

September 2020

## New Paradigm is Needed for Infectious Disease Prevention and Control

CHEN Liang

---

### Recommended Citation

Liang, CHEN (2020) "New Paradigm is Needed for Infectious Disease Prevention and Control," *Bulletin of Chinese Academy of Sciences (Chinese Version)*: Vol. 35 : Iss. 9 , Article 1  
DOI: <https://doi.org/10.16418/j.issn.1000-3045.20200901001>  
Available at: <https://bulletinofcas.researchcommons.org/journal/vol35/iss9/1>

This Article is brought to you for free and open access by Bulletin of Chinese Academy of Sciences (Chinese Version). It has been accepted for inclusion in Bulletin of Chinese Academy of Sciences (Chinese Version) by an authorized editor of Bulletin of Chinese Academy of Sciences (Chinese Version). For more information, please contact [lcyang@cashq.ac.cn](mailto:lcyang@cashq.ac.cn), [yjwen@cashq.ac.cn](mailto:yjwen@cashq.ac.cn).

---

## New Paradigm is Needed for Infectious Disease Prevention and Control

**Citation:** CHEN Liang, CHEN Yuan, ZHANG Xuemin. New Paradigm is Needed for Infectious Disease Prevention and Control [J]. Bulletin of Chinese Academy of Sciences, 2020 (09): 1079–1081.

## New Paradigm is Needed for Infectious Disease Prevention and Control

CHEN Liang<sup>1</sup>, CHEN Yuan<sup>1</sup>, ZHANG Xuemin<sup>1</sup>

*1. National Center of Biomedical Analysis, Beijing 100850, China*

**DOI:** 10.16418/j.issn.1000-3045.20200901001-en

Infectious diseases have always been a major threat to the survival of human beings, which has greatly influenced the history of human civilization. The outbreak of COVID-19 in early 2020 triggered a serious public health crisis in the globe and made people to think deeply about the public health emergency system.

Scientific and technological innovation is the key to the prevention and control of emerging infectious diseases. Since the beginning of the 21st century, biotechnology has developed rapidly and its integration with nanotechnology, information technology, precision electronics, and advanced manufacturing has driven the industrial mode revolution and the comprehensive upgrading of industrial technology. The emergence of big data, cloud computing, and artificial intelligence provide new means for the prevention and control of infectious diseases. At present, the development of these technologies and the corresponding industries presents the trend of automation, intelligentization, informatization, and precision, which will alter the current passive response into a timely, rapid, precise, and efficient active response to emerging infectious diseases. Technological innovation should be achieved through interdisciplinary efforts to establish a new paradigm for the prevention and control of emerging infectious diseases.

### 1 Developing self-service and rapid diagnostic technology based on information technology

The development of automated rapid field pathogen detection technology from sample collection to result interpretation makes it feasible to complete the self-service detection in grass-roots medical institutions or even families. Originally, the detection can only be completed by professional laboratories and relies on special conditions. The development and application of test strip can realize the rapid

detection by non-professionals in family. The detection results can be uploaded to the data center through the mobile terminal application (APP), and the report of intelligent analysis can be obtained immediately. This technology presents high throughput, low cost, automation, and convenience. In response to severe epidemics, the government and related departments can get the total number of infected people and their geographical location in real time, and implement precise measures for the prevention and control on this basis. Self-service diagnosis still has many technical difficulties which need to be solved. The development of self-service detection technology in family will tremendously reduce the social cost for the prevention and control of major infectious diseases. Biotechnology is now in an era of wide cross, deep integration, and great breakthrough. Rapid diagnostic technology of infectious diseases has been integrating with information technology, nanotechnology, and materials technology, facing the opportunity of achieving significant breakthrough.

### 2 Developing intelligent early warning system for infectious diseases based on information technology

The development of automated rapid field pathogen detection technology from sample collection to result interpretation relies on the construction of the information-based intelligent early warning system for infectious diseases. The transmission of emerging infectious diseases usually follows the rule of point–line–surface. Currently, infectious diseases are mainly discovered in hospitals and reported to specialized institutions such as the Center for Disease Control (CDC) to make a judgment on the outbreak. However, at this time, the outbreak is usually at the late stage of line transmission, or

**Received:** 2020-8-31

even severer. The big data-based intelligent early warning system involving cutting-edge biotechnology, information technology, and artificial intelligence may discover emerging infectious diseases at the first stage or even when the first patient (point) appears, so as to realize real-time monitoring, timely warning, early intervention, and thus the best prevention and control performance. For example, the intelligent technology for the identification of pathogens (e.g., virus) based on the big data of microbial genetic information can realize the timely detection of the pathogens that may lead to epidemics and thus the early warning. The development of intelligent early warning system for emerging infectious diseases is a complicated and systematic project, which requires the full cooperation of talents of multiple disciplines such as big data, artificial intelligence, information technology, precision instrument, bioinformatics, microbiology, epidemiology, and infectious diseases.

### 3 Developing the big data-based intelligent traceability system for infectious diseases

Tracing of viruses and other pathogens is the key to block the spread of infectious diseases. However, the experience of dealing with epidemics in the past decades proves that it is difficult to trace the pathogen accurately through traditional methods. Generalized pathogen tracing involves genetic evolution, host, and space and time. The coming era of big data and the development of intelligent technology make it possible to trace pathogen quickly and effectively. By tracing the origin of viruses and other pathogens, we can reveal the transmission of viruses among different individuals and different host species, as well as the evolution of them under the selection pressure of different external environment and host immune response. Moreover, the key molecular characteristics that determine their transmissibility, pathogenicity, and drug resistance can be analyzed for the development of drugs and vaccines and the formulation of intervention measures. Therefore, it is of great importance to developing a big data-based intelligent traceability system for infectious diseases to realize the intelligent analysis of pathogen information through big data mining technology, rapid and accurate tracing of pathogen source, and effective prevention and control of emerging infectious diseases.



**CHEN Liang** Associated Professor of the National Center of Biomedical Analysis. She is mainly engaged in the study of cell biology and biotechnology. E-mail: lchen@ncba.ac.cn

### 4 Developing broad-spectrum antiviral specific drugs based on common mechanism

There are countless species and types of viruses. Besides, viruses evolve because of gene mutations. Therefore, when an epidemic occurs, it is difficult to develop specific drugs from scratch in time. The research on the common mechanism of viral infection should be strengthened for the unveiling of broad-spectrum antiviral drugs based on common mechanism. The expanding broad-spectrum antiviral drug library can provide an effective means for us to deal with emerging infectious diseases.

The development of broad-spectrum antiviral drugs can be started from two aspects: the common mechanism of viral infection and the innate immune mechanism against viral infection.

(1) There are some common mechanisms of viral infection, which can be used as the breakthrough points in the design of broad-spectrum antiviral drugs. ① Viral replication requires viral polymerase to synthesize genetic material, and the substrate recognition domain of viral polymerase is highly conserved. ② Some key proteins of viruses have conserved domains, such as hemagglutinin of influenza virus and capsid protein of coronavirus, which can be used as targets for the design of broad-spectrum antiviral drugs. ③ The new strategy to intervene in the unique mechanism of virus frameshift translation should be developed to inhibit the protein synthesis of virus.

(2) It is of great significance to strengthen the study on human innate immunity against virus infection. It is the first line of defense that the body has the ability of natural antiviral immunity before producing specific immunity (neutralizing antibody, etc.) after virus infection. The interferon production induced by virus infection could be enhanced via glycosylation regulation, which would significantly promote the elimination of virus from body. Strengthening such studies would provide effective measures for the prevention and control of emerging infectious diseases.

In conclusion, we should constantly strengthen the innovative layout and develop a new paradigm, so as to proactively construct an intelligent, efficient and characteristic system for the prevention and control of emerging infectious diseases, and build a strong shield for maintaining the national public health security and ensuring the health of the people.

(Translated by LIU R)



**ZHANG Xuemin**, corresponding author, Academician of the Chinese Academy of Sciences, Director of Department of Medical Science of the National Natural Science Foundation of China, Director of the National Center of Biomedical Analysis. He is mainly engaged in the study of anti-virus immunity, tumor, and autoimmune disease. E-mail: zhangxuemin@cashq.ac.cn