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Journal of Clinical Trails

Commentary

Tackling the COVID-19 Pandemic through Artificial Intelligence-Enabled Clinical Trials

Mario A Quiroz-Juárez[1*], Alfred B U'ren[2], Roberto de J León Montiel[2]

[1]*Departamento de Física, Universidad Autónoma Metropolitana Unidad Iztapalapa, San Rafael Atlixco 186, 09340 Cd, México;*

[2]*Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, Apartado Postal 70-543, 04510 Cd, México*

DESCRIPTION

Artificial Intelligence (AI) has emerged as a collection of computational techniques which seek to mimic the human brain in order to complete tasks for which standard algorithms lead to partially satisfactory results or are costly to implement [1]. Specifically in the context of health care, AI has gained attention as a promising technology [2,3]. Examples of tasks for which artificial intelligence has provided successful tools designed to mitigate the effects of the current pandemic include medical-image recognition and diagnosis [4-9], identification of high-risk patients [10-12], and predictive modeling to manage hospital resources and capacity allocation [13-16]. In this regard, AI algorithms have demonstrated the crucial capacity of pinpointing relevant, specific pieces of information "buried" in huge data sets, which would be all but impossible to accomplish through a standard visual inspection [17]. These findings have helped medical professionals in reaching key clinical decisions, leading to an enhanced efficiency in the delivery of healthcare. Perhaps, one of the major drawbacks of applying AI algorithms is the lack of clarity and interpretability of their autonomous decision-making. However, numerous efforts have recently been reported to explain and/or interpret the inner workings of AI algorithms [18,19].

The highly contagious nature of the coronavirus infectious disease (COVID-19), coupled with its significant mortality rate, has caused a devastating effect on the global population, and has placed governments as well as the world economy under enormous strain. Health care systems around the world have been overwhelmed with exceeded hospital capacities during infection peaks. This has led to the application in many countries of preventive measures also known as non-pharmaceutical interventions involving the suspension of non-essential activities [20]. In this context, researchers from all over the world have made enormous efforts during the last year and a half to exploit artificial intelligence in order to tackle specific challenges posed by the current global health crisis. Amongst such challenges, the identification of high-risk patients is particularly important: Hospital resources and capacities must be adequately managed in order to prevent the collapse of healthcare systems [21]. In this direction, a number of approaches based on machine-learning algorithms have been proposed with the aim of identifying, from the earliest stage possible, patients who are likely to become ill or critically ill. These approaches make predictions relying on basic patient information, clinical symptoms [22-24], as well as travel history [25] and discharge time of hospitalized patients. Some other efforts focus on identifying patients requiring specialized care, namely hospitalization and/or special care units, or patients at a higher fatality risk.

COVID-19 diagnosis represents an application for IA tools of immense potential benefit in the midst of the current international health crisis. Despite the fact that Reverse Transcription-Polymerase Chain Reaction (RT-PCR) tests have been an invaluable tool for COVID-19 diagnosis, they can in fact exhibit an insufficient sensitivity in cases of a low viral load, so that they should not be considered as the only option for the confirmation of a COVID-19 infection. In this regard, AI can enhance COVID-19 diagnosis tasks through the analysis of chest-area medical images, obtained as Computer-Aided Tomographies (CAT) and/or radiographs (x-rays), accelerating the treatment of COVID-19 patients. Diagnostic systems based on chest CAT scans have been implemented, which can successfully differentiate COVID-19 related pneumonia from other classes of pneumonia, even in patients with a negative RT-PCR test. Alternatively, deep learning techniques have been proposed to efficiently diagnose COVID-19 patients reducing contact between clinicians and patients, using multi-national datasets of chest CAT scans, clinical symptoms in conjunction with chest CAT images, series of CAT scan slices, and chest radiographs. Some efforts have focused on segmentation methods for pinpointing lung lesions for the estimation of their severity. So as to improve scanning efficiency during CAT scan acquisition, AI algorithms have been used to identify the positions where scanning should start and end, the so-called anatomical key points.

Correspondence to: Mario A Quiroz-Juárez, Departamento de Física, Universidad Autónoma Metropolitana Unidad Iztapalapa, San Rafael Atlixco 186, 09340 Cd, México, E-mail: maqj@xanum.uam.mx

Received: 04-Sep-2021, Manuscript No. JCTR-21-003-PreQc-22; **Editor assigned:** 08-Sep-2021, PreQC No. JCTR-21-003-PreQc-22 (PQ); **Reviewed:** 22-Sep-2021, QC No. JCTR-21-003-PreQc-22; **Revised:** 04-Jul-2022, Manuscript No. JCTR-21-003-PreQc-22 (R); **Published:** 02-Sep-2022, DOI: 10.35248/2167-0870.22.12.505.

Citation: Quiroz-Juárez MA, U'ren AB, León Montiel RdJ (2022) Tackling the COVID-19 Pandemic through Artificial Intelligence-Enabled Clinical Trials. J Clin Trials. 12:505.

Another urgent need is the prediction of future trends in COVID-19 spreading, taking into account specific local conditions, so as to be in a position to design adequate strategies to counter the pandemic. Several novel AI-based prediction models have been introduced to guide decisions and manage control measures. Machine learning models have been developed to predict future COVID-19 infection dynamics using historical data from several nations [14]. In addition, several efforts have been focused on developing models for the estimation of new COVID-19 cases based on regression analysis methods, deep learning techniques, and analysis of interaction networks. There are other types of AI applications in the context of the current pandemic, though less numerous than the ones previously mentioned, such the exploitation of the self-learning and self-evolving features of AI methods for drug discovery and vaccine development, sentiment analysis, as well as monitoring [11], and tracking of infected patients.

CONCLUSION

In conclusion, as a response to the current international public health crisis, artificial intelligence has emerged as a powerful and promising set of tools that have enabled the development of new technologies that may help in tackling the pandemic and mitigate its effects. These technologies may certainly assist medical professionals, scientists, and authorities in making informed decisions, planning medical facilities, developing useful diagnosis tools, and ultimately slowing down the spreading of the SARS-CoV-2 virus.

ACKNOWLEDGMENT

This work was supported by CONACyT under Project No. CB-2016-01/284372 and by DGAPA UNAM under UNAM-PAPIIT grants IN102920 and IN103521.

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