Historic opportunity: artificial intelligence interventions in COVID-19 and other unknown diseases

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Coronavirus disease 2019 (COVID-19) is a pandemic afflicting more than 200 million people around the world from its outbreak in 2019, with no sign of ending in the foreseeable future. Although several types of vaccines have been developed using various strategies and many people are getting vaccinated, specific drugs are still not currently available [1]. More unfortunately, there is no specific therapy means for this disease, and only symptomatic treatment and supportive therapy are being clinically tried. The COVID-19 crisis has caused a depletion of medical resources in many countries, resulting in a large number of deaths, which has a huge and profound economic, social, health, and psychological impact on the whole world [2,3]. It has highlighted the deficiencies of current medical preparedness and government management around the world, which urgently requires the involvement of new technologies in defeating COVID-19 and preventing the emergence of new public health crisis.

Artificial intelligence (AI) or machine intelligence is computational mimicking of human intelligence. It attempts to mimic biological intelligence to act with various degrees of autonomy by enabling software to process target tasks using either predetermined rules or deep learning models to make decisions, thereby reducing manual human intervention [4]. The emergence of AI is revolutionizing our lives across the board. Considering the diversity of factors affecting COVID-19 pandemics, the complexity of health hazards, and the pervasiveness of social influences in COVID-19, AI is highly intelligent, efficient, and convenient to meet the current challenges of COVID-19 crisis [5].

An excellent paper published in Nature Medicine proved the high effectiveness of an AI algorithm in rapid and accurate diagnosis of patients with COVID-19 in China and overcame the shortcomings of possible false diagnosis results of reverse transcription polymerase chain reaction test kits and chest computed tomography, showing the very strong ability of AI [6]. Digital smartphone tracking and risk assessing for COVID-19 can be used by policy-makers in any nation with available data to plan the allocation of limited resources ahead of ongoing outbreaks, just showing the significant power of AI [7,8]. Our recently developed K-SEIR-Sim software that can simulate the spread of COVID-19 especially can assess the effects of lockdown and predict the pandemic waves, showing the great value of AI [9]. But that is just the tip of the iceberg for the application of AI [10], and better AI technologies for combating COVID-19 remain to be developed. As the situation of COVID-19 crisis continues to deteriorate and the death toll of COVID-19 patients around the world rises exponentially, the development of novel AI technologies is critical to minimize the number of COVID-19 deaths. Thus, the abovementioned micro AI models inspire us here to discuss macro AI models that should be used to promote the development of new AI technologies. We propose that five AI models are required to predict the risk and spread of COVID-19-related infectious diseases and provide effective strategies for the diagnosis and treatment of these diseases. They are as follows (Fig. 1):

1. ‘AI models for risk assessment’. These assessments include genetic risk assessed by analyzing big data of patient omics; risk of infection assessed by analyzing implementation of social distancing and sales of mask selling; risk of getting sick assessed by matching pre-symptoms and by examining body functions; and risk of death assessed by analyzing preexisting diseases and complications.

2. ‘AI models for disease diagnosis’. Although the diagnosis of this disease is not impossible, the current speed and accuracy of diagnosis cannot meet the requirement. Due to the limitations of the currently available methods, we need to use AI technology to combine various datasets from symptoms matching, lung imaging, travel records, and molecular markers to make a comprehensive judgment.

3. ‘AI models for treatment selection’. Current treatment options cannot meet the actual needs, and we should accelerate the development and increase the supply of treatment alternatives.
Five types of AI models are required. They are models for risk assessment, disease diagnosis, treatment selection, outbreak surveillance, and policy-making. These macro models contain a large number of micro models. These micro models also consist of countless mini models.

For example, vaccine development, drugs screening, therapy options, and patients' management are all indispensable for the participation in AI technologies.

(4) ‘AI models for outbreak surveillance’. The spread and outbreak of COVID-19 can be influenced by various factors, such as total and distribution of health resources, economic and social development levels, cultural differences, living habits, and population density. The analysis of such big data must rely on AI to improve efficiency and credibility for outbreak surveillance, especially for monitoring the recurrence or periodic occurrence.

(5) ‘AI models for policy-making’. Individual regions and countries cannot prevent COVID-19 from recurrence. Traffic control, travel restrictions, and communication among people all require the involvement of AI. Medical resources, living materials, industrial supplies, etc. also need the help of AI to be efficiently dispatched. Analysis of numerous big datasets requires AI to help countries and regions to formulate coordinated policies.

Collectively, the recently published ideas on the rapid diagnosis [6], quick tracking and risk assessment [7,8], and simulation of the spread of COVID-19 [9] are very inspiring for us to fight against COVID-19 and the emerging infectious diseases or other unknown diseases. Considering the delayed applications of AI, accelerating the development of AI technologies integrated into COVID-19 containment is an urgent need. Furthermore, it looks rather unlikely that humans will encounter such disease again, which has widespread and profound influence on many aspects. Therefore, the outbreak of COVID-19 has given us not only challenges, but also opportunities. Now, it may be the best time for AI to be fully involved in curbing the disease. Last but not the least, the models of AI proposed here will provide a required framework for future responses to emerging infectious diseases or other unknown diseases.

Acknowledgement
Despite our best endeavors, many excellent studies regretfully could not be cited due to space constraints. We are thankful to these scientists for their help to overcome the new disease.

Conflict of Interest
The authors declare that they have no conflict of interest.

Funding
This work was supported by the grants from the Academic Leaders Training Program of Pudong Health Bureau of Shanghai (No. PWRd2019-12), Key Specialty Construction Project of
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