Modernising infectious disease surveillance and an early-warning system: The need for China's action

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The severe acute respiratory syndrome (SARS) outbreak in 2003 gave impetus to the establishment of an internet-based timely reporting system in China, that has improved the efficiency of the Infectious Disease Surveillance System. The re-analysis of SARS data and proposed use of hotspot mapping as a tool for early identification of outbreak area(s) for quarantine provided a rationale for locking down[1] when the coronavirus disease 2019 (COVID-19) entered Wuhan, China. The implementation of the Chinese Infectious Disease Automated-Alert and Response System since 2008 has further facilitated the timely response to disease outbreaks.[2] Although systems for reporting notifiable infectious disease have been evolving for more than 70 years,[3] the COVID-19 pandemic has once again reminded us the need for a responsive, intelligent and robust surveillance system that will rapidly provide an early warning and a timely response against unforeseen challenges. Learning and responding rapidly to emerging novel pathogens will not only benefit China but also globally.

Effort to integrate multi-channel surveillance data to form an all-in-one surveillance network

Sources of surveillance data in China come from multiple channels and includes notifiable disease surveillance, syndromic surveillance, all-cause mortality surveillance and laboratory surveillance.[4] Integrating all these data requires a joint effort of the Centre for Disease Control and Prevention (CDC) at all levels, hospitals, schools, and communities.[5] Currently, China's CDC maintains five general category surveillance systems related to infectious diseases and four specific disease surveillance systems.[5] The process of data collection is complex and fragmented. To collect data more efficiently and rapidly so that data are readily examinable and to reduce unnecessary duplication of reporting, there is an urgent need for integrating different surveillance systems into an all-in-one surveillance network. Such integrated network is exemplified by "EpiPulse" that was launched by the European CDC to provide a seamless access to data on a single platform.[6] An integrated monitoring network requires standardisation of data entry, development of automatic validation systems to ensure data quality and the facilitation of multi-source data fusion to reduce the number of independent systems.

To implement the aforementioned strategies would require not only the efforts of the CDC at multiple levels but also the co-operation of diverse sectors such as animal farms and wastewater surveillance for the presence of novel pathogens in humans and animals. Collating these new data with continuous surveillance would effectively bring information under an all-in-one surveillance network, a 'One-Health' approach.

Standardising and modernising surveillance and setting up early-warning systems

Our current early-warning mechanism needs to be optimised to ensure an orderly data flow which is accurate and sensitive for identifying risk factors. First, a consistent case definition of infection is a prerequisite. Improved diagnostic coincidence rates for infectious diseases will accurately identify outbreaks. For novel diseases where case definitions are not available in time, outbreaks can be sensitively detected by combining diverse surveillance indicators. Second, standardised open-source analysis tools need to be developed and applied to enhance interoperability. This will empower health personnel at all levels to make early-warnings and accelerate grassroots response. Third, an internal forum needs to be established to enhance technical exchange and experience and sharing of data among health authorities. Fourth, research on the epidemiological characteristics of diseases outbreak based on historical data could be strengthened. On this basis,

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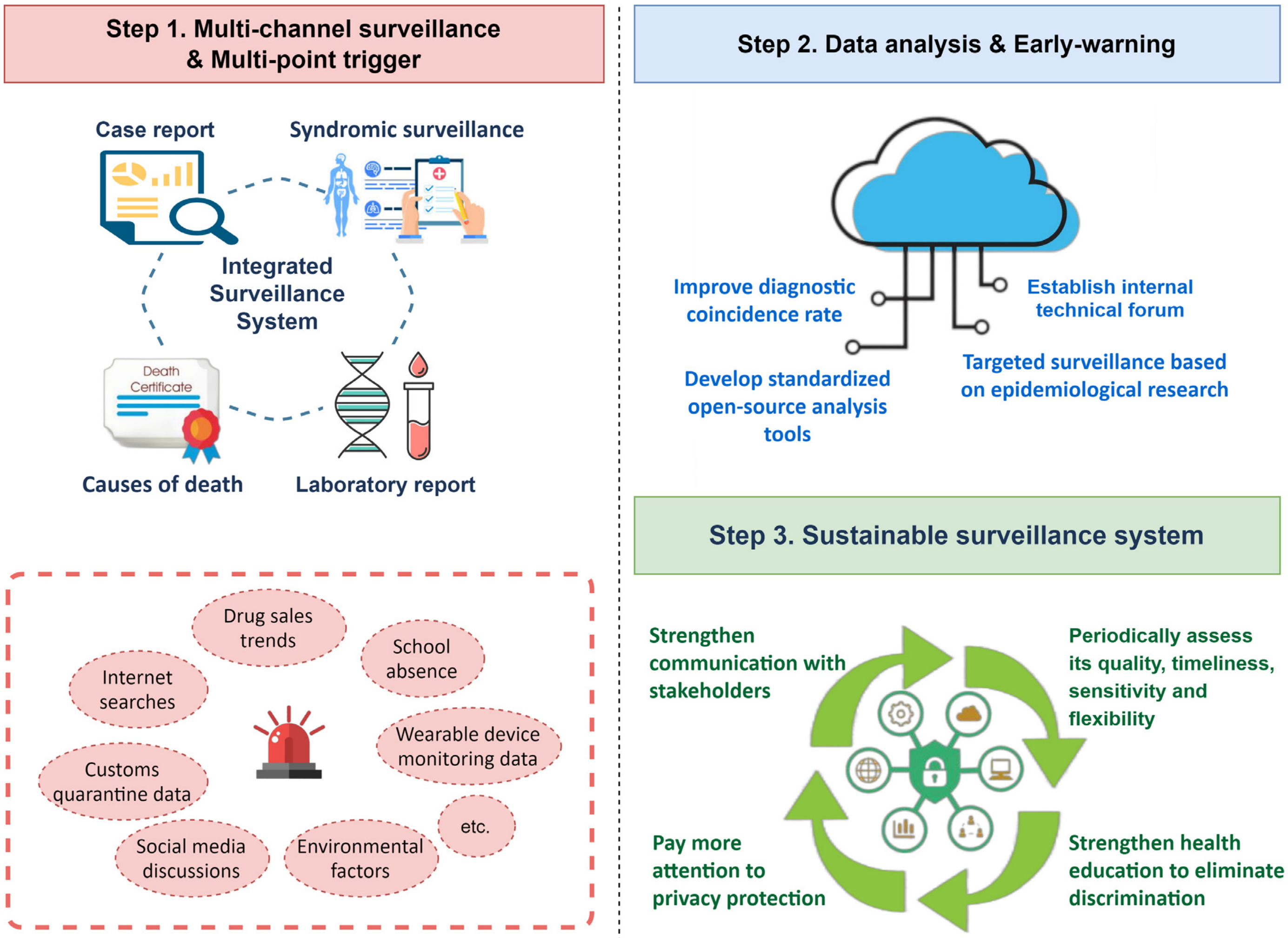

Figure 1. Illustration of modernized infectious disease surveillance and early-warning system.

targeted surveillance can be carried out for specific populations, at specific times, and in specific areas.

Optimising multi-point trigger warning and response system

The current surveillance of COVID-19 in some regions in China has already applied a multi-point trigger warning system that provides an early-warning of outbreaks.[7] Diversifying trigger indicators will improve the speed and sensitivity of the identified risks and the precision of an early warning system. Furthermore, the roles of novel environmental factors, social media discussions, drug sales trends, quarantine data, and sewage analysis need to be included in identifying early cluster outbreaks.[8,9] As a new generation of information technology emerges, such as cloud computing, Internet of Things and Artificial Intelligence, there is a greater need for health authorities to strengthen cooperation with research institutions and technology companies. Furthermore, a multi-point trigger early-warning system requires the establishment of a data sharing platform that necessitates the clarification of responsibilities and the authority of relevant entities in their roles of sharing platform.

Towards a sustainable surveillance network

The maintenance and improvement of the surveillance network requires massive influx of funding and many trained personnel. Therefore, the CDC is expected to communicate with stakeholders about these resources in order to sustain the continuity and growth of the country's surveillance network. In addition to publishing regular disease surveillance reports and informing policy changes, CDC is also expected to build an interactive disease surveillance visualisation platform to enhance the presentation of results. These user-participable displays facilitate the government, institutions, and the public in understanding and value the disease surveillance efforts. Moreover, the data quality, timeliness, sensitivity and flexibility of the surveillance system should be evaluated regularly to maintain stable and efficient operation. To reduce under-reporting, it is also important to pay attention to privacy protection, to strengthen health education to eliminate discrimination and to reduce the mental burden of patients with infectious diseases in seeking treatment.

Infectious disease surveillance and early-warning requires the close collaboration of the whole community. A comprehensive system will lead to efficient use of health resources, rapid decision-making, timely and accurate prevention and control as well as orderly responses to future outbreaks. Therefore, modernising our surveillance with an early-warning system will be an important undertaking in China as will also be useful for other countries, and these new surveillance techniques and responses could contribute rapidly to the improvement of global health. No country is an independent entity in a pandemic. China, as a large country with a population of 1·4 billion, has the responsibility to develop an efficient surveillance and early-warning system to protect the health of the community as well as using the surveillance system findings to communicate globally its observations (Figure 1).

Contributors

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Declaration of interests

We declare no competing interests.

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