Editorial on Current Status of Diagnosis and Forecast of COVID-19

COVID-19 focused series: diagnosis and forecast of COVID-19

Tao Xu[1#], Jing Cheng[2#], Zifeng Yang[3#], Wenda Guan[3], Zhiqi Zeng[3]

[1]Guangzhou Laboratory, Guangzhou, China; [2]Medical Systems Biology Research Center, School of Medicine, Tsinghua University, Beijing, China; [3]State Key Laboratory of Respiratory Disease, National Clinical Research Center for Respiratory Disease, Guangzhou Institute of Respiratory Health, the First Affiliated Hospital of Guangzhou Medical University, Guangzhou, China

[#]These authors contributed equally to this work.

Correspondence to: Prof. Tao Xu. Guangzhou Laboratory, Guangzhou 510005, China. Email: xutao@ibp.ac.cn; Prof. Jing Cheng. Medical Systems Biology Research Center, School of Medicine, Tsinghua University, Beijing 100084, China. Email: jcheng@tsinghua.edu.cn; Dr. Zifeng Yang. State Key Laboratory of Respiratory Disease, National Clinical Research Center for Respiratory Disease, Guangzhou Institute of Respiratory Health, the First Affiliated Hospital of Guangzhou Medical University, Guangzhou 510180, China; Guangzhou Laboratory, Guangzhou Key Laboratory for Clinical Rapid Diagnosis and Early Warning of Infectious Diseases, Guangzhou 510180, China. Email: jeffyah@163.com.

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How to successfully manage the globally coronavirus disease 2019 (COVID-19) pandemic which encompasses prevention and control of the disease as well as patient treatment, has always been a grand challenge since the beginning of the pandemic. Non-drug preventative and control measures have been proven to be crucial (1) in limiting the spreading of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus. As more effective medicines and vaccines are developed and put into use, the incidence and fatality rates of critically ill patients have declined greatly.

Nevertheless, the SARS-CoV-2 virus has kept evolving into multiple variants, which are not only highly transmissible but also can escape the immune surveillance of people. Hence, it is imperative to reliably predict and accurately identify new SARS-CoV-2 variants and their transmission pattern. Precise forecast of epidemic trends can facilitate rational decision-making by authority, leading to reduced number of illnesses and fatalities (2). Furthermore, prompt and accurate diagnosis of SARS-CoV-2 virus infection can provide medical/pharmaceutical researchers with reliable data, which can be applied to develop more appropriate therapeutics (3).

Predictive modeling and diagnosis can influence one another in the COVID-19 epidemic. Accurate diagnosis generates a significant amount of training data for prediction models, while reliable predictions provide references for diagnosis. Only when both measures generate reliable results and corroborate each other in practice can the number of infections be drastically decreased and a significant number of fatalities prevented.

Currently, COVID-19 is diagnosed by molecular detection of SARS-CoV-2, together with clinical symptoms and lung computed tomography (CT) scans. Common SARS-COV-2 detection methods can be divided into two main categories: (I) nucleic acid test, including real-time reverse transcription polymerase chain reaction (RT-PCR), gene sequencing, etc. (4-6); (II) antigen detection. The primary objective of antigen detection is to identify the nucleocapsid protein (N) and spike (S) protein of SARS-CoV-2 virus in a person's sample in the early stage of infection. Because of its ease of use, antigen detection is used in Point-of-Care testing and for large-scale epidemic screening (7). RT-PCR is regarded as the gold standard for identifying SARS-CoV-2 infection. As the epidemic spreads rapidly and affects a wide range of areas, the heavy workload of molecular detection calls for more rapid and integrated approaches for nucleic acid testing, as well as multi-variants detection at the same time. Large-scale mobile screening devices have also been developed to identify infection cases as fast as possible (8). During the current COVID-19 pandemic, there has been growing interest in using reverse-transcription loop-mediated isothermal amplification

(RT-LAMP) and clustered regularly interspaced short palindromic repeats (CRISPR)-based diagnostic techniques to develop rapid and accurate assays for detecting SARS-CoV-2. In addition to these detection methods, artificial intelligence (AI)-assisted diagnosis based on lung CT scan images is also actively under development (9).

For successful model building, data accuracy is most crucial in epidemic prediction; thus, the premise of predictive modelling is the reliability of diagnostic results. Globally, multiple modelling approaches have been developed by many research teams, such as statistical models, classic transmission dynamics models, training-based AI or machine learning methods to predict and analyze the epidemic trend, which are utilized to evaluate the effectiveness of governments' prevention and control measures and to assist in decision-making of public health policies (10-14).

To finally end the COVID-19 pandemic, however, there are many problems ahead of us to be resolved, for example, (I) how to rapidly translate novel diagnostic products and technologies developed in a laboratory into clinical applications; (II) how to exploit the application of different diagnostic products in various scenarios; (III) how to improve the accuracy and timeliness of epidemic forecasting; (IV) how to effectively communicate epidemic prediction results to medical professionals and public health officers.

This focused series is primarily intended to keep professionals in related fields up-to-date on the most recent diagnostic technologies and prediction methodologies, as well as to provide a solid communication platform for studying the technologies and applications.

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