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September 21, 2020

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Announcements

The 27th World Alzheimer's Day — September 21, 2020

Alzheimer's disease (AD) is a common chronic progressive neurodegenerative disorder among the elderly. It was first described by Alois Alzheimer in 1906 for a patient he first encountered in 1901 (*1*). As the most common form of dementia, it affects 3.21% of the population over the age of 65 years old in China (*2*). The number of people affected by the disease is expected to increase dramatically as it devastates families and communities and is one of the costliest chronic conditions to manage (*3*).

World Alzheimer's Day was launched by Alzheimer's Disease International (ADI) on September 21, 1994, and then September was designated as World Alzheimer's Month in 2012 (*4*). World Alzheimer's Day and Month have become global efforts to raise awareness and challenge the stigma that surrounds dementia.

The theme of this year's campaign — "Let's talk about dementia" — is especially important as the coronavirus disease 2019 (COVID-19) pandemic has led to extremely high death rates amongst people with dementia globally (*5*).

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Preplanned Studies

Undetected Dementia in Community-Dwelling Older People — 6 Provincial-Level Administrative Divisions, China, 2015–2016

Shige Qi[1]; Han Zhang[1]; Haoyan Guo[1]; Jing Wu[1]; Zhihui Wang[1,#]

Summary

What is already known about this topic?

Dementia affects approximately 5.3% of the population aged over 60 years in China — an estimated more than 10 million elderly people. Many older adults living with dementia have not been formally diagnosed, and a previous study found a peak of 93.1% of dementia patients during 2007–2011 remained undetected.

What is added by this report?

The latest undetected dementia rate and differences between urban and rural areas were estimated in this study based on a large nationwide study carried out in China in 2015–2016. The overall proportion of undetected dementia was 85.8%, 75.0% in males, 90.4% in females, 77.5% in urban residents, and 93.5% in rural residents.

What are the implications for public health practice?

Efforts should be made to increase the awareness of dementia in the public, to improve the capacity of early recognition of dementia by primary care physicians in community settings, and also to improve the local diagnostic capability of dementia.

Dementia is a leading cause of disability in people older than 65 years old worldwide, and dementia patients in China account for approximately 25% of all patients with dementia worldwide (*1*). According to a previous study, 93.1% of dementia was undetected (*2*). In order to understand the latest proportion of undetected dementia in China, data from the Prevention and Intervention on Neurodegenerative Disease for Elderly in China (PINDEC) study was analyzed, and the proportion of undetected dementia was estimated using questionnaire-based interviews and a standard procedure of dementia screening and diagnosis. The differences of undetected dementia between demographic and geographic subgroups were analyzed via chi-squared test. This study reported that the proportion of undetected dementia declined from the past but remained at a high level among the elderly in China, especially among those whom were female (compared to male), resided in rural areas (compared to urban), were aged <75 years (compared to other age groups), and were illiterate (compared to literate). Awareness of dementia should be increased in the general public to improve the capacity of early recognition of dementia by primary medical doctors in the community setting and also to improve the local diagnostic capability of dementia.

Dementia is a chronic disease with progressive deterioration in activities of daily living (ADLs), cognition, and behavior leading to severe disability and ultimately death (*3*). Globally, dementia is one of the most prevalent neurological disorders and accounts for the fourth largest loss of disability-adjusted life years (DALYs) and the second largest proportion of deaths among all neurological disorders (*4*). A recent meta-analysis reported an overall prevalence of dementia of 5.30% for the Chinese population aged 60 years and above in 2018 (*5*); this would be an estimated 10 million elderly people affected by dementia in 2019 based on the number of elderly people in China. In recent years, measures including policy initiatives, health education, and training programs were conducted to improve dementia screening and diagnosis, but little is known about the latest proportion of undetected dementia, especially differences between residents of urban and rural areas.

All patients were from the PINDEC study that was initiated in 2015 aiming to understand the epidemiology of neurodegenerative diseases and associated risk factors among the population aged 60 years and above in China. We used multistage clustered sampling to select the study sample based on geographic location, population size, and level of economic development. The selected provincial-level administrative divisions (PLADs) included Beijing, Shanghai, Hubei, Sichuan, Guangxi, and Yunnan. Within each PLAD, one urban district and one rural county were randomly selected as study sites (counties/districts). Within each site, one subdistrict in urban areas and one township in rural areas were selected with probability proportional to size. Within each subdistrict or township, four to eight neighborhood communities or administrative villages were selected with probability proportional to size. Within each neighborhood community or administrative village, 100 to 200 households with people aged 60 years and above were randomly selected as study households. In the final stage, all family members aged 60 years and above who have a registered Hukou (household registration) and lived in the household for more than one year were selected as study participants. A total of 26,164 people were selected and 24,117 participated in the survey. In 2015–2016, 24,117 community residents participated in questionnaire-based interviews and a procedure of dementia screening and diagnosis. The study was approved by the Ethical Committee of the National Center for Chronic and Non-Communicable Disease Control and Prevention, China CDC. All participants provided written informed consent.

Dementia was assessed using a three-stage approach. All participants were first screened with a Chinese version of the Ascertain Dementia 8 (AD8) (*6*). Participants with AD8 score ≥2 were then assessed with the Mini-Mental State Examination (MMSE) and cognitive impairment was defined as MMSE ≤17 for illiterate participants, ≤20 for those with primary school education and below, and ≤24 for those with junior high school education and above (*7*–*8*). In the final stage, all participants with cognitive impairment underwent a thorough clinical examination by neurologists. Dementia was diagnosed based on the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (*9*).

Descriptive statistical analyses of different undetected dementia were performed for gender, age, and area type (urban/rural) by using software SAS (version 9.4; SAS Institute, Inc. Cary, NC, USA). Chi-squared tests were adopted to analyze the differences of undetected dementia between subgroups, with a *p*-value of <0.05 considered statistically significant. Patients with undetected dementia were defined as those who were diagnosed in the survey but did not have doctor-diagnosed dementia before.

The characteristics of study participants were presented in Table 1. Among the 24,117 participants in the survey aged 60 years and above, 44.5% were men, 53.7% resided in urban areas, 22.8% were widowed, and 11.7% were living alone. Among 24,117 participants, we diagnosed 740 (3.1%) as having dementia. Among those detected, there were 105 (14.2%) patients who had doctor-diagnosed dementia before. The overall proportion of undetected dementia was 85.8% (95% CI: 83.3%–88.3%), 75.0% (95% CI: 69.2%–80.8%) in men, and 90.4% (95% CI:

TABLE 1. General characteristics of the study sample from the Prevention and Intervention on Neurodegenerative Disease for Elderly in China (PINDEC) conducted in 6 provincial-level administrative divisions, 2015–2016.

Characteristics	Number of participants (n=24,117)	Proportion (%)
Location		
Urban	12,950	53.7
Rural	11,167	46.3
Sex		
Men	10,722	44.5
Women	13,395	55.5
Age group (years old)		
60–64	5,346	22.2
65–69	7,033	29.2
70–74	5,076	21.0
75–79	3,639	15.1
≥80	3,023	12.5
Marital status		
Non-widowed	18,613	77.2
Widowed	5,504	22.8
Education		
Illiterate	9,376	38.9
Primary school	7,652	31.7
Junior high school and above	7,089	29.4
Living status		
Alone	2,824	11.7
With family	21,293	88.3

Abbreviation: n=number.

87.8%–92.9%) in women. The proportion of undetected dementia was higher in the group aged 70–74 years than the other age groups, higher in widowed participants than non-widowed, higher in people living alone than living with families (Table 2).

The proportion of undetected dementia in rural populations was significantly higher than that in urban populations (93.5% *vs.* 77.5%, p<0.001). In urban areas, the proportion of undetected dementia increased with age before 75 years but decreased with age after 75 years (p=0.011) and was higher in widowed participants than non-widowed (p<0.001). However, no age group and marital status differences were found among rural residents (p=0.332 and p=0.068, respectively). In addition, both in rural and urban areas, the proportion of undetected dementia was higher in illiterate groups than literate groups. (Table 2).

DISCUSSION

This study showed that older adults in China had a high level of undetected dementia, especially among females (compared to males), rural residents (compared to urban), age <75 years (compared to other age groups), and illiterate people (compared to literate). The overall proportion of undetected dementia was 85.8%, which was much higher than the world average and some developed countries. Systematic research was conducted until October 2016 for studies reporting the proportion of undetected dementia in either the community or in residential care settings worldwide and found that the pooled rate of undetected dementia was 61.7% (*10*). Amjad et al. estimated that about 58.7% of older adults with probable dementia were undetected in the US (*11*). The World Health Organization's (WHO) *Global action plan on the public health response to dementia 2017–2025* set out a target for countries: "in at least 50% of countries, as a minimum, 50% of the estimated number of people with dementia are diagnosed by 2025" (*12*).

This study showed progress in China toward this goal. According to a previous study with a sample of 7,072 participants aged ≥60 years in 6 PLADs during 2007–2011, a peak of 93.1% of dementia patients were undetected (*2*). An explanation for the recent decline to 85.8% found in this study may be due to general improvements of socioeconomic conditions and health services, such as medical insurance coverage, the establishment of memory clinics, and the increased education level of the public.

This study found that an increased risk of having undetected dementia was strongly associated with low socioeconomic factors such as residing in rural areas, having lower levels of education, and being windowed, which was consistent with previous studies (*2*,*11*) and may be due to the lack of healthcare, poor health awareness, and health insurance coverage. This study also found that women had a higher proportion of undetected dementia than men, which is consistent with a previous study in China but was different from the US (*11*). Gaps still existed in dementia diagnosis in rural and urban areas with 93.5% of patients being undetected in rural areas and 77.5% being undetected in urban. This might be due to rural elderly residents having lower awareness and worse medical conditions when compared to urban residents or due to the higher prevalence of dementia in rural areas than in urban areas (*13*). This study also found that in urban areas, the proportion of undetected dementia increased with

TABLE 2. Numbers and proportions of undetected dementia by basic characteristics among the elderly (aged ≥60 years) from the Prevention and Intervention on Neurodegenerative Disease for the Elderly in China (PINDEC) conducted in 6 provincial-level administrative divisions, 2015–2016.

Characteristics	n (%)	Overall			Urban			Rural		
		Number	Proportion (%) (95% CI)	*p*-value	Number	Proportion (%) (95% CI)	*p*-value	Number	Proportion (%) (95% CI)	*p*-value
Sex				<0.001			0.004			<0.001
Men	220(29.7)	165	75.0(69.2−80.8)		93	69.4(61.5−77.3)		72	83.7(75.8−91.7)	
Women	520(70.3)	470	90.4(87.8−92.9)		183	82.4(77.4−87.5)		287	96.3(94.2−98.5)	
Age group (years old)				0.030			0.011			0.332
60–64	73(9.9)	61	83.6(74.9−92.3)		22	78.6(62.4−94.8)		39	86.7(76.3−97.0)	
65–69	129(17.4)	115	89.1(83.7−94.6)		56	84.8(76−93.7)		59	93.7(87.5−99.8)	
70–74	130(17.6)	122	93.8(89.7−98.0)		53	91.4(83.9−98.8)		69	95.8(91.1−100.6)	
75–79	188(25.4)	158	84.0(78.8−89.3)		66	71.7(62.4−81.1)		92	95.8(91.8−99.9)	
≥80	220(29.7)	179	81.4(76.2−86.5)		79	70.5(62.0−79.1)		100	92.6(87.6−97.6)	
Marital status				<0.001			<0.001			0.068
Non-widowed	485(65.5)	393	81.0(77.5−84.5)		187	71.9(66.4−77.4)		206	91.6(87.9−95.2)	
Widowed	255(34.5)	242	94.9(92.2−97.6)		89	92.7(87.4−98.0)		153	96.2(93.2−99.2)	
Education				<0.001			<0.001			0.001
Illiterate	454(61.4)	430	94.7(92.6−96.8)		138	92.0(87.6−96.4)		292	96.1(93.9−98.3)	
Primary school	157(21.2)	115	73.2(66.2−80.2)		66	68.0(58.6−77.5)		49	81.7(71.6−91.7)	
Junior high school and above	129(17.4)	90	69.8(61.7−77.8)		72	66.1(57.0−75.1)		18	90.0(75.6−104.4)	
Living status				0.043			0.116			0.815
Alone	129(17.4)	118	91.5(86.6−96.4)		39	86.7(76.3−97.0)		79	94.0(88.9−99.2)	
With family	611(82.6)	517	84.6(81.7−87.5)		237	76.2(71.4−81.0)		280	93.3(90.5−96.2)	
Overall	740(100.0)	635	85.8(83.3−88.3)		276	77.5(73.2−81.9)		359	93.5(91.0−96.0)	

Abbreviation: CI=confidence interval.

age before 75 years but decreased with age after 75 years. People with dementia before the age of 75 may have mild symptoms, which is considered normal aging, or, because of stigma, they might not want a dementia diagnosis while they can live without help.

Detecting people living with dementia is crucial for necessary care and treatment. Early diagnosis allows for advanced-care planning and improves prognosis (*2*). However, there are many factors that affected the accurate diagnosis of dementia such as the following: a shortage of dementia specialists; the stigma associated with dementia; inconsistent versions or cutoff scores for neuropsychological tests; the costs of certain advanced techniques to assist with the diagnosis, such as positron emission tomography (PET), which are not fully covered by health insurance; the refusal by patients and their families of invasive diagnostic examinations such as lumbar puncture and brain pathological examinations; lack of regular screening programs in community settings; and an low awareness of dementia (*1*,*14*–*15*).

This study was subject to some limitations. First, the proportion of undetected dementia among community-dwelling older people might be overestimated because patients with dementia living in hospitals or private nursing institutions were not included in this study. Second, the data for undiagnosed dementia for each type cannot be distinguished in this study, because the types of dementia were not subdivided in the diagnostic stage. Furthermore, this study was conducted not for the purpose of identifying the knowledge, attitudes, and practice of screening and early diagnosis of dementia in primary care and cannot offer information for the examination of factors affecting accessibility to diagnosis.

In conclusion, this study represents the most up-to-date data with a relatively large sample size and standard diagnostic criteria to estimate the proportion of undetected dementia (85.8%) in China. Despite improved access to health services, inadequate diagnosis and management for dementia is still common, particularly in rural areas. Efforts should be made to increase the awareness of dementia in the public, to improve the capacity of early recognition of dementia by primary care physicians in community settings, and also to improve the local diagnostic capability of dementia.

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Preplanned Studies

Two-Week Prevalence of Disease Among the Rural Elderly — 6 Provinces, China, 2018−2019

Tong Xu[1]; Hui Han[1,#]

Summary

What is already known about this topic?

As population aging becomes serious in China, the elderly health problems stand out prominently. The 2-week prevalence of the elderly is rising year by year, but it has been rarely studied for the rural seniors in the central and western China.

What is added by this report?

The 2-week prevalence rate of rural elderly in the central and western China is 28.5%, and it varies among different ethnic groups. The top prevalence is chronic diseases, and the severity of diseases is higher in female and high age group (80-year-old and over) people.

What are the implications for public health practice?

Considering the health status, health awareness and ethnic differences of the elderly in the central and western China, medical and health resources should be rationally allocated to prevent and treat chronic diseases and support differentiated health services. This is of great significance for the development of health service plan.

Population aging is a sign of human social progress and an inevitable trend of world population development (*1*). As the elderly population increases, their health problems become larger concerns to society. The 2-week prevalence of disease is a key indicator reflecting the health status and the demand for health services of the residents surveyed. In this study, the 2-week prevalence of disease among the elderly in central and western China was analyzed to provide a basis for improving the health of the elderly and the quality of health services.

Through multistage random cluster sampling, 14,656 rural elderly people aged 60 years and over in 20 project counties were selected for the survey.

The survey results revealed that the 2-week prevalence of any disease was 28.5%, and the group of disease with the highest prevalence was chronic diseases. An estimated 61.1% of the people surveyed had a chronic disease that continued during the 2-week period. The severity of disease was higher in females than males and higher in the higher age group (aged 80 years or more) than the lower age group (aged 60–79 years).

Thus, the rural elderly population's health should be protected by preventing chronic diseases and improving access to and quality of medical and health services.

This study was based upon a survey under the "Community Participation to Promote Rural Elderly Health – Phase II" project of China's National Health Commission. The survey was completed from November 2018 to January 2019 for the elderly aged 60 years and over who were capable of answering the questions on their own and with a residence history exceeding half a year. The participants were selected through multistage random cluster sampling from 130 administrative villages in 65 towns of 20 project counties. These project counties referred to poor counties with a large elderly population and a willingness to be surveyed, and 2–3 towns of each county were selected by random sampling according to the population of the county with 2 villages of each town being selected by random cluster sampling in 6 project regions [provincial-level administrative divisions (PLADs) including Yunnan Province, Xinjiang Uyghur Autonomous Region, Shanxi Province, Qinghai Province, Hubei Province, and Chongqing Municipality].

The survey consisted of face-to-face questionnaire that included two parts: general information of the respondent (e.g. demographic features, health-related conditions, etc.) and 2-week prevalence (e.g. type of 2-week prevalence of disease, onset of 2-week prevalence of disease, and severity of disease). The 2-week prevalence of disease meant that the respondent, within the 14 days before the day when he/she is surveyed: 1) had a disease and visited a medical organization for treatment; 2) had a disease and began self-treatment (e.g. self-administration of drugs, or adjuvant therapy like hot compress) instead of visiting a medical organization; or 3) had a disease and rested at home or stayed in bed for more than 1 day instead of visiting a medical organization or taking any self-treatment (*2*).

The 2-week prevalence of disease was defined as the number of persons who had a disease in the past two weeks to the total number of persons surveyed or through a second definition comparing the number person-times suffering a disease in the past two weeks to the total number of persons surveyed. The numerator using the number of persons was adopted in several previous studies and this study, and the additional numerator of person times was used for comparison with the National Health Service Survey data. In this survey, the diseases and the severity were diagnosed based on ICD-10. The types of diseases investigated were subject to the reporting of the respondents.

Statistical analyses were performed using SPSS statistical software (version 22.0, SPSS Inc, Chicago, IL, USA). The significance level was set to α = 0.05. The statistical method is the chi-square test.

The effective sample size of this survey is 14,656 persons including 7,404 males (50.5%) and 7,252 females (49.5%;) and exhibiting an average age of 69.86 ± 6.98 years old (including 8,435 persons or 57.6% of the total population aged 60 to 69 years) as shown in Table 1.

Among the 14,656 persons, the number of person-times reported to experience disease in the 2 weeks was 4,182, so the 2-week prevalence of disease was derived to be 28.5%. The number of persons who had an illness in the 2 weeks was 2,546, so the 2-week prevalence was determined to be 17.4%. Particularly, the 2-week prevalence of disease were 14.9% for males

TABLE 1. Basic information and the illnesses over the 2-week study period of the rural elderly — 6 provinces, China, 2018–2019.

Demographic characteristics	Number of surveyed	Composition ratio (%)	Number of respondents with illnesses	Prevalence (%)	χ^2	*p*
Gender					64.522	<0.001
Male	7,404	50.5	1,102	14.9		
Female	7,252	49.5	1,444	19.9		
Age (years old)					14.208	0.001
60–	8,435	57.6	1,380	16.4		
70–	4,492	30.6	839	18.7		
80–	1,729	11.8	327	18.9		
Ethnicity					372.133	<0.001
Han	3,235	22.1	612	18.9		
Uighur	5,980	40.8	815	13.6		
Tujia	2,532	17.3	470	18.6		
Kazakh	838	5.7	118	14.1		
Lahu	701	4.8	271	38.7		
Tibetan	637	4.3	60	9.4		
Other	733	5.0	200	27.3		
Educational level					111.850	<0.001
Illiterate or semiliterate	7,516	51.3	1,542	20.5		
Primary school	5,394	36.8	726	13.5		
Junior high school and above	1,746	11.9	278	15.9		
Marital status					83.967	<0.001
Unmarried/widowed/solitary	1,758	12.1	287	16.2		
Only husband and wife living together	6,566	44.8	956	14.6		
Living with children	6,322	43.1	1,303	20.6		
Total	14,656	100.0	2,546	17.4		

and 19.9% for females, and it was the highest (18.9%) in the age group of 80 years and over as shown in Table 1.

The 5 disease categories with the highest 2-week prevalence were hypertension (3.9%), common cold (2.5%), arthritis/rheumatoid (2.3%), gastroenteritis/peptic ulcer (2.1%), and asthma/bronchitis/emphysema and other lung diseases (1.6%). Among the 2,546 persons who reported an illness in the past 2 weeks, 61.1% (1,557/2,546) had a chronic disease which started before the 2 weeks but continued during this period, 25.9% (659/2,546) had an acute disease, and 13.0% (330/2,546) had an acute disease that continued in the 2-week period. See Table 2 for more details.

The severity of disease in the surveyed elderly in the 2 weeks was different between genders and between age groups. The number of sick days in the 2 weeks per 1,000 people was 1,601 days for females, which was more than the 1,176 days reported for males. The number of sick days in the 2 weeks per 1,000 people was 1,683 days for the higher age group and more than 1,253 days for the lower age group. In addition, the bedridden rate and the number of bedridden days were higher for females than for males, and higher for the higher age group than for the lower age group. See Table 3 for more details.

DISCUSSION

The 2-week prevalence was a key indicator that reflected the health status of the elderly and assessed the demand for health services. This survey revealed the 2-week prevalence of disease in elderly people aged 60 years and over in rural areas in central and western China as 28.5% (based on the number of person-times), which is lower than the 2-week prevalence rate of 45.8% in the Fifth National Health Service Survey (*2*) (p<0.05). This difference was believed to be driven by seasonal factors and the lower availability/quality of health services, weaker health awareness of residents, and other factors in central and western China (*3–4*). In view of ethnic groups, the Lahu ethnicity was discovered to have the highest 2-week prevalence of any disease, with the top 5 disease categories being gastroenteritis/peptic ulcer (101.3‰), arthritis/rheumatoid (98.4‰), common cold (74.2‰), intervertebral disc disease (54.2‰), and hypertension (22.8‰). The high prevalence of hypertension may be attributable to the dietary habits of the Lahu people, which includes a relatively high consumption of salt, such as barbecue and pickles as found in our survey. Additionally, the elderly were susceptible to colds, arthritis, and gastrointestinal diseases in the seasonal transition from autumn to winter in Yunnan Province when the survey was performed (*5*).

The disease category with the highest 2-week prevalence in the rural elderly was chronic diseases such as hypertension. Among the elderly who reported a disease in the surveyed 2 weeks, 61.1% had a chronic disease that continued in the 2-week period. This was similar to the results of most studies, indicating that chronic diseases are the major contributor to the 2-week prevalence of disease (*6–9*). However, the 2-week prevalence was low in the surveyed regions, possibly because the regions are poor rural areas in central and western China where the living standards of residents are lower and led to a lower prevalence of chronic

TABLE 2. Prevalence and composition of the survey subjects in the 2-week survey period — 6 provinces, China, 2018–2019.

Disease name	Male		Female		Total	
	Prevalence (%)	Composition ratio (%)	Prevalence (%)	Composition ratio (%)	Prevalence (%)	Composition ratio (%)
Hypertension	3.3	22.2	4.6	22.9	3.9	22.6
Cold	2.0	13.5	3.0	15.0	2.5	14.4
Arthritis/rheumatoid	1.8	12.1	2.8	14.1	2.3	13.2
Gastroenteritis/peptic ulcer	1.7	11.3	2.4	12.1	2.1	11.8
Asthma/bronchitis/emphysema and other lung diseases	1.5	10.0	1.7	8.7	1.6	9.3
Intervertebral disc disease	1.2	8.0	1.6	7.9	1.4	7.9
Heart disease/coronary heart disease	0.8	5.1	1.4	7.0	1.1	6.2
Cerebrovascular disease(including stroke)	0.6	4.2	0.5	2.7	0.6	3.3
Prostatitis, nephritis, kidney stones, cystitis	0.6	4.2	0.2	1.0	0.4	2.4
Gallstones/cholecystitis	0.3	1.8	0.5	2.6	0.4	2.2

TABLE 3. Indicators of the severity of illness in the elderly in the 2-week survey period*— 6 provinces, China, 2018–2019.

Demographic characteristics	Age group (years old)	Days of illness	Bedridden days	Bedridden rate (‰)
Male		1,176	183	30.9
	60–	1,070	151	26.5
	70–	1,261	164	31.4
	80–	1,484	365	48.6
Female		1,601	290	50.2
	60–	1,436	237	46.3
	70–	1,799	330	51.3
	80–	1,881	445	64.3
Total		1,387	236	40.3
	60–	1,253	194	36.4
	70–	1,530	247	41.6
	80–	1,683	413	57.8

* The indicators in the table are all due to illness within two weeks. Among them: the number of sick days and bedridden days are the number of sick days and bedridden days per thousand surveyed population within two weeks. Bedridden rate = number of bedridden in 2 weeks / number of surveyed × 1,000‰.

diseases (e.g. hypertension and diabetes) than urban areas and other non-poor rural areas.

The severity of disease in the elderly in the 2-week period was different between genders and between age groups. The number of sick days, bedridden rate, and bedridden days were higher for females than males ($p<0.05$), and higher for the higher age group than the lower group ($p<0.05$). Elderly people that were female and in the higher age group were more susceptible to diseases, and the elderly people at high age lived longer but were not healthy, which is consistent with findings from Shi et al (*10*). Thus, to fully reflect the health level of the rural elderly, both the occurrence and severity of disease in the elderly should be considered.

This was the first survey conducted for the 2-week prevalence of disease in the rural elderly in central and western China using a large sample size. The 2-week prevalence of disease was lower than the average derived in the National Health Service Survey, which may be related to lower health awareness and service needs of people surveyed. The indicator varied by ethnicity, gender, etc. Medical and healthcare organizations should pay more attention to the health status of key populations among the elderly through strengthening the allocation of health resources, taking preventative and treatment measures against chronic diseases, and raising the health awareness of residents to meet the real health service needs of the rural elderly in central and western China.

This study was subject to some limitations. The 2-week prevalence obtained in this survey was subject to limitations in the survey method that was time-consuming and covered a large geographical area, which may cause the results to have wide variability. In addition, because this study only covered a period of two weeks, the results may be affected by when the participants were surveyed as they could not all be recorded at the same time.

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Preplanned Studies

Dengue Fever Outbreaks Caused by Varied Serotype Dengue Virus — Guangdong Province, China, 2019

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Summary

What is already known about this topic?

Dengue fever (DF) outbreaks affect hundreds of millions of people worldwide and have increased significantly in Guangdong Province in 2019.

What is added by this report?

This paper described briefly DF outbreaks were attributed to several types of dengue virus (DENV) including DENV-1, DENV-2, and DENV-3 in 2019 in Guangdong, tracked the sources of viruses through phylogenetic analysis and epidemiological investigation, and primarily revealed the epidemiological links among the outbreaks.

What are the implications for public health practice?

The introduction of DENV from DF endemic areas increased pressure on the prevention and control of DF in Guangdong. Early detection of suspected cases and typing and genotyping of circulating viruses should be prioritized and enhanced to promptly assess the likelihood of local transmission, of introduction, and of subsequent sustained local transmission of the virus to implement optimal prevention and control strategies and measures.

Dengue fever (DF) is a major threat to human life and affects a large number of populations in the tropical and subtropical zones with serious consequences. Over 300 million people are infected worldwide with dengue virus (DENV), which causes DF, every year per the World Health Organization (WHO) (*1*). Since 1978, DF outbreaks occurred endemically and reached epidemic levels every 4 to 7 years in China, and increased significantly in recent decades in Guangdong Province (*2*). According to China Information System for Disese Control and Prevention, DF outbreaks occurred from May to November in Guangdong in 2019, and the reported number of cases started to increase rapidly in August, peaking in October, and decreasing by November (Figure 1). As of November 30, a total of 5,968 cases, including 3 deaths, were reported to the Guangdong Provincial CDC. Among them, 1,207 cases were cases imported from abroad, and 4,761 cases were acquired through presumed local mosquito-borne transmission. The cities with the most reported cases were Guangzhou (1,376), Shantou (914), Foshan (375), Zhanjiang (336), Chaozhou (288), Jiangmen (256), Jieyang (246), Zhongshan (239), Shenzhen (208), Dongguan (116), and Qingyuan (110); all other cities in Guangdong Province had less than 100 reported cases.

In this study, 21 city-level CDCs were involved in collection of serum specimens of suspected DF cases from respective local hospitals, and these samples were sent to Guangdong Provincial CDC for laboratory detection and further analysis. As of November 20, a total of 2,293 serum specimens were collected, detected, and serotyped using real-time RT-PCR. A total of 2,175 samples were positive for dengue virus, and the serotyping results showed that 1,919 samples were type I, 159 were type II, 93 were type III, and 4 were type IV DENV infection. Virus isolation was performed using RT-PCR to detect positive samples using cell culture technology, and 427 strains were successfully isolated including 359 strains of type I, 47 strains of type II, 18 strains of type III, and 3 strains of type IV.

To trace the origins of DENV circulating in Guangdong, the entire E gene of DENV samples were sequenced from imported cases, sporadic cases acquired through presumed local transmission, and representative virus strains obtained in outbreaks from different period in 2019. A total of 326 sequences were successfully obtained, and the US National Library of Medicine Basic Local Alignment Search Tool (BLAST) from the US National Center for Biotechnology Information (NCBI) analysis showed that 287 sequences belong to type I DENV (75 from imported cases and 212 from local acquired cases), 27 type II (16 imported and 11 local), 10 type III (7 imported and 3

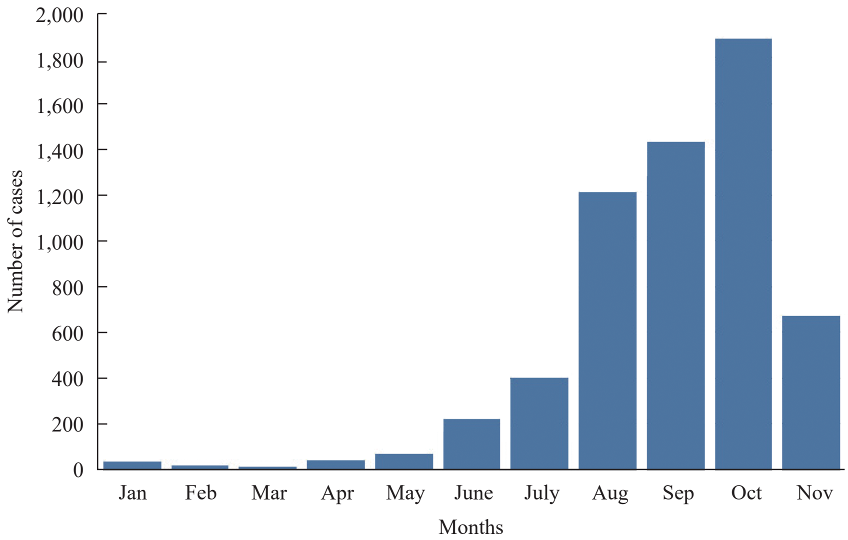

FIGURE 1. Number of dengue fever cases reported in 2019 in Guangdong Province, China.

local), and 2 type IV sequences from imported cases.

Phylogenetic analysis of the obtained E gene sequences were performed with 5 genotype representative sequences, which demonstrated that the 287 type I E gene sequences were clustered into 2 different genotypes, 280 sequences clustered to genotype I and 7 clustered to genotype V. The 212 sequences of genotype I DENV E gene, obtained from cases acquired through presumed local transmission, were clustered into 6 distinct clades, and clade 6 contained 190 sequences followed by clade 4 containing 9 sequences, clade 3 containing 8 sequences, clade 5 containing 3 sequences, and clade 1 and clade 2 containing 1 sequences. The sequences from clade 6 and clade 3 were clustered together with viral sequence obtained from cases acquired in Cambodia and shared the highest homology at the nucleotide level, which suggested that sustained local transmission might be caused by virus introduced from Cambodia. Clade 1 and clade 2 formed an independent branch, and they might be caused by virus introduced from Thailand and Myanmar. Clade 4 shared the highest homology at nucleotide level with strains imported from Thailand (D19014), and clade 5 shared the highest homology at nucleotide level with strains imported from Malaysia (D16167). In addition, the sequences of genotype V were clustered together with strains imported from Indonesia (D19011). These results suggested that DF epidemics in Southeast Asia put great pressure on DF control and prevention in Guangdong and that Cambodia, Thailand, East Timor, Malaysia, and Indonesia were sources of DENV introduced into Guangdong in 2019. The dominant genotype of the virus in subsequent local transmission was genotype I of type I DENV, which circulated in more than 16 cities, and genotype V of type I DENV was mainly found in outbreaks occurred in Zhongshan and Guangzhou (Figure 2).

Type II and III viruses were found among cases acquired both abroad and through local transmission, while DENV of type IV was only detected in imported cases. A total of 27 sequences of type II DENV E gene were clustered into Asia I and cosmopolitan genotypes, 10 sequences of cosmopolitan genotypes from cases acquired through local transmission were clustered together with viruses circulating in Cambodia and in Malaysia in clade 1 and clade 2, which revealed a possible source of the viruses causing local transmission in Guangdong. The sequence of genotype Asia I of local transmitted type II DENV clustered together with viruses introduced from Vietnam. The 10 sequences of DENV type III viruses clustered into genotype I and II respectively, among which two local strains belonged to genotype I, which clustered into the same clade with the virus imported from Indonesia, and the sequence of local transmitted virus of genotype II showed high similarity with imported strains from Cambodia.

DISCUSSION

In the history of Guangdong (including Hainan Province), more than 10,000 cases of DF have been reported in six years, and the latest one was 2014, with more than 45,000 cases were reported (*3–4*). In recent years, the frequency of DF outbreaks increased in

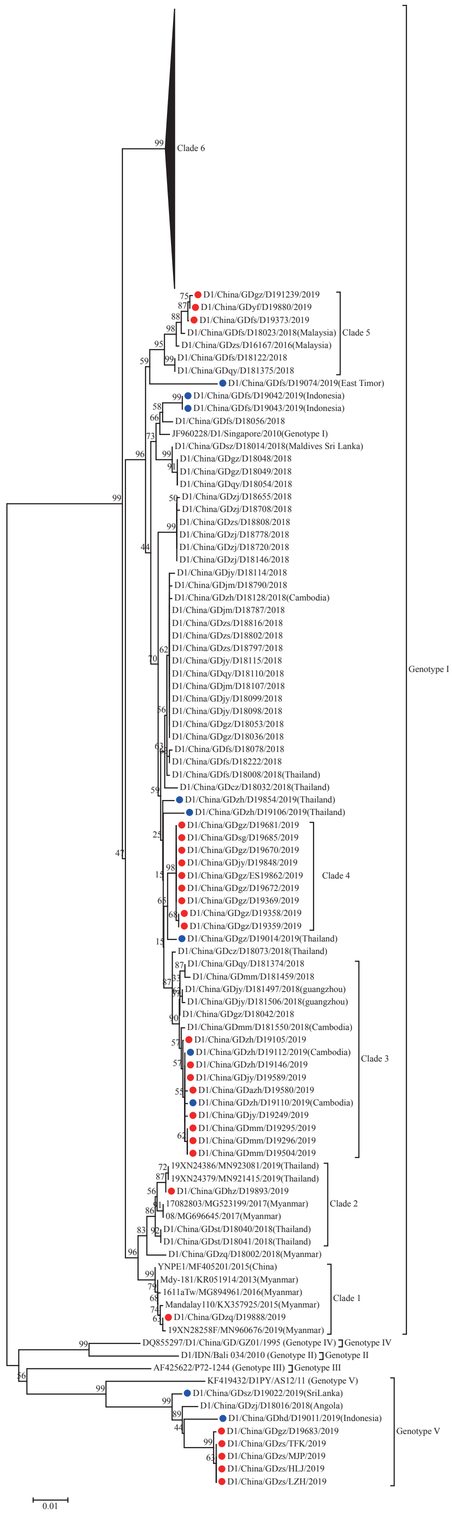

FIGURE 2. Phylogenetic tree of type-1 dengue virus isolated from the 2019 outbreak in Guangdong Province, China. A total of 287 E gene sequences from isolated strains were used for phylogenetic tree reconstructions, and 5 genotypes were assigned according to previous studies. The outbreak isolates are indicated by red circles, and the isolates from the imported cases are indicated by blue circles.

Guangdong and the affected area has expanded year after year. Before 2011, dengue fever was prevalent in Guangdong for only one to two months, and then gradually increased to seven to eight months. Outbreaks of DF have also started occurring yearly since 2011, ranging from thousands to tens of thousands of cases. The affected area had expanded from being concentrated in the Pearl River Delta to widely affecting most of Guangdong Province. This may be related to the gradual rise of the earth's temperature and the rapid spread of DENV, but it could also be related to the rapid development of China's economy, the acceleration of urbanization, and increasing foreign trade and tourism (*5*–*6*).

The annual circulation of DENV has expanded from a single type of DENV to multiple serotypes and genotypes circulating simultaneously. DENV type I has caused outbreaks every year since 2011; type II has caused outbreaks every year since 2013, accounting for the highest proportion in 2015 and reaching 63.82% of all cases; type III has caused local outbreaks in 2013, 2015, 2016, and 2019 (*7*–*8*); type IV virus was mainly detected from imported cases with only a few local transmission caused by type IV virus were reported. In 2019, the dominant type of dengue virus in Guangdong was type I, and type II and III were also detected in outbreaks through local transmission.

DF outbreaks in Guangdong were still often local outbreaks caused by imported viruses. Cambodia was the main source of DENV introduced to Guangdong in 2019, followed by Indonesia, Thailand, and Malaysia. According to data from China Information System for Disese Control and Prevention, imported dengue viruses from more than 43 countries and regions were found in Guangdong in 2019, and Southeast Asia was the most important source, of which Cambodia contributed the largest number of imported cases, followed by Thailand and Malaysia. The surveillance results are consistent with our molecular tracing results in this report, suggesting that DF outbreaks in Guangdong were mainly caused by imported virus. Therefore, early detection of suspected cases and typing and genotyping of circulating viruses should be prioritized and enhanced to promptly assess the likelihood of local transmission, of introduction, and of subsequent sustained local transmission of the virus to implement optimal prevention and control strategies and measures.

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Perspectives

Application of 'Blockchain Plus Public Health'

Jiaqi Ma[1,#]

On October 25, 2019, senior Chinese officials conveyed the significance of blockchain to all sectors of society through the 18th Collective Study of the Political Bureau of the Central Committee of the Communist Party of China. Blockchain is the distributed ledger that maintains a growing list of chronological blocks linked by cryptographic techniques. It is a combined innovation of peer-to-peer networks, cryptography, consensus protocols, smart contracts, etc., which offers tamper-resistance and traceability characteristics to solve trust issues (*1–2*).

Since blockchain is a promising technical infrastructure to promote the upgrading of strategic sectors, and industries are actively seeking to understand and apply it. 'Blockchain + Public Health' has also been recognized as a vital research direction.

To regulate blockchain application, the Cyberspace Administration of China issued the Regulations on the Management of Blockchain Information Services on January 10, 2019 that came into effect on February 15, 2019 (*3*). Based on the application scenario, blockchain systems can be classified as public, consortium, or private systems.

GLOBAL BLOCKCHAIN APPLICATIONS

Blockchain has received great attention from academics and governments worldwide. It is gradually moving from conceptual research to integration with the real economy. China is in a leading position to explore industrial blockchain applications (*4*). In 2016, blockchain technology was included in the 13th Five-Year Plan for National Informatization Planning for the first time.

Currently, there are three typical blockchain applications in the public health field:

1) Applications for data integration and sharing. Researchers at Sichuan University designed a league blockchain system for infectious disease data, named the Virus Database Chain (VD Chain), based on Practical Byzantine Fault Tolerance (PBFT). The system was used for integrating and sharing infectious disease surveillance data to overcome the difficulty in information sharing and to reduce the risk of data security caused by random sharing. The system was based on a structure composed of five layers: data, network, consensus, contracts, and application. Data from CDCs, medical institutions, and health administrative departments are stored in blockchains or databases, and the system also provides a client interface at the application layer for information query and management (*5*).

2) Applications for tracking vaccines. The non-tamperability, unforgeability, and traceability of blockchain offers significant advantages in tracing the source of vaccines. Several institutions and individuals have developed blockchain-based vaccine full-life-cycle surveillance approaches and systems (*6*). The basic idea is to determine the blockchain nodes corresponding to the parties involved in vaccine management and to build a league blockchain, in which each party in a certain link of the vaccine life cycle represents a node. The manufacturers, supervisors, managers, transporters, and vaccinators publish and retrieve data generated during vaccine manufacturing, distribution, use, and management in the league blockchain to ensure that the information is tamper-proof and traceable.

3) Applications for Personal Health Record (PHR) exchange. In a study conducted in Taiwan, China, a blockchain-based PHR exchange architecture and management platform was designed to secure the transfer and sharing of PHR data between patients and medical health care providers. The platform comprises two main components. The first is the PHR management platform, which performs the functions of viewing PHRs for personal health management, sharing PHRs with a doctor, and securing the blockchain content. The second component is the blockchain exchange architecture based on Ethereum for creating a private chain. The platform has been recently deployed in Southeast Asian countries (*7*).

Electronic Health Record Management: Chinese medical institutions generally lack overall information plans. Health data is scattered among medical systems and hard to share. Blockchain is well suited for the construction and management of electronic health records (EHR). The medical consortium blockchain will unify patient records into a unique 'health ledger' that can be shared among related institutions. Through safe circulation and storage, the updating, accuracy, and integrity of EHR have been greatly improved. In addition, the system greatly reduces the institution's data obtaining costs.

Vaccine Traceability and Management: The life cycle of vaccines involves pre-development, testing, approval, production, quality inspection, procurement, storage, transport and inoculation. Problems in any link will affect the vaccine quality. Therefore, quickly obtaining the tracking data can help identify problems. The traditional system uses Internet of Things (IoT) devices to obtain production, cold chain storage/transport, and inoculation information. However, the information is separated and controlled by the institutions, which is vulnerable to tampering. In contrast, a blockchain records all information in a decentralized way, which prevents data tampering and guarantees its authenticity.

Vectors and Pathogens Monitoring and Management: Electronic evidence recording is the technical process of electronic data collection, collation, storage to secure integrity. There are currently two major bottlenecks in vector and pathogen monitoring. One is that authentication methods and access standards for test data have not been fully developed for laboratory networks. The other is that the risk of tampering with laboratory test data makes it difficult to implement credible evidence chains.

A blockchain-based electronic evidence system can provide reliable and traceable digital certification for monitoring. Blockchain technology can be used for quality control and whole-process inspection. A blockchain system can monitor and process vector and pathogen data to promote information management and sharing. With rational rules and incentive mechanisms (*8*), blockchain can be used to establish a credit-based quality-control system for testing laboratories.

BLOCKCHAIN APPLICATION CONSTRAINTS

A key problem of industrial blockchains is the lack of necessary technical standards and specifications, including basic technology, blockchain business standards, and application specifications. Therefore, blockchain applications have some constraints.

Decentralization. Decentralization is one of the most significant features (*9*) of blockchain. However, a completely decentralized blockchain without central authority is incompatible with national public health supervision. A consortium blockchain is more appropriate for public health.

Openness. Openness and sharing are blockchain's foundation. The blockchain ledger is open to the public and highly transparent (*8*). However, since personal health information is sensitive, we must pay special attention to privacy protection.

Independence. Through cryptographic algorithms, nodes can automatically exchange and verify blockchain data (*8*). Most blockchain systems use open-source cryptographic algorithms. However, Chinese blockchain applications must support the domestic cipher algorithm for higher security.

Security. As long as 51% of the nodes are honest, blockchain system will not be manipulated. Therefore, blockchain systems have relative rather than absolute security, which may not meet industrial standards for data security. Besides, blockchain's multiple backups may arouse information security concerns.

Anonymity. Technically, blockchain nodes do not need to disclose their identities for information transmission (*8*). However, real-name authentication is required for consortium blockchain.

REFLECTION

Consortium blockchain is the optimal blockchain-based public health schema. Currently, most industrial applications adopt the consortium blockchain, which forms the multi-center trustworthy 'ecosphere.'

Furthermore, smart contracts can determine ownership in real-time, which achieves automation, openness, and transparency. When faced with emergencies, departments can track the circulation quickly to enhance accountability.

The autonomous and controllable standards and specifications are prerequisites for implementing blockchain applications, including application scope, data standards, and technical and interface standards. The consortium blockchain platform provides secure data registration services and service docking. Therefore, service providers can develop blockchain applications with the standard framework and its programming interfaces. Besides, with these standards, reliable public health monitoring data trading system can be established, in which separate information can benefit the entire system to improve traceability and accountability. In addition, security issues in blockchain need to be highlighted (*10*).

In conclusion, the blockchain application in public health is very promising, but only a secure and controllable system can be widely used in China.

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Key Statistics

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[2] National Center for AIDS/STD Control and Prevention, Chinese Center for Disease Control and Prevention

Reported Cases of Respiratory Infectious Diseases — China, January–June, 2018–2020

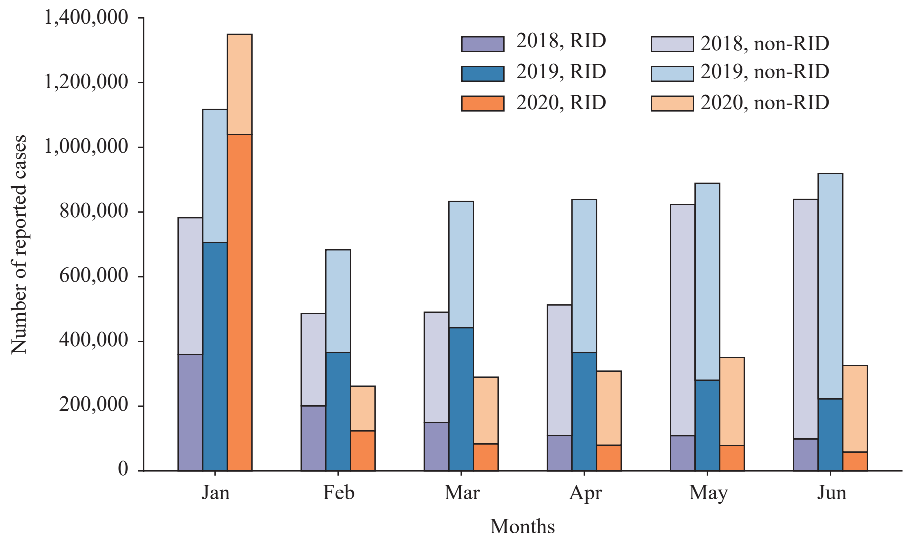

FIGURE 1. The number of respiratory infectious diseases (RID) and non-respiratory infectious diseases (non-RID) in China from January to June in 2018–2020. Respiratory infectious diseases included measles, tuberculosis, epidemic cerebrospinal meningitis, pertussis, scarlet fever, seasonal influenza, diphtheria, infectious atypical pneumonia, avian influenza H7N9, and coronavirus disease 2019 (COVID-19). Non-respiratory infectious diseases refer to other notifiable infectious diseases except respiratory infectious diseases.

Between January and June 2020, a total of 2,885,058 cases of infectious diseases were reported from China's National Notifiable Disease Report System (CNNDRS) including 1,463,406 cases of respiratory infectious diseases (RID) and 1,421,652 cases of non-RID. The total number of infectious disease cases in the period of January to June in 2020 was 45.36% lower than in 2019 (5,280,102 cases) and 26.67% lower than in 2018 (3,934,342 cases). For RID in 2020, case numbers were highest in January (1,039,648) and lowest in June (58,310), but the overall total number of cases was 38.59% lower than in 2019 (2,383,019). Since February 2020, the number of RID cases has been at a consistently lower level with monthly reported cases lower than in both 2018 and 2019. Compared with non-RID, the number of RID cases decreased more sharply in 2020, with an especially large decrease of 81.11% in March 2020.

Before the COVID-19 outbreak in 2020, RID maintained a relatively consistent trend during the January to June period. The higher numbers of RID cases in January 2020 was expected because of the contribution of COVID-19. However, this was followed by a dramatic fall in case numbers in February 2020, which was maintained through June of that year. This is due to COVID-19 containment and suppression strategies (*1*). The implementation of these strategies reduced opportunities for people to move about and interact with one another, which greatly reduced infectious disease transmission.

One such strategy is wearing face masks. Wearing face masks is a simple and effective way to block transmission of COVID-19 (*2*). In China, all people are strictly required to wear masks to protect themselves from infection and to prevent transmission of infection to others. This strategy cuts off the main transmission route and blocks invisible infection sources of COVID-19 (i.e., asymptomatic persons unaware of their infection). Similarly, wearing face masks also cuts off a main transmission route of other RIDs. According to the National Health Commission's

National Medical Service Situation Report for January to June 2020, the total number of person-visits to medical and health institutions reached 3.27 billion in China, a year-on-year decrease of 21.6% (*3*). This included 1.43 billion person-visits to hospital, a year-on-year decrease of 21.4% (*3*). The above factors may have affected the detection and reporting of infectious disease patients in China.

These data indicated that at least some of the containment and suppression strategies (e.g., mask wearing and hand washing) implemented to combat COVID-19 were effective for other RIDs as well. Therefore, their further study and targeted implementation to address future RID outbreaks and/or regular seasonal trends in RIDs should be considered. Adoption of simple changes to everyday life for Chinese people could improve health, wellbeing, and productivity considerably.

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Source: Statistics based on onset date, China's National Notifiable Disease Report System (CNNDRS), 2020.

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Profiles

Jiaqi Ma, China CDC's Chief Expert of Health Information

Peter Hao[1,&]; Nankun Liu[1,&]; Zhenjun Li[1]; Jingjing Xi[1,#]; Feng Tan[1,#]

Jiaqi Ma is the Chief Expert of Health Information of China CDC and has been engaged in public health informatics for more than 30 years. As a leading figure, he put forward creative information construction concepts at multiple key periods and led his team to achieve the establishment of the Chinese Information System for Disease Control and Prevention (CISDCP), which represented a major development of China's public health informatics.

In 1987, Ma graduated from Kunming Medical University majoring in preventive medicine. After two years of working at the county-level sanitation and anti-epidemic station, he returned to the Yunnan Provincial-Level Station and set up an information center. Early in his career, Ma focused on applying information technology for business needs. He learned computer programming languages independently and helped developed of software including the magnetic card health supervision and management information system, iodine deficiency disorders monitoring information system, and infectious disease detection report information system. In 1993, his self-developed "National Endemic Disease Statistical Reporting Software" passed the Ministry of Health (now the National Health Commission) expert review and was applied nationwide. In 1999, as a core technical expert, Ma organized the development of the National Infectious Disease Registration and Report Information System.

In 2002, Ma joined the newly established China CDC. Four months later, the severe acute respiratory syndrome (SARS) epidemic occurred in China, and public health surveillance faced a huge challenge. Ma proposed surveillance system solutions, including promoting online real-time reports, and, within three months, led the establishment of the "Web-based information system for notifiable diseases directed reporting" (predecessor of CISDCP). Under the system, he established a data center for centralized national management. The operation of CISDCP has completely changed the old information management mode of filling out forms and reporting infectious diseases step by step, which significantly improved the timeliness, completeness, and accuracy of infectious disease reporting, and shortened the reporting time of notifiable infectious diseases from 5 days to less than 4 hours. Currently, the system has been operating stably for 16 years and has covered 180,000 users in 73,000 medical institutions across China. It has become a key milestone in China's public health information construction.

From 2004 to 2010, Ma participated in the MBA program of Tsinghua University and the information analysts training at the Chinese Academy of Sciences. He also obtained a master's degree in software engineering from Beihang University. Through years of work and practice, Ma has gradually formed his understanding of the combination of information technology and public health. He believes that information construction must be business-based, requirement-oriented, and technology-led. He has led his team to undertake many research projects under the National Science and Technology Major Project, National Natural Science Foundation of China, and National Science and Technology Support Program. His team published more than 50 papers during the process and obtained 1 patent and 23 software copyrights.

In 2009, China CDC moved to a new location, and Ma led the technical team to start construction on a new information system. His team spent four years establishing the Chinese Data Center for Disease Control and Prevention and the Disaster Recovery Backup Center, thus achieving the transfer and reconstruction of CISDCP. They constructed more than ten core business information systems and the Virtual Private Network (VPN) covering various medical and health institutions at all levels across the country. They also promoted the digital transformation of multiple disease control areas to make the information system safer and more efficient. In 2015, his team was awarded the title of National Advanced Group for Disease Prevention and Control.

In 2017, Ma became the technical director of the construction of the disease prevention and control information system of the National Health Informatization Project, but he did not rest content with old practice. Taking into account the advancement of information technology and the increasingly complicated requirements of informatization in the field of disease prevention and control, he proposed and put into practice the information management concept of building an integrated cloud data center and Electronic Disease Record (EDR). Under the guidance of this concept, the reconstructed CISDCP was launched in 2020, which realizes the information management of individual major diseases with life cycle health event monitoring. In the prevention and control of coronavirus disease 2019 (COVID-19), the system quickly made adaptive adjustments, providing functions such as case reporting, epidemiological investigation, transfer treatment, information collection of nucleic acid testing, and big data comparisons to find close contacts.

Ma is responsible for several academic groups. He initiated the establishment of the Public Health Information Professional Committee of Chinese Medical Information, Big Data Association, and the Professional Committee of Health Big Data and Artificial Intelligence Application of Chinese Prevention Medicine Association and leads the information professionals of the national disease control institutions to carry out scientific research and academic exchanges.

As a Chief Expert of Health Information, Ma always pays attention to the development of information technology and public health informatics. In the future, he will comprehensively promote the development of national public health information through four aspects: 1) by implementing the national information strategy; 2) by guiding and training key technical staff; 3) by strengthening multidisciplinary horizontal cooperation; and 4) by actively participating in the development plan for disease control information. Ma's professional opinions will continue to contribute to the development of public health informatics and public health informatization.

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Erratum

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In the article entitled 'Detection and associated factors for cervical precancerous lesions among HIV-positive women from high HIV-burden Areas — China, 2015–2016' [2020, 2(20): 355–361. doi: 10.46234/ccdcw2020.092], the third sentence of the second paragraph on page 355 'The follow-up survey followed the same procedure as the baseline survey, which was conducted *1.5 years* later on average.' should be 'The follow-up survey followed the same procedure as the baseline survey, which was conducted *15 months* later on average.'

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