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Short communication

Immunization information system status in China, 2017

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ABSTRACT

Immunization Information Systems (IIS) are computerized population-based systems with individual-level vaccination-related information used to help ensure protection from vaccine preventable diseases. The Chinese Center for Diseases Control and Prevention (China CDC) conducted a survey of the 32 mainland China provincial CDCs to determine IIS coverage and implementation of key functions: individual vaccination records, vaccine management, cold-chain management, and school entry vaccination status verification. Twenty-seven IISs collectively managed 252 million immunization records, 43.8% for children under 6 years; 20 could exchange records with other IISs. The within-province duplicate-record rate varied from 0.3% to 4.0%, but compared with National Statistical Bureau's census estimates, 138.0% of births from 2012 to 2017 were represented in the IISs, implying significant across-province record duplication. China CDC should consider developing a national-level IIS center for data exchange and analysis.

1. Introduction

Immunization Information Systems (IIS) are confidential, computerized population based-systems that collect and manage vaccination information [1]. IISs can help ensure that individuals are vaccinated and can estimate vaccination coverage at population levels to guide immunization programs [2]. IISs can provide denominators for vaccine safety and effectiveness evaluation, and provide useful information to public health authorities, vaccine providers, and vaccine recipients [3].

China's annual birth cohort of 16 million requires administration of over 500 million vaccine doses annually [4]. A two-child per family policy replaced the one-child policy in 2016, increasing the birth rate: 12.95‰ in 2016 compared with 12.07‰ in 2015 [5]. Provincial CDCs started developing IISs in 2004 [6]. Most IISs use a clinic-based client application and a web-based management platform in the provincial CDC. Client application functions include vaccination record-keeping and forecast-based appointment management. Providers in clinics have access to searching and statistical analyses. Web-based platforms used in county, prefecture, and provincial CDCs enable exchange of data, including vaccination data on the floating (migrant) population. Most CDC web-based platforms have vaccine management functions for cold chain, delivery, and storage, including inventory and shipping transactions and make and model of refrigerator.

Vaccination data are entered by nurses through client application software. Children have unique identifiers allocated by the client software, consisting of an 18-digit number: a 10-digit clinic identifier, 4-digit number for the birth year, and a 4-digit serial number. This identifier is used nationally throughout the IIS systems. Information stored in the client application is uploaded to the web-based management platform in real time or periodically.

In 2017, we surveyed provinces on the functional status of their IIS and obtained analyses of provincial IIS records of children born between 2012 and 2017 for assessment of duplicate records. The survey included 32 CDCs (including Xinjiang Corps, but not including Taiwan, Hong Kong, and Macao); all responded. Core functions of IIS included vaccination record keeping, vaccine management, cold-chain management, and school entry immunization status verification. We determined the number of children's records uploaded to the provincial platform and assessed duplicate record rates. Duplicate records were determined using name, birth date, and birth place; mother's name and phone number were used as supplementary information for de-duplication when necessary. We used census-based total population and birth rates to estimate birth cohort sizes, which served as denominators for assessing inter-provincial duplicate record rates.

2. Results

At the end of 2017, 27 provincial CDCs operated IISs and two are developing IISs. All operating IISs function as individual-level immunization registries, recording personal-identifying and vaccination information, serving as an official medical record. Eighteen

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IISs had vaccine management functions, 14 had cold-chain management functions, and 13 conducted school entry vaccination record checks. Twenty IISs were able to exchange individual-level vaccination data, 13 exchanged vaccine management information, 18 contained birth hospital vaccinations, and 6 exchanged data with other electronic health records (Fig. 1).

The 27 IISs managed 252 million individuals' immunization records, of which 43.8% were of children under 6 years. Among these, 2.4% were within-province duplicates: 4.0% in eastern provinces, 0.3% middle, and 2.5% western. Using National Statistical Bureau denominators, 138.0% of births between 2012 and 2017 were captured in the IISs (Fig. 2).

3. Discussion

This survey provides information on IIS implement and system functionalities in mainland China. Most provinces have an IIS capable of managing 4 core functions: official record keeping, immunization status verification for school entry, and management of vaccines and cold-chain. Some IISs were able to exchange data on vaccine management, birth hospital, and electronic medical records. The IISs were managing 252 million individuals' vaccination records.

In 1978, China established the Expanded Program on Immunization (EPI), which currently includes 14 vaccines against 15 vaccine preventable diseases [7]. Originally, doses-administered data were reported monthly from clinics to county CDCs, which reported aggregate data to municipal, provincial, and national CDCs for estimating vaccination coverage [8]. This paper-based data collection method was inefficient and had significant limitations, including a lack of information about manufacture and vaccine lot and an inability to conduct fine-grained coverage assessments. IISs were viewed as an advanced way to manage the national immunization program with near-real-time data availability.

The 27 functioning IISs are able to provide numerators for vaccination coverage estimation, making it possible to identify areas with low vaccine uptake. Zhejiang provincial IIS, as an example,

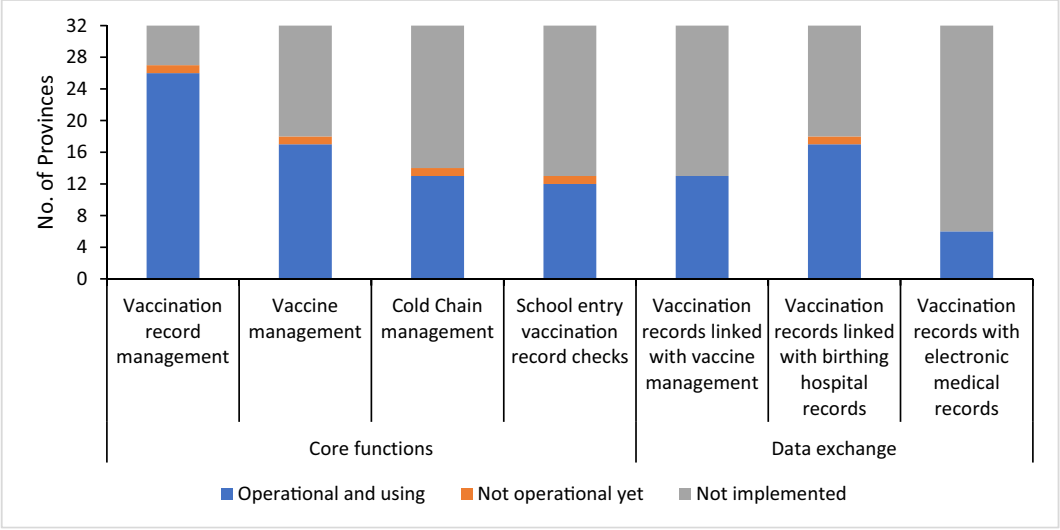

Fig. 1. Number of provinces with core functions and data exchange capabilities.

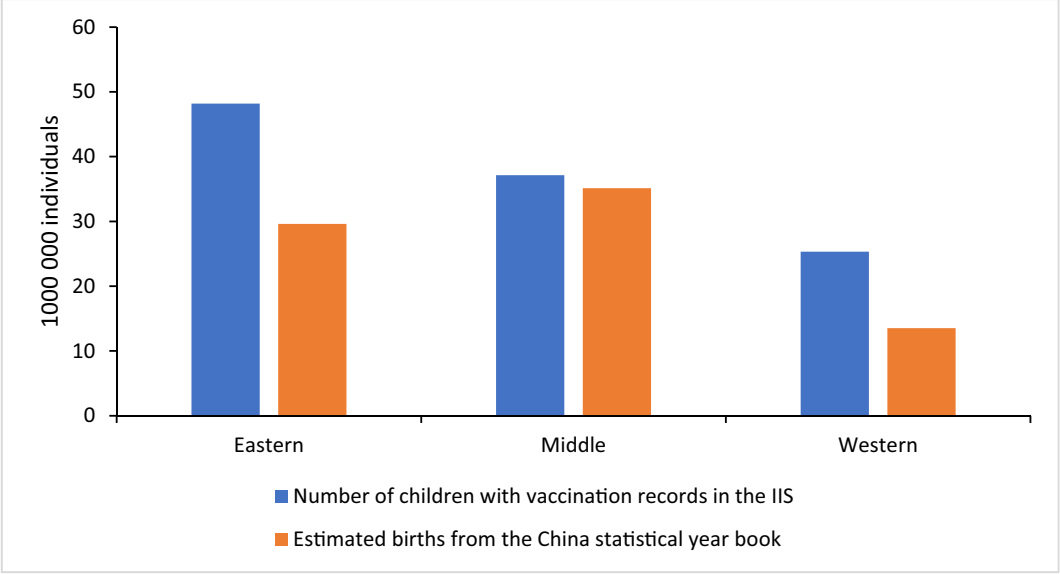

Fig. 2. . Number of children registered in an IIS compared with the number of children born, by region.

recorded vaccination data on more than 3 million children, 40.7% of which were migrant children [6]. This IIS showed that vaccination coverage of infants exceeded 90%, but coverage >12 months was lower and varied by municipality.

We obtained information on duplicate records, an important data quality indicator [9]. China has several migration patterns – within village, county, prefecture, province, and across provinces. All vaccination occurs in clinics managed by county governments, and record duplication could happen at any level. We found an average of 3% duplicate records within provinces, and that duplicated record rates were higher in the eastern region than the western region. Since there is no national IIS platform, we could not calculate an exact number of nation-wide duplicates, but using census-estimated birth cohorts as denominators, our record-to-denominator rate was 138%, compared with the United States lower duplication rate of 106% [9]. Beside of the duplicated cases, the annual denominators from census projections may be imprecise, because the census data, the birth indicators, and/or the migration data may be outdated [10].

Exchange of information is useful for integration of public health systems. Half of the IISs could verify vaccination status for school entry, important for ensuring completion of vaccination prior to school entry. Linking IIS data with birth hospital data is an important entryway into the immunization system so that children's vaccinations can be managed by clinics. Based on the Analysis Report of National Health Services Survey in China, 2013 [11], China's hospital delivery rate is 96.3%, indicating that the vast majority of birth can be captured by hospital obstetrics departments.

We found that 13 provinces have bidirectional exchange of vaccine management and immunization record data. Linking vaccines distributed to provinces with IIS records may be able to minimize data entry errors [2]. Vaccine and cold chain management functions facilitate supervision of vaccine supply, including security of the vaccine. In 2016, the State Council required exploration of a vaccine traceability system integrated with IISs.

Our findings are subject to limitations. First, self-administered reports were used in our survey, with potential for response bias. Second, only a subset of IIS functionality was including in the survey. Third, individual-level data were not collected by China CDC, precluding evaluation of nationally-representative immunization coverage levels. For denominators, we used annual census population data and birth rates measure from the National Statistical Bureau which may be imprecise.

This was the first national-level survey on IIS functionality in mainland China and will serve as a baseline for assessing progress in IIS development. Through the survey, it could give a demonstration on the IIS development in such a populous county and adding valuable experience for global IIS development. To ensure enrollment of migrant children, minimized duplicated records, and improve data quality, China should consider developing a national center for IIS data. China is developing a universal electronic medical record system, which will ultimately include IIS data. Integrating IIS data with the universal medical record will enable new functions such as active vaccine safety monitoring.

Brief description

This survey provides information on IIS implement and system functionalities in mainland China. Most provinces have an IIS capable of managing 4 core functions. Some IISs were able to exchange data on vaccine management, birth hospital, and electronic medical records. The IISs were managing 252 million individuals' vaccination records.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

[1] CDC. Progress in immunization information systems—United States, 2012. MMWR Morb Mortal Wkly Rep 2013;62:1005–8.
[2] Martin Daniel W, Elaine Lowery N, Brand Bill, et al. Immunization information systems: a decade of progress in law and policy. J Public Health Manag Pract 2015;21(3):296–303.
[3] Derrough T, Olsson K, Gianfredi V, et al. Immunization information systems-useful tools for monitoring vaccination programmes in EU/EEA countries, 2016. Eurosurveillance 2017;22(17). https://doi.org/10.2807/1560-7917.pii=30519.
[4] Guo B, Andrew Page, Wang H, et al. Systematic review of reporting ratesof adverse events following immunization: an international comparison of post-marketing surveillance programs with reference to China. Vaccine 2013;31:603–17.
[5] National Bureau of Statistics of the People's Republic of China. Annual data on birth rates. http://data.stats.gov.cn/easyquery.htm?cn=C01 (accessed on 05-06-2018).
[6] Li Qian, Hu Yu, Zhong Yanpeng, et al. Using the immunization information system to determine vaccination coverage rates among children aged 1–7 years: a report from Zhejiang province, China. Int J Environ, Res Public Health 2014;11:2713–28.
[7] Zheng J-S, Zhou Y-Q, Wang H-Q, et al. The role of the China Experts Advisory Committee on Immunization Program. Vaccine 2010;28(S1):84–7.
[8] National Health Commission of the People's Republic of China. Standard operation of vaccination and immunization; 2016.
[9] Murthy Neil, Rodgers Loren, Pabst Laura, et al. Progress in children vaccination data in immunization information systems – United States, 2013–2016. MMWR Morb Mortal Wkly Rep 2017;66(43):1178–81.
[10] Ronveaux O, Arreta F, Curto S, Laurani H, Danovaro-Holliday MC. Assessment of the quality of immunization data produced by the national individual registration system in Uruguay, 2006. Rev Panam Salud Publica 2009;26(2):153–60.
[11] Center for Health Statistics and Information, NHFPC. An Analysis Report of National Health Services Survey in China, 2013; 2015.1.5. Beijing.