

Preplanned Studies

Increased Incidence of Scarlet Fever — China, 1999–2018

Yuanhai You¹; Ying Qin²; Mark J. Walker³; Luzhao Feng²; Jianzhong Zhang^{1,*}**Summary****What is already known about this topic?**

Scarlet fever had high incidence between the 1950s and 1980s, but during the 1980s and 1990s, the incidence of scarlet fever dropped to a relatively low and stable levels in China.

What is added by this report?

Starting in 2011, scarlet fever incidence significantly increased in China. In the eight years between 2011 and 2018, 479,555 cases were reported, which exceeded the total number of 241,365 cases reported in the previous twelve years 1999–2010.

What are the implications for public health practice?

Both patient and pathogen epidemiological surveillance need to be heightened to monitor serious cases of scarlet fever and to implement timely control measures.

Scarlet fever is a common pediatric respiratory disease caused by *Streptococcus pyogenes* (Group A *Streptococcus*; GAS), which can also cause other mild infections such as pharyngitis and impetigo and serious invasive infections including necrotizing fasciitis. The major clinical manifestations of scarlet fever include sore throat, fever, diffuse red rash, and a “strawberry tongue” (1). China CDC affiliated researchers analyzed reported scarlet fever cases from 1999 to 2018 from the National Notifiable Diseases Reporting System (NNDRS) of Mainland China to determine incidence trends. In this period, 720,920 cases were reported with a sudden increase in 2011 and a peak incidence in 2018 of 5.68 cases per 100,000 population, which represents a 2018 total of 78,864 reported cases.

Scarlet fever was considered a fatal disease during 19th and early 20th centuries. The morbidity and mortality of scarlet fever dramatically dropped worldwide when antimicrobial drugs became widely used. Most scarlet fever cases are now diagnosed as mild infections, and fatal infections are now rare. However, a small proportion of cases still may develop serious sequelae.

Since 1950 in China, scarlet fever has been listed as

a Type B notifiable disease, which is required to be reported within 24 hours. According to previous analysis (2), the incidence of scarlet fever in China was high between the 1950s and 1980s and then dropped to a low level during the 1990s. In 2011, compared to the baseline level prior to the epidemic, a sudden 2.6-fold increase in the incidence of reported scarlet fever cases was recorded (2). Meanwhile, many other countries also reported significant increases of scarlet fever epidemics worldwide (3–6). The resurgence of scarlet fever has been a concerning public health problem globally.

In early 2019, an *emm12* genotype scarlet fever isolate related to UK scarlet fever outbreak strains was detected in Australia through sentinel hospital surveillance (7). The surveillance in China indicates that *emm12*-type GAS has been predominantly responsible for the scarlet fever resurgence since 2011. All isolates in China are susceptible to β -lactams but are mostly resistant to macrolide antibiotics (2).

Scarlet fever cases reported through the NNDRS of China from 1999 to 2018 were retrieved for analysis (2). Only verified clinic-diagnosed and laboratory-confirmed cases from Mainland China were included in the analysis, excluding Hong Kong, Macao, Taiwan, and foreign residents. Population size data from the China National Bureau of Statistics for denominators were used to calculate incidence rates of scarlet fever. Annual case number and incidence of reported scarlet fever from 1999 to 2018 were analyzed to investigate long term temporal trends. The geographic incidence data and case number were extracted from 1999 to 2018. After a comparison between each year, the incidence data for the year 2010 and 2018 were shown to reflect the variation of geographic incidence before and after the year 2011 when the outbreak started. The age data for scarlet fever incidence were also extracted and shown for the years 2010 and 2018 as representatives before and after the year 2011.

Between 1999 and 2018, there have been three peaks at four-year intervals including 2007, 2011, and 2015. A fourth peak has now been observed in 2018

with 78,864 reported cases and an incidence rate 5.68 per 100,000, which is the highest total over the last 20 years. The incidence increased 5.34% compared to that of 2017 (Table 1, Figure 1). Rare cases of death were reported during 1999 and 2018 (Table 1). The highest number occurred in 1999 with five reported deaths. There was one death in the 2011 epidemic, and in the following years, a total of five deaths were reported. Both 2010 and 2018 data show incidences of northern regions are higher than southern regions. The incidence rate of 2018 significantly increased compared to that of 2010 (Figure 2). The age group from 5 to 6 years old had the highest incidence for both 2010 and 2018 (Supplementary Figure S1 available in <http://weekly.chinacdc.cn/>).

Discussion and Conclusions

The data reported in this and a previous study (2) indicate the incidence of scarlet fever in China is still increasing, which emphasizes the importance of national scarlet fever alerts. Before 2011 when the epidemic began, the highest number of scarlet fevers

TABLE 1. Reported number of cases, incidence rates, and number of deaths caused by scarlet fever per year, 1999–2018 in China.

Year	Reported cases	Reported incidence (1/100,000 persons)	Reported deaths from scarlet fever
1999	15,246	1.23	5
2000	13,720	1.08	3
2001	11,261	0.94	2
2002	15,234	1.14	2
2003	10,063	0.75	1
2004	18,939	1.46	1
2005	25,068	1.93	2
2006	27,620	2.11	0
2007	33,488	2.55	1
2008	27,782	2.10	0
2009	22,068	1.66	0
2010	20,876	1.56	0
2011	63,878	4.76	1
2012	46,459	3.45	2
2013	34,207	2.53	2
2014	54,247	4.00	0
2015	68,249	5.00	1
2016	59,282	4.32	0
2017	74,369	5.39	0
2018	78,864	5.68	0

occurred in 2007 during the period of 1999 and 2018 (Table 1, Figure 1). Similar epidemic patterns were observed in other East Asian countries including Singapore, and European countries (Germany), where an incidence peak was observed in 2008, prior to the 2011 epidemic surge (4,6). These clues may reflect a similar mechanism attributed to the resurgence of scarlet fever across different parts of the world. The higher incidence of northern regions suggests that more attention should be given to strengthen surveillance in these areas. Active bacterial surveillance on the susceptible populations of age group with highest incidence is necessary.

The reasons underlying the scarlet fever resurgence in China and other countries are still unclear. Several studies have suggested possible reasons for this scarlet fever incidence increase (2,8–9), such as weakened herd immunity, environmental factors, and genetic mutations in the pathogen. Because there is no commercial vaccine for scarlet fever (GAS) prevention (1), natural population immunity may play an important role in the disease epidemic cycle. Further investigations are needed to learn more about the changing immunity patterns in susceptible and resistant populations.

For the current epidemic in Western and Asian countries including China, multiple scarlet fever-causing serotypes and clones have been identified, many of which contain genetic elements carrying streptococcal exotoxins and antimicrobial resistance genes that are widely detected among Asian and European predominant clones. These virulence determinants are thought to play an important role in triggering the epidemic, though further investigations are required (2,10).

The findings in this report are subject to one limitation. The most accurate diagnosis of scarlet fever should be based on pathogen isolation. The majority of reported cases are clinically diagnosed and the proportion of confirmed cases based on pathogen isolation is less than 5%. Thus, the accuracy of surveillance data could be affected by introducing false negative or false positive clinically diagnostic cases.

In summary, China is in a new period of high incidence of scarlet fever. A vaccine is not available for prevention of scarlet fever currently, although advances are being made in GAS vaccine research. Nonetheless, antibiotic treatment is effective. Prevention and control measures for scarlet fever could include identifying cases as early as possible and providing effective antibiotic treatment, controlling cases clusters and

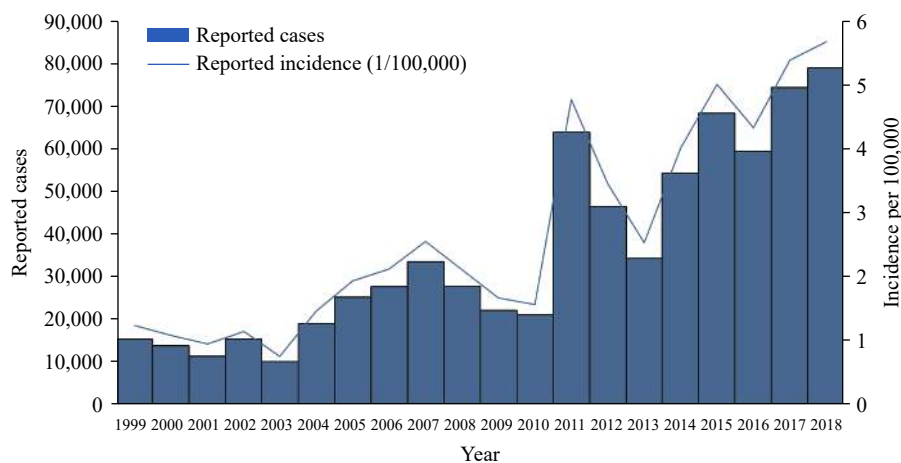


FIGURE 1. Total reported scarlet fever cases and incidence between 1999 and 2018 in China.

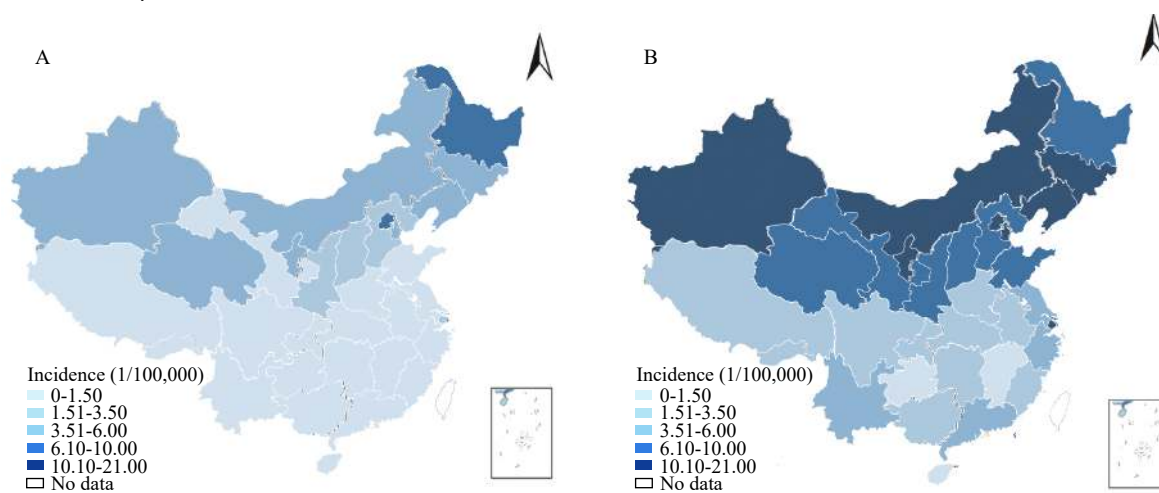


FIGURE 2. Reported scarlet fever incidence according to geographic region in China in 2010 and 2018. (A) Reported incidence in 2010. (B) Reported incidence in 2018.

dealing with public health events in a timely fashion, and strengthening health education in schools and kindergartens.

The increasing disease burden caused by scarlet fever suggest that health facilities and the public health professionals should pay increasing attention to scarlet fever prevention and control. Medical and health institutions at all level should enhance scarlet fever surveillance. Clinicians should be aware of the increasing trend of scarlet fever incidence in China and undertake early diagnosis and precise treatment with antibiotics. Public health facilities should report suspected cases and detect and control outbreaks in a timely manner. The general public should learn about the knowledge of scarlet fever control and prevention such that if children experience symptoms suspected to be scarlet fever, they should promptly seek a medical diagnosis and treatment.

Scarlet fever GAS pathogen surveillance capabilities should be established where not available, and enhanced if limited to only a few dispersed centers within provinces of China, so as to closely monitor epidemic foci, spread, complications and severe cases, and identify any genetic changes related to bacterial drug resistance, virulence and epidemiology.

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Conflict of interests

The authors declare no competing interests.

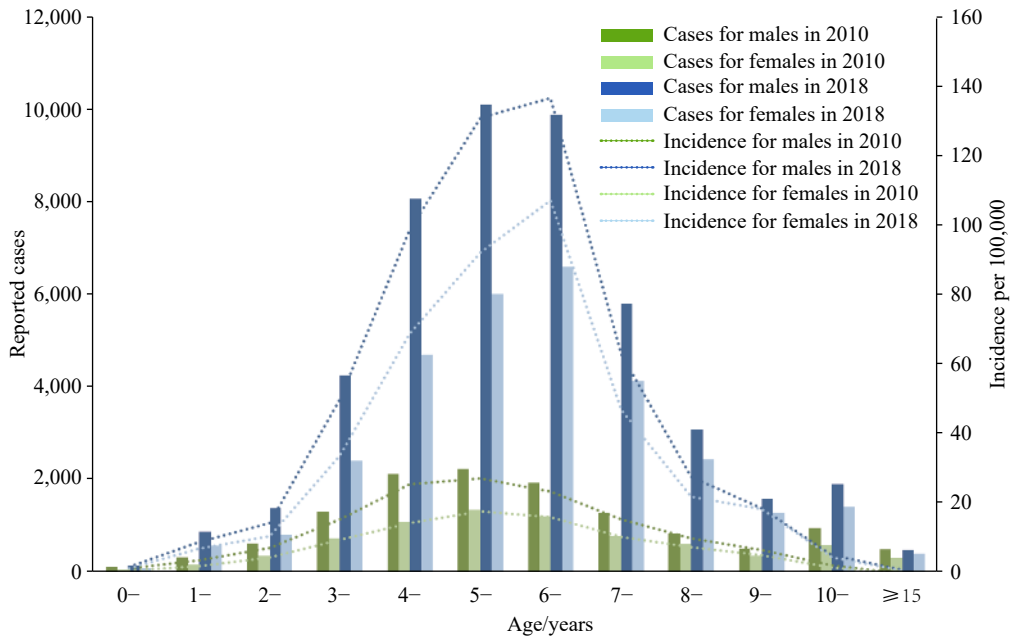
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SUPPLEMENTARY FIGURE S1. Reported scarlet fever cases and incidence according to age and gender in China for 2010 and 2018.