01 Decembre 2021.

[23] I. Montaigne, Covid-19: l'Asie orientale face à la pandémie, Paris, 2020.

[24] A. K. B. a. M. L. N. Neelima Arora, «The role of artificial intelligence in tackling COVID-19,» 2020.

[25] M. J. I. H. K. A. H. Raju Vaishya, «Artificial Intelligence (AI) applications for COVID-19 pandemic,» Diabetes & Metabolic Syndrome: Clinical Research & Reviews, vol. 14, 2020.

[26] M. J. I. H. K. Abid Haleem, «Current status and applications of Artificial Intelligence (AI) in medical field: An overview,» Current Medicine Research and Practice, 2019.

[27] P.-E. P.-P. P. T. (pepp), «https://www.pepp-pt.org/,» 01 06 2020. [En ligne].

[28] O. d. c. e. d. d. é. (OECD), «Tracking and tracing COVID: Protecting privacy and data while using apps and biometrics,» Secretary-General of the OECD, 2020.

[29] C. f. S. S. a. E. (CSSE), «https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6,» 01 juin 2020. [En ligne].

[30] coronavirus.app, «https://coronavirus.app/map,» 01 juin 2020. [En ligne].

[31] S. K. R. M. M. S. U. R. a. H. A. Dey, «Analyzing the Epidemiological Outbreak of COVID-19: A Visual Exploratory Data Analysis (EDA) Approach,» Journal of Medical Virology, 2020.

[32] F. K. F. Amanat, «SARS-CoV-2 Vaccines: Status Report,» Immunity, p. 583–589, 2020.

[33] e. a. Q. Gao, «Development of an inactivated vaccine candidate for SARS-CoV-2,» Science, 2020.

[34] M. e. a. Yuan, «A highly conserved cryptic epitope in the receptor-binding domains of SARS-CoV-2 and SARS-CoV,» Science, 2020.

[35] J. W. Z. F. G. G. T. B. H. W. I. S. P. B. H.M. Berman, «The Protein Data Bank,» Nucleic Acids Research, pp. 235-242, 2000.

[36] A. e. a. Grifoni, «A Sequence Homology and Bioinformatic Approach Can Predict Candidate Targets for Immune Responses to SARS-CoV-2,» Cell Host & Microbe, 2020.

[37] S. Q. A. &. M. M. Ahmed, «Preliminary identification of potential vaccine targets for the COVID-19 coronavirus (SARS-CoV-2) based on SARS-CoV immunological studies,» Viruses 12, p. 254, 2020.

[38] M. e. a. Bhattacharya, «Development of epitope-based peptide vaccine against novel coronavirus 2019 (SARS-COV-2): Immunoinformatics approach,» Journal of Medical Virology, 2020.

[39] M. &. S. L. Zheng, «Novel antibody epitopes dominate the antigenicity of spike glycoprotein in SARS-CoV-2 compared to SARS-CoV,» Cellular & molecular immunology, 2020.

[40] E. &. C. B. Fast, «Potential T-cell and B-cell Epitopes of 2019-nCoV,» bioRxiv, 2020.

[41] G. Lucchese, «Epitopes for a 2019-nCoV vaccine,» Cellular & Molecular Immunology, 2020.

[42] WHO, «https://www.who.int/news-room/feature-stories/detail/who-and-rakuten-viber-fight-covid-19-misinformation-with-interactive-chatbot,» 01 juin 2020. [En ligne]. Available: https://www.who.int/news-room/feature-stories/detail/who-and-rakuten-viber-fight-covid-19-misinformation-with-interactive-chatbot.

[43] G. Cloud, «https://cloud.google.com/blog/products/ai-machine-learning/support-for-contact-centers-during-covid-19,» 01 juin 2020. [En ligne]. Available: https://cloud.google.com/blog/products/ai-machine-learning/support-for-contact-centers-during-covid-19.

[44] Google, «https://cloud.google.com/solutions/contact-center,» 01 juin 2020. [En ligne]. Available: https://cloud.google.com/solutions/contact-center.

[45] V. PorteaMedical, «https://healthvision.in/portea-medical-and-verloop-launch-cobot-19-chatbot/,» 01 juin 2020. [En ligne]. Available: https://healthvision.in/portea-medical-and-verloop-launch-cobot-19-chatbot/.

[46] B. Z. Z. A. a. a. Alex Zhavoronkov, «Potential non-covalent SARS-CoV-2 3C-like protease inhibitors designed using generative deep learning approaches and reviewed by human medicinal chemist in virtual reality,» 12 Mai 2020.

[47] B. S. Kevin Kohler, «L'intégration de l'IA dans la protection de la population,» Center for Security Studies (CSS) de l'ETH Zurich, n° %1260, avril 2020.

[48] V. A. Z. a. a. Alex Zhavoronkov, «Potential 2019-nCoV 3C-like protease inhibitors designed using generative deep learning approaches,» 19 February 2020.

[49] A. V. Q. &. O. T. I. Zhavoronkov, «Will Artificial Intelligence for Drug Discovery Impact,» 2020.

[50] F. l. Tournoulx, «NEON,» 6 septembre 2019.

[51] A. P. I. G. C. T. O. O. D. S. P. R. Justin Stebbing, «COVID-19: combining antiviral and anti-inflammatory treatments,» 27 February 2020.

[52] K. C. L.-. P. Jean-Francois, «Le pilulier connecté imedipac de Medissimo est désormais disponible à la vente».

[53] Z. y. h. z. c. t. s. x. Tao Ai, «Correlation of Chest CT and RT-PCR Testing in Coronavirus ,Disease 2019(COVID-19)i china: A report of 1014 cases,» 24 february 2020.

[54] Y. L. C. L. G. Z. ,. Z. X. J. S. Xiaoshuai Ren, «Application and optimization of RT-PCR in diagnosis of SARS-CoV-2 infection,» 28 february 2020.

[55] S. A. e. a. Soldati G, Proposal for international standardization of the use of lung ultrasound for COVID-19 patients; a simple, quantitative, reproducible, J Ultrasound Med éd.

[56] LeFigaro, «https://www.lefigaro.fr/flash-actu/le-coronavirus-detecte-par-une-intelligence-artificielle-bien-avant-l-oms-20200129,» 29 janvier 2020. [En ligne]. Available: https://www.lefigaro.fr/flash-actu/le-coronavirus-detecte-par-une-intelligence-artificielle-bien-avant-l-oms-20200129. [Accès le 07 mai 2020].

[57] N. A.-R. H. AL-NAJJAR, «A classifier prediction model to predict the status of Coronavirus CoVID-19 patients in South Korea,» European Review for Medical and Pharmacological Sciences, vol. 24, pp. 3400-3403, 2020.

[58] AfricaNews, «https://fr.africanews.com/2020/02/12/coronavirus-la-chine-se-tourne-vers-l-intelligence-artificielle//,» fevier 2020. [En ligne]. Available: https://fr.africanews.com/2020/02/12/coronavirus-la-chine-se-tourne-vers-l-intelligence-artificielle//. [Accès le 10 mai 2020].

[59] J. M. Bennett, «Call for Ministry of Health to deploy/utilizeArtificial Intelligence Diagnosis to detect Covid19/Coronavirus2019,» 17 fevrier 2020.

[60] A. O. N. K. M. K. A. A.-J. A. I. C. A. R. Sohrabi C, «World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19),» 26 February 2020.