Preplanned studies

Effectiveness of the Integrated TB Surveillance System — China, 2018–2019

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Summary

What is already known about this topic?

China's national health information system provides important support and means for deepening the country's medical and health reform, for improving relevant delivery services, for enhancing the level of scientific management of health, and for promoting the goal of basic medical and health services for everyone in China.

What is added by this report?

To further the construction of the national health information system, the National Center for Tuberculosis Control and Prevention of China CDC, started a pilot project for a new tuberculosis (TB) integrated health (iHealth) surveillance system, which was integrated with regional health information platforms. The goal was to explore automatic data exchange between hospitals and disease control facilities to reduce the workload of data-entry.

What are the implications for public health practice?

This pilot proved that data sharing and automatic exchanges between different information systems can be achieved through a unified surveillance dataset, which could provide a reference point for the construction of surveillance systems for other infectious diseases or for the entire public health information system.

In 2005, China launched an electronic Tuberculosis Information Management System (TBIMS), which was the largest in the world. All TB dispensaries across the country now enter TB case information into the system via the internet in real time (*1*).

In November 2011, the General Office of the State Council issued the *National TB Control Program* (*2011 to 2015*), which requires that, in principle, each county in China should designate at least one hospital to diagnose, treat, and register TB patients. In June 2012, the former Ministry of Health and the State Administration of Traditional Chinese Medicine issued the *Guiding Opinions on Strengthening the Construction of Health Information System*, which clarifies the overall framework, basic principles, work goals, key tasks, and safeguard measures of the health information system.

By the end of 2012, 48% of health facilities nationwide had built electronic medical record systems (*2*), but could not exchange data with the TBIMS. All the surveillance data related to TB need to be re-entered into TBIMS, although these data were already electronically stored in the hospital information system. In November 2016, the National Development and Reform Commission issued the *National Health Security Project Construction Plan*, which required data aggregation and business collaboration of six major business application systems including public health. By the end of 2017, more than 75% of secondary public hospitals had established electronic medical record systems, and the overall information construction situation of China's secondary and higher medical institutions has improved (*3*).

TBIMS serves as the main data source to evaluate the implementation of the National TB Control Program. Yet with advancements in information technology, changes to TB service delivery, and the requirements of the national health information system, it was necessary to develop a new TB surveillance system. The National Health Commission of China-Bill & Melinda Gates Foundation TB Collaboration project organized a pilot of a new TB surveillance system from 2016 to 2019. The system was designed to be applicable to the current state of TB control and prevention and to be able to exchange data automatically with regional health information platforms.

The pilot first developed a unified TB surveillance dataset and data exchange interface specifications. China CDC then developed the new TB surveillance system, and the pilot areas accordingly upgraded their local hospital information systems and regional health

information platforms. With these processes and systems in place, the pilot achieved automatic data exchange and sharing between the various platforms—a requirement of the national health information system construction. The pilot further aimed to provide experience and lessons learned that could be used to build infectious disease surveillance models for other diseases or for an entire public health information system.

According to the characteristics of China's TB service delivery models, the pilot project selected one health facility each from the eastern, central, and western regions of China. The eastern region chose the Central Hospital of Huzhou City in Zhejiang Province as a designated hospital model; the central region chose the TB dispensary of Jilin City in Jilin Province as an independent TB dispensary model; and the western region chose the Fourth People's Hospital of Ningxia Hui Autonomous Region as an integrated model.

The pilot first unified the standards for TB surveillance datasets (Figure 1), which included basic information, physical examination screening history, medical history/disease, epidemiological investigation history, and so on. All the collected information was transformed into an electronic disease record (EDR) with the patient ID at its core, thereby making data exchange and full lifecycle monitoring possible. In the process of data exchange, unsuccessful exchanges and data inconsistencies were analyzed and corrected in real time. Moreover, the function of data extraction and collation of hospital information systems was improved constantly and so was data verification and logical checking of national and regional health information. The goal was to reduce the data entry burden of medical staff and ultimately improve the timeliness and accuracy of surveillance data.

After preparing for national system development and regional system upgrade, the pilot officially started in July 2018 and ended in June 2019. During the pilot period, each region automatically uploaded relevant data of TB patients to the new national TB surveillance system through the regional health information platform. According to the requirements, the infectious disease report card and medical record information of TB patients were entered into the National Notifiable Disease Reporting System (NNDRS) and TBIMS respectively. Three indicators were analyzed for each pilot area during the pilot period.

The three indicators—data exchange rate, infectious disease report card filing rate, and medical record filing rate—have all improved, reaching 95% and above by June 2019, with some indicators approaching or reaching 100% (Figure 2).

Discussion

In the early stages of the pilot, due to certain problems in the upgrade and reconstruction of the hospital information system, the lack of mastery of the new system by medical staff, and the unstable exchange link between the national system and the regional health platforms, the data quality was lacking. For example, the patient registration number is required to have a length of 21 digits. If the length of the uploaded data from each region is not exactly 21 digits, the upload will fail, the percentage of TB patients records successfully transmitted to the new system will be reduced; the patient ID number in the new system was required, while in the old system it was an optional

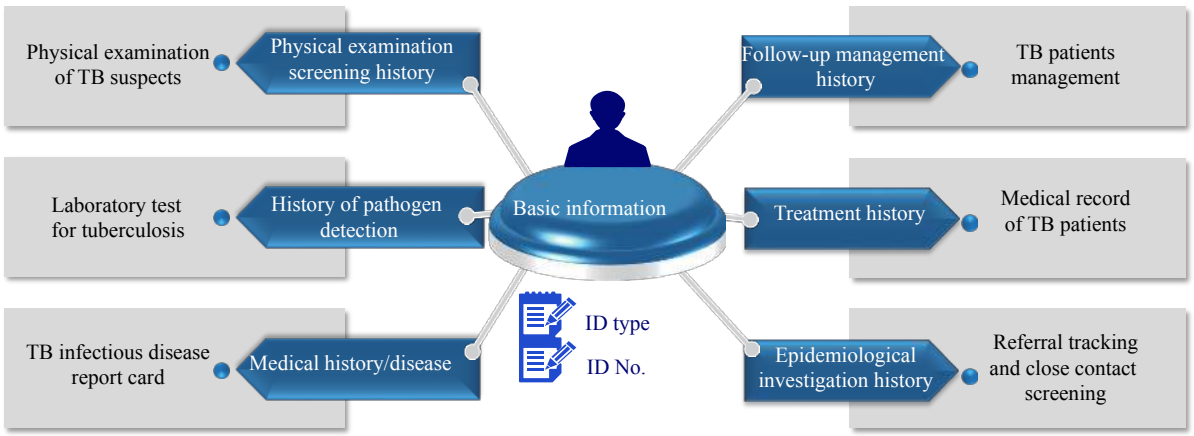

FIGURE 1. Tuberculosis (TB) surveillance dataset used for national and regional systems.

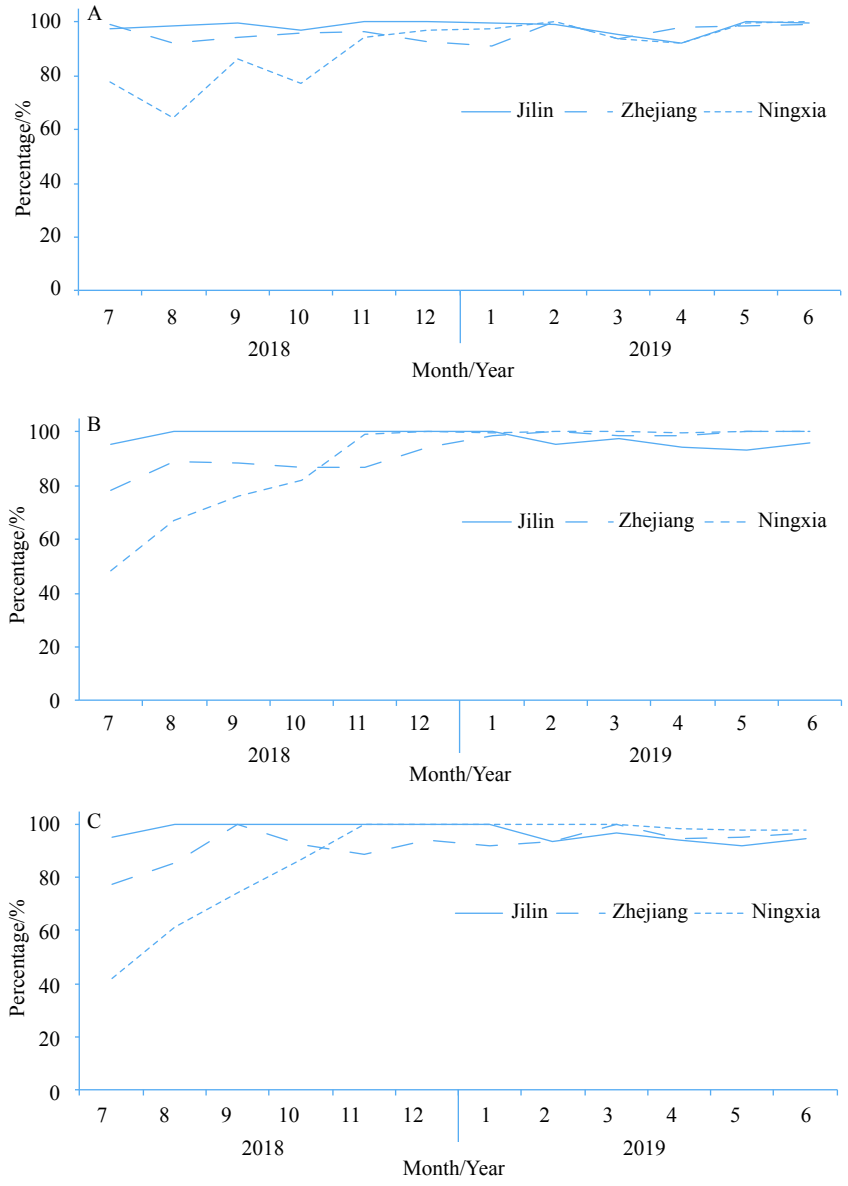

FIGURE 2. Pilot result of the new Tuberculosis (TB) integrated health surveillance system, three regions, 2018–2019. (A) Percentage of TB patients records successfully transmitted from regional health information platform to new national TB surveillance system; (B) Percentage of TB infectious disease report cards reported from National Notifiable Disease Reporting System (NNDRS) to new national TB surveillance system; (C) Percentage of TB medical records registered from TBIMS to new national TB surveillance system.

item and medical staff often didn't enter the ID number, which resulted in inconsistent matching when comparing the data records of the two systems and lower percentages of infectious report card and medical record at the beginning of operation. After discovering these problems, a data verification mechanism was developed at the national level, and records of exchange failures and records of inconsistent matching between systems were sent back to the pilot areas for verification. The pilot areas reported the reasons and solutions to the national level on a weekly basis. With continuous resolution of the problems found during monitoring, continuous improvement of information systems, and continuous improvement of data exchange links, the quality of the pilot data became better and more stable. The data quality of Jilin has, from the beginning, been better than the other two regions. One of the reasons may be that Jilin developed a new system according to the requirements of surveillance data sets and exchange specifications, while Zhejiang and Ningxia upgraded existing systems.

In this new era of big data, technologies such as the

Internet of Things and cloud computing have stepped onto the stage (*4*). Upgrade of China's medical and health information system also faces more expectations of the people, higher policy requirements, more complex construction requirements, and faster technological evolution. This sets up an urgent need to organize the information system development of the medical and health field in various stages, summarize and refine the development characteristics, and further improve the overall design (*5*). This pilot proved the design concept of case-based, lifecycle disease monitoring system with a unified surveillance dataset, which could realize automatic data exchanging, sharing among different information systems, and eradicating data islands. This pilot also could provide a reference point for the construction of surveillance systems for other infectious disease or for the entire public health information system.

This article mainly discusses the feasibility of data exchange between information systems and does not analyze the sensitivity and quality of surveillance data. The main challenge for this pilot is whether the software engineers can fully and correctly understand the surveillance dataset and upgrade the hospital information system accordingly to retrieve all the data as required. To overcome these challenges, training for engineers must be adequate and comprehensive discussions with medical staff must be held.

This study is subject to a few limitations. The pilot was implemented in three areas, and the new national TB surveillance system only exchanged data with three regional health information platforms. Given the complexity and difference of regional health information platform in China, there may be problems in exchanging data with other regional health information platforms, which need to be studied in the future.

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References

1. Huang F, Cheng SM, Du X, Chen W, Scano F, Falzon D, et al. Electronic recording and reporting system for tuberculosis in China: experience and opportunities. J Am Med Inform Assoc 2014;21(5):938 – 41. http://dx.doi.org/10.1136/amiajnl-2013-002001.
2. Liu XQ, Hua YL, Xue CB. Preliminary analysis of the development course on Hospital Informatization in China. Chin J Health Inform Manage 2016;13(2):142 – 52. http://dx.doi.org/10.3969/j.issn.1672-5166.2016.02.08. (In Chinese).
3. Preparation Committee of China Medical Reform Development Report of Chinese Academy of Medical Sciences. China medical reform development report (2016). Beijing: China Union Medical College Press. 2017. (In Chinese).
4. Hu HP, Xie LQ, Chen QK, Gao X, Pi YQ, Dai T. Analysis and measurement of China's Population Health Informatization development strategy. Stud Health Technol Inform 2019;264:1388 – 92. http://dx.doi.org/10.3233/SHTI190455.
5. Zhou GH, Xu XD, Hu JP. Health informatization: development, characteristics and prospects. Chin J Health Inform Manage 2019;16 (4):384 – 8, 394. http://dx.doi.org/10.3969/j.issn.1672-5166.2019.04.01. (In Chinese).