Preplanned Studies

Predicted Impact of the COVID-19 Responses on Deaths of Tuberculosis — China, 2020

Caihong Xu[1,&]; Tao Li[1,&]; Dongmei Hu[1]; Hui Zhang[1]; Yanlin Zhao[1,#]; Jianjun Liu[1,#]

Summary

What is already known about this topic?

The World Health Organization has estimated the impact of reductions in the performance of global tuberculosis (TB) detection and care on TB deaths. However, the actual impact of COVID-19 pandemic on TB deaths in China remains unclear.

What is added by this report?

The stringent public interventions to fight COVID-19 including lockdown led to more than 20% decrease of TB detection in China. It was predicted that the reduction of TB detection might result in 11,700 excess deaths based on assumption of no detection rebound. Based on the prediction the total deaths will be 51,100 in 2020 which might surpass the deaths in 2011.

What are the implications for public health practice?

Rapid restoration of TB diagnosis and care services is critical for minimizing the potential effects on TB-related deaths and bringing TB burden back to control. It is urgent to ramp up case detection including active case finding and to provide an uninterrupted supply of quality-assured treatment and care for TB cases in post-COVID-19 outbreak.

In order to reduce transmission of coronavirus disease 2019 (COVID-19), China implemented a series of public health interventions including cancelling public transportation; prohibiting public gatherings; closing schools, libraries, and other public spaces; recommending a 14-day home quarantine for individuals from highly-affected areas; and deploying a large amount of resources and dispatched health workers to fight the epidemic (*1*–*3*). All these interventions have successfully brought COVID-19 under control. But at the same time, these interventions have adversely affected other public health issues that deserve the public's concern and should be addressed including tuberculosis (TB) control (*4*–*5*).

TB is a bacterial disease predominantly affecting the lungs. During 2018, an estimated 10 million new TB cases occurred globally, while 0.86 million cases were registered in China, which ranks second in the world (*6*). Although, TB-related mortality declined from 8.7/100,000 person-years (PY) in 2000 to 2.6/100,000 PY in 2018, TB still caused an estimated 39,400 deaths (including TB/HIV deaths) in 2018 in China (*7*).

Some studies have discussed the possible impact of COVID-19 on the performance of TB control regarding diagnosis, treatment, and management (*8*). The World Health Organization (WHO) has estimated the impact of reductions in the performance of global TB detection and care on TB deaths (*9*). However, the actual impact of COVID-19 pandemic on TB deaths in China remains unclear.

The TB detection data was extracted from Tuberculosis Information Management System (TBIMS) on July 15, 2020. Considering the epidemic of COVID-19, the study estimated excess TB deaths in 3 geographic areas (Wuhan City, Hubei Province and China overall) and 4 phases (Phase I: January 23, 2020 to February 11, 2020; Phase II: February 12, 2020 to March 24, 2020; Phase III: March 25, 2020 to April 8, 2020; Phase IV: April 9, 2020 to June 30, 2020). These phases were divided based on 4 events: 1) January 23, 2020, lockdown of Wuhan City; 2) February 11, 2020, China CDC issued a notice to guide management of TB patients during the COVID-19 epidemic; 3) March 24, 2020 (World TB day), China promoted a campaign of "Jointly fighting COVID-19 and TB, and breathing healthy together" and the National Health Commission issued a "Notice on Further Strengthening TB Control and Prevention" and 4) April 8, 2020, China lifted the 76-day lockdown on Wuhan which meant the whole country started gradually returning to normal life.

Excess TB mortality ΔM resulting from the perturbation to TB detection was calculated using the following formula (*9*):

$$\Delta M = \sum_{h} \left[(1-d) \left(f_u^h - f_t^h \right) T^h \right] \quad (1)$$

The perturbation d of TB detection was expressed in terms of a reduction in the number of treated cases as compared to the expected number in the absence of the COVID-19 pandemic. Subscript u denotes untreated TB and subscript t denotes treated TB. Distributions of f are taken from the death surveillance points of China. It is assumed that the value of d is the same among HIV-positive and HIV-negative individuals. The h represent HIV status.

The number of detected active TB cases in China, Hubei, and Wuhan were found to decrease by 20%, 29%, and 44%, respectively, during January 23 to June 30, 2020 when compared with the same period in 2019. The highest reduction appeared in phase I nationwide and in phase II in Hubei and Wuhan. Wuhan had an especially large reduction at 74% (Figure 1).

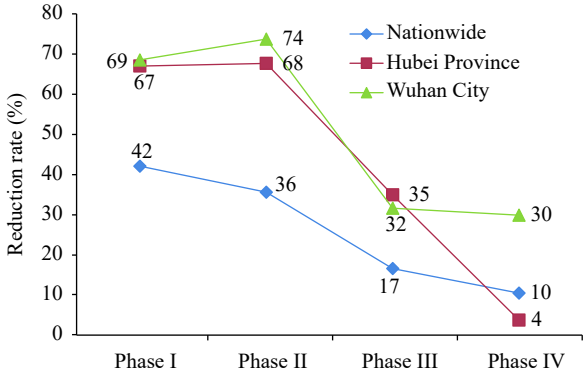

FIGURE 1. The reduction in tuberculosis case detection in China overall, in Hubei, and in Wuhan in different phases in 2020.
Phase I: January 23, 2020 to February 11, 2020; Phase II: February 12, 2020 to March 24, 2020; Phase III: March 25, 2020 to April 8, 2020; Phase IV: April 9, 2020 to June 30, 2020.

The estimated additional TB deaths would be 186 cases, 760 cases and 11,700 cases which brought the total TB deaths to 478 cases, 2,520 cases and 51,100 cases in Wuhan, Hubei, and China, respectively. The estimated nationwide number of deaths surpassed the level of TB deaths in 2011 (50,900) and caused a serious setback in the progress towards the End TB strategy milestones and targets. More than half of the

TABLE 1. The predicted number of tuberculosis deaths including tuberculosis (TB) deaths in HIV-negative and in HIV-positive cases during different phases in China overall, in Hubei, and in Wuhan in 2020.

	Perturbation	Predicted excess deaths among HIV-positive cases (N)	Predicted excess deaths among HIV-negative cases (N)	Predicted total excess deaths (N)	Excess deaths/annually deaths in 2018 (%)
Wuhan City					
Phase I	0.962	0	34	34	11.8
Phase II	0.915	1	77	78	26.6
Phase III	0.987	0	12	12	4.1
Phase IV	0.932	1	61	62	21.3
Subtotal		2	184	186	63.8
Hubei Province					
Phase I	0.963	2	201	203	11.5
Phase II	0.963	4	427	430	24.4
Phase III	0.986	1	79	79	4.5
Phase IV	0.922	0	47	47	2.7
Subtotal		6	753	760	43.1
Nationwide					
Phase I	0.977	24	2,827	2,851	7.2
Phase II	0.959	43	5,022	5,065	12.9
Phase III	0.993	7	835	842	2.1
Phase IV	0.976	25	2,917	2,942	7.5
Total		98	11,601	11,700	29.7

Note: The study estimated excess TB deaths in 3 geographic areas (Wuhan City, Hubei Province and China overall) and 4 phases (Phase I: January 23, 2020 to February 11, 2020; Phase II: February 12, 2020 to March 24, 2020; Phase III: March 25, 2020 to April 8, 2020; Phase IV: April 9, 2020 to June 30, 2020).

excess deaths were due to the reduction in case in Phase II. The estimated excess deaths during the COVID-19 pandemic accounted for 63.8%, 43.1%, and 29.7% of annual deaths in Wuhan, Hubei, and China, respectively (Table1).

DISCUSSION

Our study showed that stringent responses to COVID-19 that have slowed transmission of the virus also caused and might continue causing disruptions to TB programs in the short and long terms. Lockdowns have already severely reduced TB notification rates by 20%–44% in various areas between January 23 and June 30, 2020. The reduction in TB detection during the 5-month period was estimated to lead to a 30% increase in TB deaths in 2020, bringing the total TB deaths to 51,100 TB, which will setback progress in reducing TB deaths to levels seen in 2011 in China. Globally, the 3-month lockdown is estimated to reduce TB detection rates by 50% and bring the number of TB deaths to 1.85 million, which is similar to global levels seen in 2012 (*9*).

The public interventions to fight the COVID-19 pandemic adversely impacted TB detection and mortality in the following ways. First, the restriction of traffic has created barriers for patients to access healthcare, difficulties for health providers in tracing presumptive TB cases, transporting sputum samples, managing TB patients' daily medication, and visiting patients' households for close contact tracing. Second, healthcare staff from TB programs, TB laboratories, and TB wards have been re-assigned to fight against COVID-19, which reduced capacity of TB diagnosis, treatment, and management. Third, concerns of COVID-19 transmission has reduced willingness of patients to visit health facilities. Finally, supply interruptions and low supplies of TB drugs and lack of care for TB cases could lead to delays in initializing TB treatment or involuntary treatment interruption.

The results of the study need to be interpreted with caution since the estimation of the excess deaths was on the assumption that the beneficial effect of lockdown and social distancing policies on TB reproductive number may be offset by increased duration of infectivity under lower case detection and treatment performance. The estimation did not address the interaction between TB and the COVID-19 virus.

Our results have certain implications for the National Tuberculosis Program (NTP) in China. Generally, rapid restoration of TB diagnosis and care services is critical for minimizing the potential effects on TB-related deaths and bringing TB burden back to control. Specifically, it was pivotal to maintain awareness of recognizing and responding to symptoms suggestive of TB; it is urgent to ramp up case detection including active case finding and to provide an uninterrupted supply of quality-assured treatment and care for TB cases. Systemic evaluation, referral, and management of complications at diagnosis of the disease should also be prioritized. Meanwhile, the COVID-19 pandemic also provided opportunities for simultaneous testing of TB and COVID-19, better implementation of infection control measures, and effective contact tracing investigations.

This study was subject to some limitations. Only the excess deaths caused by declines in detection of TB patients were estimated, while the impact on TB deaths may be more complicated. For example, measures devoted to screening based on symptoms and temperature monitoring during the disease-response period may increase the sensitivity of patients' detection. In addition, results among different areas with different controls strategies were not compared to further measure potential impact of the lockdowns.

In conclusion, the response to fight the COVID-19 pandemic has caused directly impacted TB case detection and might result in potential effects on TB deaths, which may wipe out the TB control program efforts made in the last few years. To cope with the adverse effects, comprehensive measures should be implemented in the aftermath of the pandemic, including strengthening human resources for TB control, scaling up of laboratory testing, ensuring an uninterrupted supply of medicines, providing holistic treatment management care, and other measures. These will help to ensure timely TB diagnosis and full course treatment for all TB cases.

Acknowledgement: Dr. Philippe Glaziou; Dr. Hemant Deepak Shewade.

Funding: JY 18-2-18 Acceptability of preventive treatment among close contacts of tuberculosis.

doi: 10.46234/ccdcw2021.004

[#] Corresponding authors: Yanlin Zhao, zhaoyl@chinacdc.cn; Jianjun Liu, liujj@chinacdc.cn.

[1] Chinese Center for Disease Control and Prevention, Beijing, China.
[&] Joint first authors.

Submitted: August 25, 2020; Accepted: September 27, 2020

REFERENCES

1. Pan A, Liu L, Wang C, Guo H, Hao XJ, Wang Q, et al. Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. JAMA 2020;323(19):1915 – 23. http://dx.doi.org/10.1001/jama.2020.6130.
2. Tian HY, Liu YH, Li YD, Wu CH, Chen B, Kraemer MUG, et al. An investigation of transmission control measures during the first 50 days of the COVID-19 epidemic in China. Science 2020;368(6490):638 – 42. http://dx.doi.org/10.1126/science.abb6105.
3. Zhang JJ, Litvinova M, Liang YX, Wang Y, Wang W, Zhao SL, et al. Changes in contact patterns shape the dynamics of the COVID-19 outbreak in China. Science 2020;368(6498):1481 – 6. http://dx.doi.org/10.1126/science.abb8001.
4. Burdorf A, Porru F, Rugulies R. The COVID-19 (coronavirus) pandemic: consequences for occupational health. Scand J Work Environ Health 2020;46(3):229 – 30. http://dx.doi.org/10.5271/sjweh.3893.
5. Adepoju P. Tuberculosis and HIV responses threatened by COVID-19. Lancet 2020;7(5):e319 – 20. http://dx.doi.org/10.1016/S2352-3018(20)30109-0.
6. World Health Organization (WHO). Global tuberculosis report 2019. Geneva (Switzerland): World Health Organization; 2019. https://apps.who.int/iris/handle/10665/329368.[2020-08-10].
7. World Health Organization. WHO's global tuberculosis database. https://www.who.int/tb/data/en/. [2020-08-15].
8. Amimo F, Lambert B, Magit A. What does the COVID-19 pandemic mean for HIV, tuberculosis, and malaria control? Trop Med Health 2020;48:32. http://dx.doi.org/10.1186/s41182-020-00219-6.
9. Glaziou P. Predicted impact of the COVID-19 pandemic on global tuberculosis deaths in 2020. http://dx.doi.org/10.1101/2020.04.28.20079582. [2020-08-12].