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Cover Photo: A nurse interpreting the adverse drug effects for a multi-drug resistant tuberculosis (MDR-TB) patient in a TB consultation room at the Zhenjiang TB Dispensary, Jiangsu Province, September 13, 2018.

Preplanned Studies

Epidemiological Characteristics of Rifampicin-Resistant Tuberculosis in Students — China, 2015–2019

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Summary

What is already known about this topic?

The number of students with tuberculosis (TB) has been increasing since 2015. However, the prevalence of rifampicin-resistant tuberculosis (RR-TB) among student population is unclear.

What is added by the report?

The number of students with RR-TB has significantly increased from 2015 to 2019, especially in the western region of China. The majority of patients were college students. Students with RR-TB were mainly new patients.

What are the implications for public health practice?

The following measures are recommended: strengthening TB surveillance in schools, promoting the application of convenient and rapid molecular drug susceptibility testing tools, and actively carrying out drug resistance screening and follow ups for cohabiting children of adult RR-TB patients.

Rifampicin-resistant tuberculosis (RR-TB) is defined as having any resistance to rifampicin, including mono-resistance, multidrug resistance (MDR), and polydrug resistance (*1*). RR-TB is a more serious type of tuberculosis (TB) and is currently the focal point of TB control in China. Students are of special concern for TB control, as once a case of infectious TB occurs, it is easily spread, which will cause public health events and arouse widespread concern in the community. To strengthen the control and prevention of TB among students, the *Guidelines for the Control and Prevention of Tuberculosis in Schools (2017 Edition)* was issued and the single-case early warning system for TB in schools was launched with the China Infectious Diseases Automated-Alert System in July 2018 (*2*). Therefore, although the absolute size of the national TB epidemic is shrinking year by year, the number of the TB cases in schools have grown since 2015 (*3*–*4*). In addition, the prevalence of students with RR-TB is still unclear because of a lack of information on the national drug resistance baseline among children under 15 in the student population. Therefore, it is imperative to analyze the characteristics of the RR-TB epidemic among students.

The Programmatic Management of Drug-Resistant Tuberculosis (PMDT) was initiated in China in 2006. In order to achieve the End TB Strategy's vision and goals proposed by the World Health Organization (WHO) in 2015, China rapidly scaled up coverage of PMDT and expanded the drug resistance screening population for Rifampicin-resistant (RR) from screening high-risk groups of RR-TB to screening all bacteriologically-confirmed TB patients since 2015. The number of RR-TB patients notified after 2015 can better reflect the trends of RR-TB. Therefore, based on the nationwide Tuberculosis Information Management System (TBIMS), this study analyzed the epidemiological characteristics of RR-TB patients registered as students in the occupational classification in the TBIMS from January 1, 2015 to December 31, 2019.

The analysis results showed that the number of students with RR-TB that were reported and the detection rate of RR-TB among student TB patients continued to increase year by year from 2015 to 2019. The number of patients in 2019 was 3.7 times that of 2015 (732 compared to 197), which was higher than the 1.4 (47,732/34,260) times increase of students with TB in the same period. The most significant increase was observed in the western region. Since 2017, the proportion of RR-TB patients has surpassed that of the central and eastern region, ranking first, while the proportion was relatively low in the previous two years (Table 1). The proportion of students with RR-TB in all RR-TB patients also increased year by year (Figure 1).

From Table 1, the number of students with RR-TB notified was predominantly male. The RR-TB patients were mainly college students, followed by high school students. The fewest were primary school patients, with less than 20 cases reported in the 5-year period. Although college students notified the most patients,

TABLE 1. The number of student with TB and with RR-TB, classification of registration and distribution of sex, education level and region of students with RR-TB in China, 2015–2019

Item	2015	2016	2017	2018	2019	Total
No. of students with TB	34,260	36,094	40,656	48,289	47,732	207,031
No. of students with RR-TB (%)*	197 (0.6)	274 (0.8)	383 (0.9)	546 (1.1)	732 (1.5)	2,132 (1.0)
Classification of registration						
New cases (%)	116 (58.9)	180 (65.7)	253 (66.1)	398 (72.9)	570 (77.9)	1,517 (71.2)
RR-TB high-risk groups (%)	81 (41.1)	94 (34.3)	130 (33.9)	148 (27.1)	162 (22.1)	615 (28.8)
Sex						
Male (%)	115 (58.4)	157 (57.3)	201 (52.5)	319 (58.4)	420 (57.4)	1,212 (56.8)
Female (%)	82 (41.6)	117 (42.7)	182 (47.5)	227 (41.6)	312 (42.6)	920 (43.2)
Age						
Primary school: 6–12 years (%)	0 (0)	0 (0)	1 (0.3)	9 (1.6)	9 (1.2)	19 (0.9)
Middle school: 13–15 years (%)	0 (0)	5 (1.8)	6 (1.6)	27 (4.9)	65 (8.9)	104 (4.9)
High school: 16–18 years (%)	9 (4.6)	14 (5.1)	45 (11.7)	103 (18.9)	257 (35.1)	428 (20.1)
University: ≥19 years (%)	186 (94.4)	255 (93.1)	330 (86.2)	407 (74.5)	403 (55.1)	1,581 (74.2)
Region						
East (%)	85 (43.1)	102 (37.2)	125 (32.6)	173 (31.7)	248 (33.9)	733 (34.4)
Central (%)	50 (25.4)	107 (39.1)	122 (31.9)	151 (27.7)	218 (29.8)	648 (30.4)
West (%)	62 (31.5)	65 (23.7)	136 (35.5)	222 (40.7)	266 (36.3)	75 1(35.2)

Note: High-risk groups refer to at least one of the following: (a) chronic TB patients /failure of retreatment TB patients; (b) close contact with a known RR-TB patient; (c) new TB patients of initial treatment failure; (d) relapsed or returned TB patients; or (e) new TB patients with remaining sputum culture or positive smear at the end of the second month after treatment. The ages of students were divided into primary school, middle school, high school, and university categories according to the ages of 6–12, 13–15, 16–18, and 19 years and above. The eastern region included the following provincial-level administrative divisions: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan; the central region: Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan; and the western region: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet (Xizang), Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang.
* Detection rate of RR-TB among student TB patients.
Abbreviations: TB=tuberculosis, RR-TB=rifampicin-resistant tuberculosis.

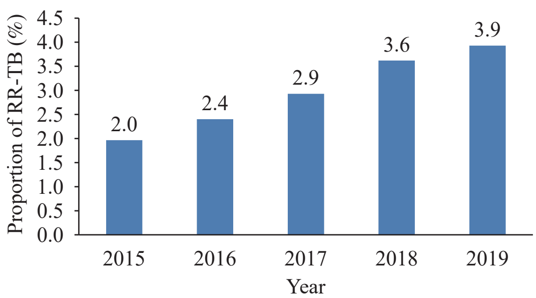

FIGURE 1. The proportion of students with rifampicin-resistant tuberculosis (RR-TB) among all RR-TB patients in the same period in China, 2015–2019.

their proportion decreased year by year, from 94.4% in 2015 to 55.1% in 2019. At the same time, the proportion of RR-TB patients in middle schools and high schools increased year by year, especially in high schools. The increases in students with RR-TB in 2019 were mainly from middle schools and high schools, and the same patients from universities decreased slightly. The majority of students with RR-TB were new patients (71.2%) with no history of TB treatment or treatment duration less than 1 month. The proportion of new patients to the total number of patients increased year by year, from 58.9% in 2015 to 77.9% in 2019. The number of RR-TB patients reported monthly did not show obvious trends (Figure 2).

DISCUSSION

The analysis indicated the number of students with RR-TB increased significantly during 2015–2019 and especially after 2017. This is likely explained because China has successively introduced regulations and early warning measures for the management of TB in schools, which has led to an increase in TB reporting and a corresponding increase in the reported number of students with RR-TB. The increase in students with RR-TB being much higher than students with TB is

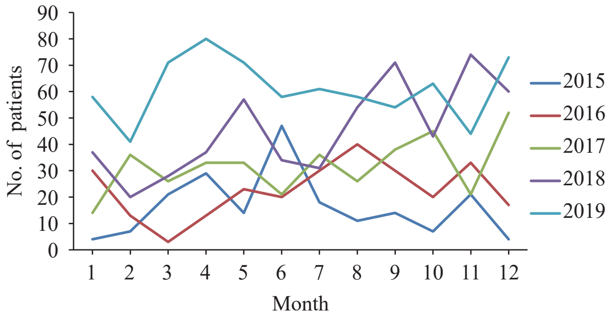

FIGURE 2. Time distribution of the number of students with rifampicin-resistant tuberculosis (RR-TB) reported in China, 2015–2019.

likely related to the rapid increase in RR screening rates, especially the screening rate of new patients after 2015 (*5*).

The number and composition ratio of student RR-TB cases in the western region both increased in 2015–2019. The main reason for this is that the number of students with reported TB and the RR rate in the western region were higher than those in the eastern and central regions (*3*), the number of RR-TB patients in the western region should be the largest. From 2015 to 2018, the Chinese government invested about 260 million CNY to support economically underdeveloped areas, including the western region, to equip drug susceptibility testing (DST) equipment (*6*). Since it will take time for the equipment to be operational, the ability of laboratory personnel to be improved, and an overall increase in DST capacity, fewer students with RR-TB were detected in 2015–2016 compared to the significant increase post-2017.

This study implied that despite the significant increase in students with RR-TB notified from 2015 to 2019, the RR-TB epidemic among primary and secondary school students was underestimated. There are several possible reasons. First, there were few RR-TB cases reported in primary schools at less than 20 cases in 5 years. It is more difficult to detect RR-TB in children compared with adults due to an immature immune system and a difficulty in collecting sputum samples. As a result, there were extremely limited baseline data on TB drug resistance in children in many countries worldwide. According to the estimation of mathematical models, there were 25,000 cases of children in the world with multidrug resistance TB alone. India, China, and Russia, which rank top three in RR-TB cases, accounted for about 7,000 cases (*7*). Therefore, the current data likely underestimates the true situation, and the epidemic of drug resistance in children under 15 in China is likely also underestimated. Second, the rate of RR in high school students should be consistent with that of adults. In 2018, the number of high school students with TB was 1.2 times as high as college students (*3*). However, the number of RR-TB reported in high schools was only one-quarter that of college students. Although the number of notified high school students with RR-TB increased significantly in 2019, the number of college students with RR-TB was 1.5 times higher than that of high school students (403/257). Therefore, the RR-TB notified among high school students was also likely lower than the actual level.

Another issue was that most students with RR-TB were new TB cases, and the proportion of new patients increased year by year. Even in 2015–2017, the screening rate of RR among new TB patients was only about 30% (*5*), the proportion of students with new RR-TB was far higher than that of high-risk groups of RR-TB. In 2019, this proportion was close to 80%, far exceeding the proportion of 54.8% being new cases among all RR-TB patients (*8*). Patients with new RR represent primary drug resistance, so RR-TB among Chinese students was mainly caused by transmission.

The study was subject to some limitations. A more significant feature of student RR-TB cases was that they were prone to clustering. For example, two outbreaks of RR-TB in schools were notified in 2017 and 2019 (*9–10*). Our data source was TBIMS, which cannot yet identify whether student RR-TB patients were from the same school. Therefore, our study did not analyze students with RR-TB clustered epidemics. In addition, there were still some student RR-TB cases, especially those cases under the age of 15 that are not notified in TBIMS, which need to be investigated and analyzed further.

In conclusion, the number of students with RR-TB notified increased significantly in 2015–2019. There was still gap in the detection of students with RR-TB, and students with RR-TB were mainly caused by transmission. In order to reduce the spread of RR-TB in schools and especially to prevent the occurrence of clustered RR-TB outbreaks, the ability to detect RR-TB should be improved and RR-TB should be detected as early as possible. Therefore, it is recommended to strengthen the surveillance of TB in schools, promote the application of convenient and rapid molecular DST tools, and actively carry out drug resistance screening and follow ups for cohabiting children of adult RR-TB patients.

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Preplanned Studies

The Impact of COVID-19 on Tuberculosis Patients' Behavior of Seeking Medical Care — China, 2020

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Summary

What is already known on this topic?

The coronavirus disease 2019 (COVID-19) pandemic has disrupted the tuberculosis (TB) service system. However, the impact on TB patients in China remains unknown.

What is added by this report?

This report firstly addressed the impact of COVID-19 on TB patients in China. About half of TB patients did not revisit the hospital due to personal reasons. The reasons for irregular medication and postponing or cancelling examination after full treatment course were different.

What are the implications for public health practice?

Health education and risk communication should be strengthened for better TB patient management and treatment adherence, especially in light of the COVID-19 pandemic.

As a new acute respiratory infectious disease, coronavirus disease 2019 (COVID-19) has become one of the world's most important public health problems. As a high tuberculosis (TB) burden country, China promptly adopted two overarching strategies of containment and suppression in response to the COVID-19 epidemic (*1*), which have already affected TB control, including notification, follow-up examinations, and treatment outcomes (*2–4*). However, existing studies presented the impact mainly based on routine surveillance data from the TB service system. The impact on TB patients' behavior of seeking medical care from the perspective of TB patients remains unknown. To address this issue, China CDC randomly selected 294 counties from 31 provincial-level administrative divisions (PLADs) and conducted a national questionnaire survey in May 2020. The survey result showed that about half of TB patients did not revisit the hospital due to personal reasons, and the reasons for irregular medication and postponing or canceling examination after full treatment course were different. Therefore, health education should be strengthened for better TB patient management in addition to guaranteed uninterrupted service system.

To better understand the potential impact of COVID-19 on TB patients' medical care seeking behavior, we conducted a national TB patients survey. A total of 294 counties were randomly selected (10% of all counties) by PLADs, and whether the county had reported cases of COVID-19, of which 116 counties reported COVID-19 cases and 178 counties did not report COVID-19 cases. Then, a total of 18 cases were randomly selected for each county including 6 TB cases with treatment for less than 2 months, 6 cases treated for 2 months, and 6 cases that finished the whole treatment course from the period of January 25 to April 8, 2020, which was defined as the COVID-19 period as it marked the starting point of the national emergency response to COVID-19 to the reopening of Wuhan city. If there were fewer than 6 cases for any category in the county, then all the TB cases in that category were surveyed. Finally, a total of 3,224 TB cases were selected and investigated by CDC staff, with 665, 1,224, and 1,335 cases from each group, respectively. In the questionnaire, some questions were for all cases and some questions were for specific TB cases (Table 1).

Of the 850 TB cases that were diagnosed in the COVID-19 period, the diagnoses of 192 (22.6%) cases were affected. There were 81 (42.2%), 52 (27.1%), and 59 (30.7%) cases who postponed seeking medical care due to traffic restrictions, TB service disruptions, and personal reasons, respectively. No significant differences existed between counties with/without COVID-19 in terms of the diagnosis of TB (P=0.597) and the main underlying reason for postponing seeking care (P=0.231).

Of the 3,224 TB cases that should have taken anti-TB drugs regularly in the COVID-19 period, only 110 (3.4%) cases reported irregular intake of medication

TABLE 1. Main questions surveyed for different groups of tuberculosis (TB) cases conducted by China CDC in China — May, 2020.

Questions	Treated less than 2 months	Treated for 2 months	Finished treatment
If diagnosis of TB was affected and the main underlying reason	Yes	Yes	No
If regular intake of medication was affected and the main underlying reason	Yes	Yes	Yes
If sputum examination after 2 months' treatment was affected and the main underlying reason	No	Yes	No
If sputum examination after full treatment course was affected and the main underlying reason	No	No	Yes

and no significant differences existed between counties with/without COVID-19 (*P*=0.618). Due to side effects and personal reasons, 48 (43.6%) and 62 (56.4%) cases, respectively, did not take medication regularly. There were significant differences between counties with COVID-19 and without COVID-19 in terms of the main underlying reason for irregular medication (*P*<0.001).

Of the 1,224 TB cases that should have sputum examination after 2 months' treatment in the intensive period, 322 (26.3%) cases were affected. A total of 110 (34.2%), 51 (15.8%), and 161 (50.0%) cases postponed or canceled the examination due to traffic restrictions, TB service disruptions, and personal reasons, respectively. There were no significant differences between counties with COVID-19 and without COVID-19 in terms of the percentage of sputum examination (*P*=0.794) and the main underlying reason (*P*=0.454).

Of the 1,335 TB cases that should have sputum examination after full treatment course in the intensive period, 379 (28.4%) cases were affected, and there was no significant difference between counties with COVID-19 and without COVID-19 (*P*=0.794). A total of 129 (34.0%), 41 (10.8%), and 209 (55.2%) cases postponed or canceled the examination due to traffic restrictions, TB service disruptions, and personal reasons, respectively. There were significant differences between counties with COVID-19 and without COVID-19 in terms of the main underlying reason (*P*=0.002) (Table 2).

DISCUSSION

The COVID-19 epidemic in China has greatly affected the behavior of TB patients' seeking medical care, but there was no significant difference between counties with or without a COVID-19 epidemic. About a quarter of TB patients had reported that TB diagnoses and follow-up examinations were affected by the COVID-19 epidemic, which was much higher than the proportion of TB patients for whom regular intake of medication was affected. About half of TB patients did not revisit the hospital for follow-up examinations. In terms of diagnostic delays, the main underlying reasons were traffic restrictions, followed by personal reasons and TB service disruptions. The reasons for irregular intake of medication and postponing or canceling examinations after a full treatment course were different between counties with/without COVID-19 epidemic.

The behaviors of TB patients seeking medical care were all affected by the COVID-19 epidemic, which was similar to previous studies from China (*4–5*). However, regular intake of medication was the least affected. The main reason was that TB patients did not necessarily need to go out to visit the hospital for anti-TB drugs during the COVID-19 period. Under technical guidance of China CDC, healthcare workers across the country tried their best to solve the supply of anti-TB drugs and deliver the drugs to patients by different methods.

The results from our study presented no significant differences between counties with/without COVID-19 regarding the behavior of TB patients seeking medical care. As we knew little about the new infectious pathogen at the beginning of the COVID-19 outbreak, China initiated the nationwide emergency response on January 25, 2020 to tackle COVID-19 and implemented a series of nonpharmaceutical public health interventions and enforced them strictly across the country (*1,6–7*). The percentage of traffic restrictions resulting in diagnostic delays and postponing or cancelling examinations after full treatment course was a little higher in COVID-19 counties than non-COVID-19 counties, which indicated that traffic maybe was more strictly restricted in COVID-19 counties. Personal reasons, including fear of infection with COVID-19, objection of family members, and feeling lack of necessity, still accounted for the majority of TB patients who canceled or postponed follow-up examinations, which was similar

TABLE 2. The questionnaire results of tuberculosis (TB) cases from randomly selected counties conducted by China CDC in China — May, 2020.

Type	Total	Surveyed counties		*P*-value
		No COVID-19	COVID-19	
Diagnosis of TB				0.597
Not affected	658 (77.4)	267 (76.5)	391 (78.0)	
Affected	192 (22.6)	82 (23.5)	110 (22.0)	
Reason of diagnosis delay				0.231
Traffic restriction	81 (42.2)	29 (35.4)	52 (47.3)	
TB service disruption	52 (27.1)	26 (31.7)	26 (23.6)	
Personal reason	59 (30.7)	27 (32.9)	32 (29.1)	
Regular intake of medication				0.618
Not affected	3,114 (96.6)	1,177 (96.8)	1,937 (96.5)	
Affected	110 (3.4)	39 (3.2)	71 (3.5)	
Reason of irregular medication				<0.001
Side effect	48 (43.6)	26 (66.7)	22 (31.0)	
Personal reason	62 (56.4)	13 (33.3)	49 (69.0)	
Sputum examination after 2 months' treatment				0.794
Yes	902 (73.7)	326 (73.3)	576 (73.9)	
No	322 (26.3)	119 (26.7)	203 (26.1)	
Reason of postponing or cancelling examination after 2 months' treatment				0.454
Traffic restriction	110 (34.2)	41 (34.5)	69 (34.0)	
TB service disruption	51 (15.8)	15 (12.6)	36 (17.7)	
Personal reason	161 (50.0)	63 (52.9)	98 (48.3)	
Sputum examination after full treatment course				0.794
Yes	956 (71.6)	363 (72.0)	593 (71.4)	
No	379 (28.4)	141 (28.0)	238 (28.6)	
Reason of postponing or cancelling examination after full treatment course				0.002
Traffic restriction	129 (34.0)	33 (23.4)	96 (40.3)	
TB service disruption	41 (10.8)	15 (10.6)	26 (10.9)	
Personal reason	209 (55.2)	93 (66.0)	116 (48.8)	

Note: Data are presented as n (%) unless otherwise stated.

to the impact of Ebola on TB control (*8*). This also implies the importance of health education and risk communication with TB patients, which could help TB patients better understand the reasoning for why they should treat TB regularly and how to avoid infection with COVID-19 when they revisit the hospital. This will help improve TB patient management and treatment adherence.

This study was subject to several limitations. First, all the impacts were investigated from TB cases who were already diagnosed by TB designated hospitals, and we did not know the exact impact of COVID-19 on these presumptive TB cases who did not go to the hospital for a doctor. Second, we only analyzed the short-term impact of COVID-19 on TB patients' behavior, while the long-term impact on behavior of seeking medical care is still unknown. The other limitations included recall bias due to the retrospective surveys and lack of detailed information for TB cases to identify high-risk groups who suffered most during the COVID-19 epidemic.

In conclusion, the COVID-19 epidemic in China has imposed a substantial impact on the behavior of TB patients' seeking medical care, and for TB patients who did not revisit the hospital, half of them were due to personal reasons. Health education and risk communication with TB cases should be strengthened for better TB patient management and treatment adherence in addition to guaranteed uninterrupted service systems.

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Vital Surveillances

The Epidemiological Characteristics of Pulmonary Tuberculosis — Kashgar Prefecture, Xinjiang Uygur Autonomous Region, China, 2011–2020

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ABSTRACT

Introduction: National Notifiable Disease Reporting System (NNDRS) plays an important role in the early detection and control of tuberculosis (TB) in China. This study analyzed the epidemiological characteristics of pulmonary tuberculosis (PTB) in Kashgar Prefecture, Xinjiang Uygur Autnomous Region, China from 2011 to 2020 to provide a scientific basis for developing TB control strategies and measures in Kashgar.

Methods: The data were collected from the NNDRS, which included the geographical distribution, age, sex, occupation, and pathogenic classification of reported PTB cases in 12 counties/cities of Kashgar Prefecture from 2011 to 2020. Descriptive statistics were used to describe the characteristic of PTB epidemic in Kashgar.

Results: There were 189,416 PTB cases reported during 2011–2020, with a mean annual PTB case notification rate (CNR) of 451.29/100,000. A rising trend in the rate of reported PTB between 2011 and 2017 (χ^2_{trend}=26.09, P<0.01) and a declining trend between 2018 and 2020 (χ^2_{trend}=314.44, P<0.01) were observed. The months with the highest reported number of PTB cases were March to May and November to December. The mean annual rate of reported PTB was 451.88/100,000 for males and 450.67/100,000 for females. In addition, 19.76% of patients were bacteriologically-confirmed (Bac+) cases (37,425/189,416), and the mean annual Bac+ CNR was 89.17/100,000, rising from 64.76/100,000 in 2011 to 139.12/100,000 in 2020 (χ^2_{trend}=74.44, P<0.01).

Conclusions: The CNR of reported PTB in Kashgar showed a significant declining trend in the past three years. Males, elderly population, winter and spring, and farmers as an occupation were the main factors associated with high incidence of tuberculosis in Kashgar. Targeted prevention and treatment of TB should be strengthened in key groups in this region.

INTRODUCTION

Tuberculosis (TB) is a chronic respiratory infectious disease caused by *Mycobacterium tuberculosis* (*MTB*) infection (*1*), which can be airborne and poses a serious threat to human health. MTB can invade all organs of the human body but mainly affects the lungs with a typical manifestation of pulmonary tuberculosis (PTB) (*2*). TB is one of the major infectious diseases affecting the health of public in both China and around the world. The TB epidemic in China is still severe. China is one of the 30 high TB burden countries and ranks second for the number of new estimated TB cases after India (*1*,*3*). In 2019, the number of new TB cases worldwide was about 9.96 million, with TB incidence of 130/100,000 (*4*). A total of 775,764 PTB cases were reported in the National Notifiable Disease Reporting System (NNDRS) in China, and the rate of reported PTB was 55.6/100,000, ranking second among Class A and Class B notifiable communicable diseases in the country (*5*). In 2020, the reported TB incidence in Kashgar, a prefecture in Xinjiang Uygur Autonomous Region with 12 counties/cities, was 250.4/100,000, which was 4.3 times that of the national average for the same time period. TB remained one of the major public health concerns in Kashgar. This study reviewed and analyzed the epidemiological characteristics of TB in Kashgar in the past decade to provide scientific evidence to inform the development of TB prevention and control strategies in Kashgar.

METHODS

The information on geographic distribution, age, sex, occupation, and pathogenic classification of TB patients reported in Kashgar Prefecture during 2011–2020 was collected from the National Notifiable Disease Reporting System (NNDRS), and the demographic data were obtained from Kashgar Prefecture Bureau of Statistics.

We processed the data using Microsoft Excel (version 2016, Microsoft, USA). The data were analyzed using SPSS 22.0 (IBM, Chicago, IL, USA). The trend chi-squared test or chi-squared test was conducted to compare the rate of reported PTB in groups with different characteristics, and *P*<0.05 was considered statistically significant.

RESULTS

In 2011–2020, a total of 189,416 cases of PTB were reported in Kashgar, with the rate of reported cases increased from 402.18/100,000 in 2011 to 524.64/100,000 in 2017 (χ^2_{trend}=26.09, *P*<0.01) and remarkably declined from 806.75/100,000 in 2018 to 250.74/100,000 in 2020 (χ^2_{trend}=314.44, *P*<0.01). The mean annual rate of reported PTB from 2011 to 2020 was 450.91/100,000, and the mean annual rate of reported bacteriological confirmed (Bac+) PTB was 89.17/100,000. The rate of reported Bac+ PTB increased from 64.76/100,000 in 2011 to 139.12/100,000 in 2020 (χ^2_{trend}=74.44, *P*<0.01). The Bac+ cases accounted for 19.76% (37,425/5.48% (6,336/11,420) in 2020 (Figure 1).

During 2011–2017, there were mainly 2 peaks in the reported cases of PTBs observed in December and in May of each year, accounting for 10.13% (19,632/189,416) and 10% (19,374/189,416), respectively. The lowest reported PTB cases was reported in September, accounting for 6.52% of all reported PTB cases (12,638/189,416), and the highest reported PTB cases occurred in the second half of 2018, June of 2019, and May of 2020 (Figure 2).

In 2011–2020, PTB cases were reported in all age groups, with the group of 50–79 years of age accounting for 70.95% (134,399/189,416), but the age group only accounted for 15.46% (6,490,776/41,972,493) of the whole population. The top 3 age groups with the highest rate of reported PTB were 75–79 (402.18/100,000), 85+ (4,864.42/100,000), and 70–74 (4,219.59/100,000) (Table 1).

During 2011–2020, the mean annual rate of reported PTB of males was 451.88/100,000, and that of females was 450.67/100,000. Among all patients, males accounted for 50.13% (95,123/189,416) and females accounted for 49.87% (94,289/189,416). However, as the percentage of male patients increased over the years, there was a statistically significant difference in the ratio of male and female patients (χ^2_{trend}=204.85, *P*<0.01) (Table 2).

In 2011–2020, the top 3 occupations of PTB patients reported were farmers (83.81%, 158,741/189,416), housework & unemployed (6.54%, 12,383/189,416), and retirees (4.51%, 8,544/

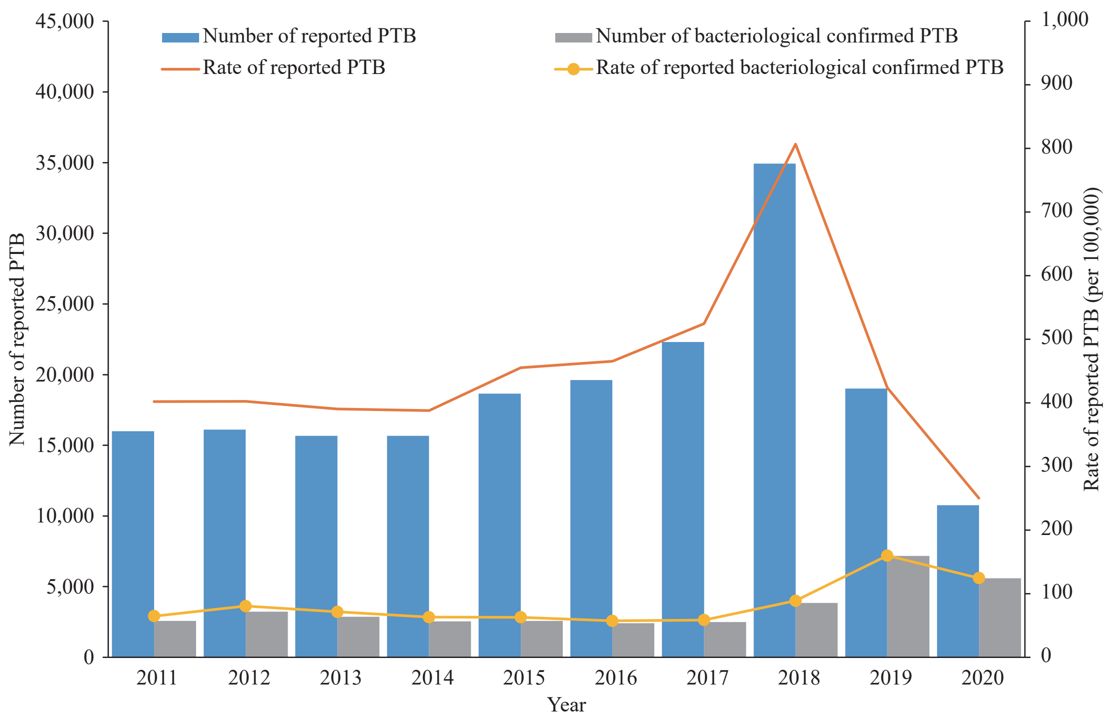

FIGURE 1. The number and case notification rate of reported pulmonary tuberculosis (PTB) in Kashgar, 2011–2020.

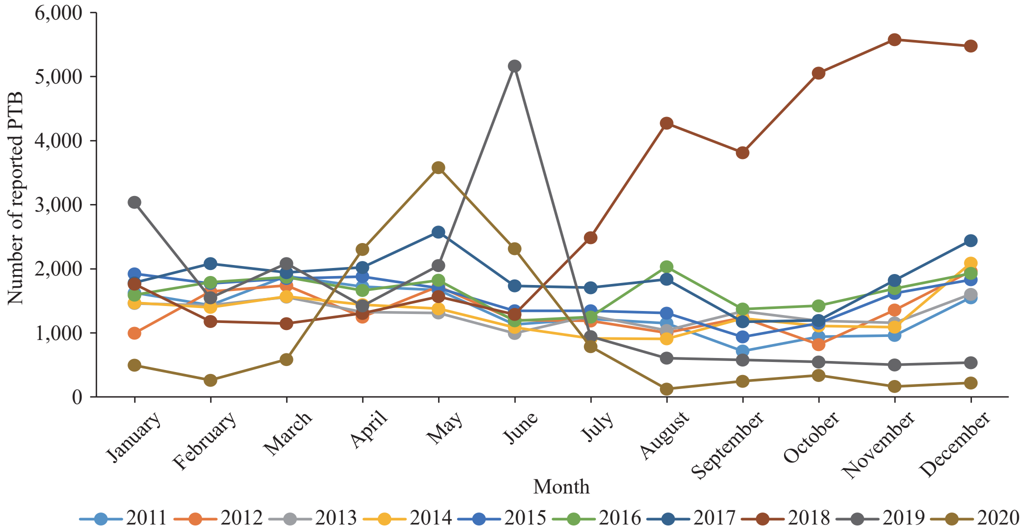

FIGURE 2. Monthly distribution of reported pulmonary tuberculosis (PTB) cases in Kashgar, 2011–2020.

TABLE 1. Age distribution of reported pulmonary tuberculosis cases in Kashgar, 2011–2020.

Age (years)	Number of reported cases (n)	Total population	Average reported incidence (1/100,000)
0–4	207	4,198,100	4.93
5–9	161	4,021,820	4.00
10–14	619	3,204,956	19.31
15–19	3,265	3,725,311	87.64
20–24	5,293	4,5641,71	115.97
25–29	6,097	4,132,047	147.55
30–34	5,755	3,249,461	177.11
35–39	5,624	3,104,012	181.18
40–44	6,590	2,706,171	243.52
45–49	8,918	2,299,515	387.82
50–54	12,244	1,740,359	703.53
55–59	18,392	1,435,042	1,281.63
60–64	27,393	1,381,596	1,982.71
65–69	32,820	963,946	3,404.76
70–74	26,498	627,976	4,219.59
75–79	17,052	341,857	4,988.05
80–84	7,910	182,041	4,345.17
85+	4,578	94,112	4,864.42
Total (average)	189,416	41,972,493	451.29

189,416), which accounted for 94.86% of all cases (179,67/189,416). The reported average annual PTB rates in Kashgar Prefecture were from Yengisar County (828.09/100,000), Zepu County (656.56/100,000), Yopurga County (556.22/100,000), Shule County (505.57/100,000), Yecheng County (477.00/100,000), Shache County (447.24/100,000), Shuhu County (396.88/100,000), Makit County (377.93/100,000), Bachu County (349.90/100,000), Kashgar City (341.33/100,000), Payzawat County (339.82/100,000), and Tashkurghan County (126.68/100,000). The 4 counties in southern Kashgar (Yecheng, Zepu, Shache, and Yengisar) accounted for 50.33% of all cases (95,335/189,416).

DISCUSSION

The results showed that the rate of reported PTB in Kashgar increased from 402.18/100,000 in 2011 to 524.64/100,000 in 2017 and declined from 806.75/100,000 in 2018 to 250.74/100,000 in 2020, with a significant downward trend in the last three years, declining to the lowest level in 2020. This is mainly due to the launch of TB screening as part of universal health check-up in Kashgar in 2018, in which TB screening test and treatment were provided to people over 15 years old, and about 2700,000 persons were screened each year. The early detection of large numbers of TB patients has been the primary cause for the significant rise in the CNR of PTB in 2018, and the secondary cause was the launch of the "New TB Prevention and Treatment Service System". Since the launch of the system, referrals within the designated hospitals enhanced patient compliance, reduced patient loss to follow-up, and ensured timely reporting of PTB cases. Meanwhile, Kashgar has implemented a policy of 100% reimbursement of outpatient care cost for suspected TB patients and over 90% reimbursement of inpatient care cost for TB patients from 2018, which

TABLE 2. Gender distribution of reported pulmonary tuberculosis cases in Kashgar, 2011–2020.

Year	Male			Female		
	Number of cases	Population	Incidence (1/100,000)	Number of cases	Population	Incidence (1/100,000)
2011	7,929	2,034,894	389.65	8,073	1,944,510	415.17
2012	7,800	2,005,603	388.91	8,311	1,998,390	415.88
2013	7,717	2,010,057	383.92	7,955	2,002,272	397.30
2014	7,525	2,036,026	369.59	8,153	2,003,363	406.97
2015	8,884	2,053,422	432.64	9,777	2,044,954	478.10
2016	9,522	2,133,707	446.27	10,098	2,080,940	485.26
2017	11,180	2,121,851	526.90	11,126	2,129,834	522.39
2018	17,981	2,149,467	836.53	16,950	2,180,376	777.39
2019	10,539	2,234,589	471.63	8,476	2,253,754	376.08
2020	6,046	2,270,730	266.26	5,370	2,283,754	235.14
Total	95,123	21,050,346	451.88	94,289	20,922,147	450.67

has raised the awareness of voluntary health care seeking of the public.

This study found that the proportion of Bac+ PTB cases in Kashgar increased from 16.10% (2,577) in 2011 to 55.48% (6,336) in 2020. The New TB Prevention and Treatment Service System was launched in 2013. In the early stage of the system operation, the quality of sputum collection and laboratory testing declined due to short of TB professionals at designated hospitals and lack of technical capacity. Thus, a downward trend in the rate of reported Bac+ patients was observed. Since 2018, the proportion of Bac+ PTB cases has increased significantly, which was related to the combination of smear, culture and molecular biological testing for TB suspects detected by universal health checkups, as well as the improvement in diagnosis (*6*).

In terms of temporal distribution, the highest number of PTB cases were reported in December and January each year, suggesting that winter was the peak season for PTB in Kashgar, which was similar to the findings of other studies (*7–8*). Possible causes for this included increased chances of survival and transmission of MTB in rural Kashgar during winter when coal was burned for heating, doors and windows were closed, rooms were crowded, and heatable brick beds were carpeted. On the other hand, autumn and winter were the slack farming seasons, in which the possibility of visiting the clinic would increase if people got sick (*9*). The highest reported PTB cases occurred in the second half of 2018, June of 2019, and May of 2020, which was coincident with the launch of the local TB control policies and the implementation TB screening as part of the local universal health checkup program launched at different month.

In terms of gender distribution, the number of male patients versus that of female patients increased over the years in Kashgar during 2011–2020. Possible causes included that as men in rural areas had more opportunities to go out to work, they became more mobile and easily to get infected. Some of their behaviors such as smoking and drinking could increase the chances of TB infection. In terms of age, the rate of reported PTB remained steady for patients aged 15–50 years, with a rising trend starting from 50 years of age, peaking at around 65 years of age, then declining rapidly. The peak in men was significantly higher than that in women at around 75 years of age. Overall, the distribution trend was similar to that of other prefectures of Xinjiang Uygur Autonomous Region and other provincial-level administrative divisions (*10*). The rise in the rate of reported PTB in the age groups above 50 years of age was similar to that of the whole Xinjiang Uygur Autonomous Region (*11*). The elderly population had lower immunity and was prone to comorbidity with other underlying diseases, making them a high-risk group for the reactivation of latent TB and development of new TB. In addition, the symptoms of TB in this group were usually atypical and could be easily ignored in diagnosis or misdiagnosed (*12*). Therefore, symptom monitoring, active screening, and other approaches should be leveraged to increase the early detection of TB for the elderly people (*13*). In terms of occupation distribution, the majority of TB patients in Kashgar were farmers, which was similar to that of other parts of China and other prefectures in Xinjiang. The TB incidence was closely related to economic level. Low-income groups were at higher risk and, together with the general low education level and low health literacy, led to less access to TB services because of rural location, longer working hours, and therefore more susceptibility to TB infection (*9*).

In terms of geographic distribution, the ranking of each county/city for the rate of reported PTB varied each year. It was worth noting that the 4 southern counties of Kashgar accounted for 50.33% of the total number of reported cases with the highest rate of reported PTB in the prefecture. The serious TB epidemic affecting these 4 counties was related to an underdeveloped economy that mainly depended on agriculture and animal husbandry, the poor living conditions, and the poor health awareness of the residents. Therefore, TB response in these 4 counties should be strengthened.

This study systematically analyzed the epidemiological characteristics of the reported PTB cases in Kashgar from 2011 to 2020, and provided a basis for TB control and prevention. At the same time, there are certain limitations in terms of time distribution and regional distribution, this study only analyzed the overall characteristics of the cumulative number of PTB cases in the past 10 years, further research is needed to reveal the temporal and spatial characteristics of the incidence of PTB in Kashgar. In summary, the continuous improvement of new TB service systems, coupled with the successful implementation of the universal health check-up program, has led to effective control of the TB epidemic in Kashgar, but a large gap is still existed between the rate of reported PTB in Kashgar and the national average in 2020. The next step should focus on the improvement of TB prevention and control in Kashgar, especially the 4 southern counties and the reinforcement of TB case detection. On the basis of routine prevention and control of COVID-19 epidemic, continued efforts should be made to screen key populations for TB and promote the TB screening as part of the universal health check-up and treatment program, which strives for early detection, diagnosis, and treatment of TB patients (*14*). Continued efforts should also be made to promote the application of new diagnostic techniques, increase education about and awareness of changing in unhealthy lifestyles, and reinforce the universal screening and treatment of TB, especially among the elderly people, men, and farmers, to further control the TB epidemic in Kashgar, strive to achieve the goals set in the *Action Plan to Stop Tuberculosis (2019–2022)* in Kashgar, and reach the relevant targets of the "Healthy China 2030" and "Poverty Alleviation in China".

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Outbreak Reports

A Tuberculosis Outbreak During the COVID-19 Pandemic — Hubei Province, China, 2020

Dan Li[1]; Xiaowang Peng[2]; Shuangyi Hou[3]; Tao Li[4,#]; Xue-jie Yu[1,#]

Summary

What is already known about topic?

Multidrug-resistant tuberculosis (MDR-TB) has become a growing threat to public health. There were few reports about family-to-school MDR-TB outbreaks in China, especially during the coronavirus disease 2019 (COVID-19) pandemic.

What is added by this report?

A tuberculosis (TB) outbreak happened in Hubei Province during the COVID-19 pandemic. The transmission chain was probably from a father（MDR-TB case）with retreated TB history to his daughter, who then spread TB to her classmates.

What are the implications for public health practice?

We should enhance TB control both in schools and households, including strengthening TB/MDR-TB detection, health education, and ventilation. The TB contact screening cannot only be limited to outside school settings and should be conducted in the school when a TB student is absent from school for 2 or 3 months, or even longer especially during the COVID-19 pandemic.

On April 17, 2020, 10 days after the coronavirus disease 2019 (COVID-19) pandemic lockdown ended and before schools reopened in Hubei Province, China, a hospital reported a student tuberculosis (TB) pleurisy case. The local CDC verified the case and conducted close contact screening and epidemiological investigations immediately. As a result, 6 active TB cases including 5 students [1 multidrug-resistant tuberculosis (MDR-TB) case, 1 rifampin-resistant TB (RR-TB) case, and 3 clinically-diagnosed TB case] and 1 student's father (MDR-TB) were identified.

INVESTIGATION AND RESULTS

The outbreak occurred at a senior high school with a total of 576 students and 82 staff members. The index case was a 17-year-old female student in Grade 2 (equivalent to 11th Grade), who complained of left side chest pain while breathing since March 10, 2020, during the COVID-19 pandemic lockdown, and was clinically diagnosed as TB pleurisy with left pleural effusion through chest X-ray on April 17 at a local TB designated hospital. Epidemiological investigation showed she stayed at home without going out from January 15 to the onset date because of the COVID-19 pandemic and community lockdown and had no history of TB clinical symptoms in the previous semester.

Close contact screening was first performed in the household of the index case. Household contacts including parents were excluded for TB because of lack of clinical symptoms and had negative laboratory test results. Then, TB screening was performed among classmates and faculty who shared a classroom with the index case according to the *National Norms of Tuberculosis Prevention and Control in School* (2017) (*1*). As a result, 20 out of 82 students (24.4%) and 1 of 9 faculty (11.11%) had strong positive purified protein derivatives tuberculosis (PPD) with tuberculin skin test (TST) without difference (Fisher's exact: 1 tailed P=0.336). Among 20 strong positive PPD students, further GeneXpert and anti-TB drug sensitivity test (DST) indicated 4 were active pulmonary TB including 1 MDR-TB resistant to rifampin (R), isoniazid (H), and ofloxacin (O); 1 RR-TB (GeneXpert MTB/RIF positive with negative culture result); and 2 clinically-diagnosed TB. The rest of the faculty (n=1) and students (n=16) with strong positive PPD were diagnosed as latent tuberculosis infection (LTBI). All TB cases in this outbreak were diagnosed and classified according to the national TB diagnosis and classification standards (*2–3*). The screening was expanded to students and faculty members who have classrooms on the same floor with the TB cases, and 1 out of the 78 students (1.3%) was diagnosed as LTBI (Figure 1).

The total attack rate among students after close contact screening was 2.5% (4/160) for active TB

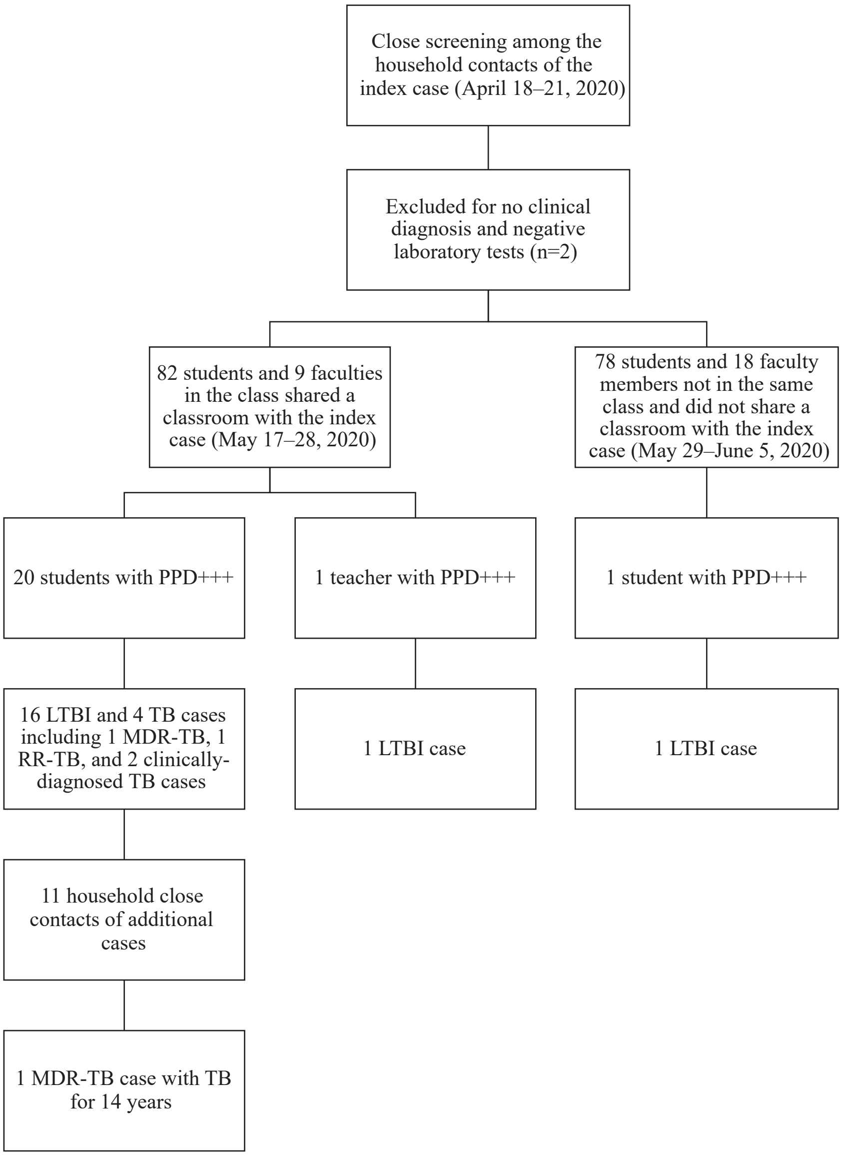

FIGURE 1. The flow chart of close contact screening and case finding of the MDR-TB outbreak — Hubei Province, China, 2020.
Note: PPD+++, strong positive PPD with induration above or equal to 15 mm and/or blisters, lymphangitis, or necrosis.
Abbreviations: MDR-TB=multidrug-resistant tuberculosis; TB=tuberculosis; RR-TB=rifampin resistant tuberculosis; LTBI=latent tuberculosis infection; n=number.

cases, 13.1% (21/160) for strong positive PPD, and 10.6% (17/160) for LTBI cases. For students sharing the same classroom with the index-case, the attack rate was 4.9% (4/82) for active TB cases, 24.4% (20/82) for strong positive PPD, and 19.5% (16/82) for LTBI cases. The risk ratio (RR) of being strong positive PPD and LTBI in the shared classroom with the index case was 19 and 15 times higher, respectively, than that of students who did not share the same classroom as the index patient. No active TB cases were identified in students who did not share the same classroom with index-case on the same floor.

Epidemiological investigation showed these 4 additional active TB cases, identified among students who shared the same classroom with the index case, stayed at home and scarcely went out from January 15 to May 17 (TB screening began) because of the COVID-19 pandemic lockdown. Among these 4 additional active TB cases, the MDR-TB student patient experienced a chronic cough for a half year since late November 2019 and had attended school for 2 months since she became ill until the school holiday on January 15, 2020. She did not declare illness in the school or visite a doctor, but only self-medicated by using common cough medicine. Retrospective investigation in her family showed that her father had a TB history for 14 years with 3 recorded times of hospital TB treatment records before the current investigation (2007, 2011, and 2013). He was eventually diagnosed as an MDR-TB case with the same drug resistance (R, H, and O resistant) in later May 2020. When investigating the TB-related knowledge in this family, members showed poor awareness about TB transmission and the potential threats.

The MDR-TB student had clinical symptoms earlier than the index case and was likely the most probable initial case in her class. She had a cough for 2 months since November 2019 while attending school. From November 2019 to January 2020, it was winter and the local temperature ranged from 1 to 10 ℃. During the wintertime, the school used air conditioning units to heat classrooms and rarely opened doors and windows for ventilation, which might have promoted the spread of mycobacterium tuberculosis (MTB) in the classroom. The school also failed on routine prevention and control measures such as morning and noon inspection of students for illnesses. The teachers and students did not have strong knowledge on suspected TB symptoms, which delayed detection and treatment.

All active TB cases were treated and managed by municipal and provincial expert groups, and suspension and resumption of school attendance were implemented according to national guidelines (*1*). All contacts with strong positive PPD reactions and normal chest X-ray results were routinely monitored and given chest X-ray reexaminations at 3, 6, and 12 month follow-ups. The results of follow-up checks showed that students and staff with strong positive of PPD had not developed any active TB as of June 15, 2021.

DISCUSSION

We reported a TB outbreak in a senior high school in Hubei Province, China, 2020. The cases were diagnosed 10 days later after the COVID-19 pandemic lockdown and before schools reopened. Although lacking of gene homology verification, the outbreak was identified based on field investigation and drug resistance results as a family-to-school related outbreak of MDR-TB. All likely subsequent TB cases were in the same class. Among the 17 LTBI cases, 16 cases were found in students sharing the same classroom with the index patient and there was only 1 exception. The risk ratio of being strongly positive PPD and LTBI in the students who were in the same classroom with the index patient was significantly higher than that of students who were not in the same classroom with the index patient. All 3 confirmed TB cases in this study were drug-resistant (2 MDR-TB and 1 RR-TB). More than 75% (82% in 2017, 78% in 2018, and 78% in 2019) of RR-TB had MDR-TB according to Global Tuberculosis Report. Considering the illness history and close contact history of each case, it was assumed that the MDR-TB student got TB from her father and disseminated TB to her classmates, although other sources of infection could not be excluded due to lack of genetic testing.

Our research has exposed some problems and challenges of TB prevention and control. First, the MDR-TB student's father had TB for 14 years, but he was never diagnosed as MDR-TB until this investigation. The father had records of three previous hospital TB treatment courses before this investigation but was likely not identified because drug sensitivity tests are not routinely carried out in this area. Second, the MDR-TB student's father had a long chronic TB history, but his low awareness of TB-related knowledge suggested a lack of public health education in local society. Third, the first MDR-TB student had a cough for 2 months, but the student continued to attend school until the winter holiday. This put other students at risk of TB/MDR-TB, indicating a lack of knowledge of TB prevention among senior middle students and faculty members. Finally, the ventilation of the classroom was insufficient. Two air conditioning units that could provide heating were used in the winter in the classroom with inadequate frequency of opening the window for ventilation. As a result of high-speed economic development, most schools are equipped with air conditioners in China, and the lower ventilation may increase risk of transmission of TB.

There were few reports about the outbreak of MDR-TB in China, especially during the COVID-19 pandemic (*4*–*5*). Due to the COVID-19 lockdown, the index TB case was absent from school for about three months prior to diagnosis. This outbreak indicated that TB contact screening cannot be ignored in the school when a student was diagnosed as a TB case although she/he may be absent from school for 2 or 3 months. Although genotyping methods to investigate the source in a school TB outbreak were effective, lack of gene homology verification due to the COVID-19 pandemic and restrictions on local laboratory conditions was the limitations in this study.

This family and school related outbreak of MDR-TB was caused by an absence of MDR-TB diagnosis knowledge and lack of overall TB knowledge. We suggest sustained efforts should be made to enhance TB health education in the community on topics such as transmission and common symptoms. We also suggest strengthening TB control mechanism in schools including morning inspections, illness tracing, and infection control activities (e.g., ventilation especially for air-conditioned places).

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Healthy China

Practical Experiences of Delivering Multidrug-Resistant Tuberculosis Comprehensive Supportive Care Services in China

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Summary

What is already known about this topic?

The World Health Organization consolidated guidelines on recommend care for tuberculosis (TB) and support for multidrug-resistant TB (MDR-TB) patients. But guidelines have not provided detailed guidance or tools for health services providers to implement comprehensive patient care.

What is added by this report?

China CDC and the United States Agency for International Development-funded Control and Prevention of MDR-TB program introduced a differentiated and personalized comprehensive and supportive care services (CSC) to improve treatment adherence.

What are the implications for public health practice?

The CSC model helps MDR-TB patients complete treatment and improve treatment success rates, and scaling up the program and implementation in other parts of the country is worth consideration.

BACKGROUND

According to Global Tuberculosis Report 2020 (*1*), the global treatment success rate for multidrug-resistant tuberculosis (MDR-TB) is 57%, far below the World Health Organization (WHO) target of curing at least 75% of MDR-TB patients. China — with a treatment success rate of 54% in 2019 — is no exception; nearly half of all treated MDR-TB patients are lost to follow-up, treatment failure, or death. Failure to support patients throughout the treatment process leads to incomplete treatment, treatment failure, and associated morbidity and mortality, and it also wastes significant financial resources the health system invested in MDR-TB diagnosis and treatment (*2*–*3*). More importantly, patients continue to suffer. They are not only at risk of developing extensive drug resistant tuberculosis (XDR-TB), but also of transmitting MDR-TB to their families and communities, increasing the incremental burden of MDR-TB patients, and fueling a growing public health crisis.

The WHO proposes that providing patient care services improves treatment adherence, helps patients complete treatment, and improves overall cure rates (*4*–*5*). However, the WHO guidelines have not provided detailed guidance or tools for national tuberculosis control programs and health services providers to implement comprehensive patient care (*6*–*7*). In 2017, China CDC and the United States Agency for International Development-funded Control and Prevention of MDR-TB program implemented by Family Health International (FHI360), introduced a differentiated and personalized comprehensive and supportive care services (CSC). The CSC framework, which was based on global MDR-TB guidelines but adapted to China's context, and included 4 thematic areas and 11 elements (*8*) which were piloted in selected sites in China to explore how to provide practical care services for MDR-TB patients (Table 1).

PILOT SELECTION AND KEY CONTENT

Beginning in June 2017, China CDC and FHI360 selected 6 cities (Jinan, Urumqi, Zhenjiang, Yichang, Wuhan, and Kunming) across 5 provincial-level administrative divisions (PLADs) (Shandong Province, Xinjiang Uygur Autonomous Region, Jiangsu Province, Hubei Province, and Yunnan Province) from the east to the west — chosen based on having a large number of MDR-TB patients and demonstrating good inter-agency cooperation — to pilot the CSC model. Each pilot site established a "care team" comprised of local CDC staff, clinical doctors, and nurses from designated TB hospitals, community/village physicians, and patient volunteers. They conducted a series of training on a range of topics including the following: standardized diagnosis and treatment management of adverse reactions for healthcare providers; counselling skills for nurses; community-based patient management, infection control at the households of

TABLE 1. The supportive care services framework – thematic areas and elements.

Thematic areas	Elements
Respect for patient autonomy and support of self-efficacy strengthened	Patient intake assessment and individual care plan Patient and family education on treatment Support treatment and care accessible to patients
Maximizing physical comfort, safety, and wellness among MDR-TB patients	Monitoring and treatment of adverse drug effects and co-morbid physical conditions Nutritional support Palliative care
Strenghtening psycho-emotional support and protection from social isolation or discrimination	Patient-centered counselling throughout care Monitoring and treatment of mental health conditions Support for reducing social isolation Protect patient and family from stigma and discrimination
Preventing catastrophic costs to patient and family strengthened	Patient cost saving or reduction activities

MDR-TB patients, and management of adverse reactions for community and village doctors; and treatment adherence support for volunteers.

During the pilot, providers focused on several key points over the course of treatment — this included nurses working with patients during in-hospital treatment to formulate a patient rehabilitation plan and provide support for a range of patient-centered care services including patient education and counselling for treatment decision making, taking daily medication, dealing with mild adverse reactions, providing sputum samples, and diet and nutrition. When discharged from the hospital, the local CDC system was mobilized for rapid connection of patients with community/village doctors for follow-up management. These community-based staff tracked patients to avoid loss to follow-up, and when patients went back to the hospital for check-ups, green channels were established for convenience for the patients. Lastly, medical staff and peer volunteers provided diversified social support services which included hotline calls for medical staff to answer healthcare questions, the establishment of 57 Zone patientcare social media communication groups via QQ or WeChat platforms, the Baidu TB online forum, provision of peer support, and volunteer services by public interest lawyers.

EFFECTIVENESS AND EXPERIENCE

The pilot has achieved remarkable results. Pilot sites provided comprehensive care services for existing and newly enrolled MDR-TB patients between July and September 2017. By the end of the pilot in March 2020, 232 MDR-TB patients had received care services for the full course, with a treatment success rate of 73% (compared to 42% for a historical cohort in 2015). Loss to follow-up decreased from 15% in 2015 to 3% during the pilot period, and self-reported satisfaction with services increased among MDR-TB patients (*9*). The model was also well accepted by healthcare staff and, at present, 5 pilot PLADs have become demonstration sites to replicate the CSC model across China. The national CDC established a national core team of counselling trainers with proven field experiences and ability from the pilot PLADs. They developed a series of illustrated tool kits to ensure care services were replicated with fidelity. The CSC model has been gradually rolling out and by December 2020 there were 45 prefectures and cities across 13 PLADs implementing the supportive care services for MDR-TB patients. Care services have also been incorporated into the national TB control work standards and guidelines. Finally, the practical experiences gained during the pilot project have been compiled into an operational manual, which will be published soon.

KEY EXPERIENCES IN THE PILOT PROCESS AS BELOW

The traditional lack of emphasis on patient care services should be changed. Care services are not a “nice to have” extra, they are a core component of effective, patient-centered MDR-TB treatment. However, ensuring comprehensive, patient-centered care and treatment services also requires that CDCs, designated TB hospitals, and community health institutions make effective and coordinated use of their respective advantages and strengths.

Communication and cooperation between CDCs, designated TB hospitals, and community health institutions is a precondition for launching the supportive care services. Before this model can be implemented, it is necessary to clarify respective responsibilities, establish a cooperative process, and optimize internal working processes among these organizations.

Training and follow-up demonstration and mentoring are key to implementing care services. As this model has been replicated, there has been a need for experienced demonstration sites and for experienced and skilled counsellors and TB clinicians. These experienced implementers can provide training and technical support and share successful innovations with the new expansion sites, whose providers can strengthen their skills in problematic areas such as case management for MDR-TB patients, patient adherence to regularly scheduled treatment monitoring visits, and compliance with the required sputum testing.

CHALLENGES & PERSPECTIVE

Early diagnosis and standardizd treatment create a solid foundation for the success of the CSC model for MDR-TB. There remains a huge gap, however, that nearly 20% of the prefectures in China do not have the capacity to diagnose MDR-TB rapidly and approximately 25% of the patients confirmed positive for MDR-TB will not be able to receive treatment due to their inability to pay for costly anti-TB drugs. In 2019, the Chinese Government developed the 2019–2022 National Action Plan To Stop Tuberculosis with joint political commitment from 8 ministries (*10*), which requires that the local governments of all the prefectures should put rapid diagnosis and standardized treatment of drug resistance TB in place by 2022. The mandate will result in promising solutions to the existing challenges and lead to greater MDR-TB treatment success.

In the meantime, the CSC model has proven to be instrumental in bridging the following gaps at the individual patient level: 1) raising presumptive MDR-TB patients' awareness for use of rapid diagnosis; 2) facilitating well-informed decision making and preparedness among the confirmed MDR-TB patients for timely diagnosis and proper treatment; and 3) providing psychosocial support to strengthen their capacity to cope with the challenges in their MDR-TB treatment to reach cure.

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