

THE INFECTIONS IN THE HISTORY OF MEDICINE

The Manchurian pandemic of pneumonic plague (1910-1911)

Running title: The Manchurian pandemic of pneumonic plague

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SUMMARY

China's winter of 1910-1911 was one of its most difficult. A deadly airborne pneumonic plague, believed to have originated from tarbagan marmots, broke out in October 1910 in a northeastern Chinese province commonly known by the exonym

Manchuria. The disease had a near 100 percent mortality rate, affecting mainly the lower socio-economic classes and eventually killing more than 60,000 people over six months. By April 1911, the epidemic was suppressed, in large part due to the efforts of a Western-educated Chinese physician, Wu Lian-Teh. Similar to the recent COVID-19 pandemic, the Great Manchurian Plague outbreak highlighted the importance of personal protective equipment, such as face masks, and a quick and efficient international medical response.

Keywords

China, Manzhouli, Harbin, Wu Lien-Teh, Mukden Conference, tarabagan marmot

Introduction

Plague outbreaks have caused fear, despair, and social disorder throughout history. In 1910, 110 years before the recent coronavirus pandemic outbreak started in Wuhan, China, the country experienced a similar outbreak of lung disease. The Great Manchurian Plague killed more than 60,000 people, mostly in the northeastern

Chinese province commonly known by the exonym Manchuria. Efforts to control the spread were similar to those taken in 2020 against COVID-19: quarantines, travel restrictions, personal protective equipment and mandatory mask wearing, and a multinational healthcare response (Figure 1) [1-4].

In 1905, with the help of U.S. President Theodore Roosevelt (1858-1919), the Treaty of Portsmouth formally ended the Russian-Japanese War over expansion into Manchuria. Nevertheless, by 1910, northeastern China was in the last years of the Qing Dynasty (1644-1912) and remained in a state of political unrest. Although officially under the control of China, the region's railroad systems connected China with Russia and Japan, and all three powers continued to compete for control over the region's resources [4]. The Treaty of Portsmouth permitted each nation to maintain a certain number of soldiers in the region for protection from thieves and for railroad administration in urban settlements.

The railway system also was divided among the three empires. The Chinese Eastern Railway, which crossed Manchuria from west to east as part of the Trans-Siberian Railway from Moscow to Vladivostok, was under Russian control, as was the area from Harbin to Ch'ang-ch'un. The Imperial Chinese Railway ran from Mukden (now Shenyang) to Peking (now Beijing) and was dominated by the Chinese government. The South Manchuria Railway began in Ch'angch'un and traveled to Mukden and Dalian, including Antung along the Korean border, and it was under Japanese control [4-7]. All three nations had military and civil power over their territories. When the plague broke out, each initiated appropriate measures to stop the outbreak and protect their interests in the region [4].

Identified in 1894 by Alexandre Yersin (1863-1943), a French-Swiss bacteriologist and physician from the Pasteur Institute, *Yersinia pestis* (plague) is a

contagious disease that can infect both humans and animals. Interestingly, just days before Yersin, another bacteriologist, Shibasaburo Kitasato (1853-1931), also isolated the bacterium during a Hong Kong outbreak in 1894. Kitasato studied under Robert Koch (1843-1910), who discovered the agents responsible for tuberculosis, cholera, and anthrax, but his initial reports on the *Yersinia pestis* bacterium were rejected due to concerns about sample contamination and inaccuracy [2,4,6,8,9].

Plague has two clinical types, bubonic and pneumonic, depending on the route of infection. The most common, bubonic plague, is transmitted by the bite of an infected flea. It is characterized by swollen lymph nodes, or buboes (*bubo* in Latin, *βουβῶν* in ancient Greek), particularly in the groin and armpits. Bubonic plague causes fever, weakness, and headache within one to seven days after exposure [10]. Pneumonic plague is more toxic. It infects the lung tissues within 24 hours of exposure and can be transmitted from human to human via droplets. Pneumonic plague is likely fatal if not treated in time. A characteristic symptom of this disease is bloody cough [4-7, 10,11].

Several major plague outbreaks have occurred around the world in the last two millennia. In the 6th century, the Plague of Justinian is believed to have started in Central Africa and then spread to the Mediterranean through Egypt. In the 14th century, The Black Death broke out in Central Asia and spread to the ports of Crimea, invading North Africa and then Europe. The Plague of London devastated England in 1665. Another outbreak started in Yunnan, China, in the 19th century, reaching Hong Kong in 1894 [4, 12]. More recently, India experienced an outbreak in 1994 [4]. Overall, more than 200 million people have died from the plague throughout the centuries [12].

Many of these diseases have zoonotic origins. For example, although not bacterial, the virus responsible for COVID-19, SARS-CoV-2, is believed to have originated in bats. Transmission from animal to human thus may have occurred via consumption of game and other wild meat products [2,13]. As previously mentioned, the bubonic plague is transmitted by the bite of an infected flea. The plague in Manchuria likely originated from the tarbagan marmot, a burrowing groundhog-like animal that was hunted for its fur (Figure 2) [1,2,4].

The Great Manchurian Plague

The Great Manchurian Plague started in northeastern China in autumn 1910. The first case occurred in Manzhouli, a town in Heilongjiang province in Inner Mongolia. At the time of the outbreak, Manzhouli was close to the Chinese-Russian border and near the Chinese Eastern Railway. On 27 October 1910, cases were identified in nearby Harbin, also in Heilongjiang province. Harbin was a sparsely populated agricultural region situated near all three railroad systems. Although mostly governed by China, the port area of Dalian was under Japanese rule. Harbin also hosted many Russians who worked for the China Eastern Railway, as well as Japanese, European, and American traders [1,4-7].

The local marmot trade expanded rapidly when the German chemical industry developed new dyes that could transform cheap marmot fur into imitation mink, otter, and sable fur [4]. Huge numbers of migrant hunters arrived in Manchuria. However, unlike the local hunters, these inexperienced hunters often trapped and handled infected marmots, thereby exposing themselves and other hunters to disease. Crowded and unsanitary living conditions among the lower socio-economical classes exacerbated the spread. However, transmission seemed to be limited to close contact.

Aside from physicians and medical staff, very few other foreigners fell ill [1,2,4-6, 11,12,14]. After an incubation period of two to five days, symptoms started with a cold sensation, loss of appetite, headache, augmented pulse rate and fever, followed by bloody cough and dyspnea within the first 24 hours of symptom onset. Pulmonary septicemia was the most common official cause of death [14].

By January 1911, more than 10,000 deaths had been recorded in Manzhouli, Harbin, Mukden, and Ch'angch'un, with very few survivors and up to 150 daily recorded deaths. The disease soon expanded to the capital city, Peking (now Beijing), infecting approximately 2.25 per 1,000 people. The crowded conditions of tarbagan marmot hunters may have exacerbated spread of the plague, as they slept close together in shared huts. Manchuria's railway network also contributed to the rapid transmission of the disease as thousands of migrant workers returned to their homes for the New Year Festival [1,4,5].

Recognizing the Need for Protective Measures

The medical response to the outbreak was rapid. Russia established a makeshift plague hospital and observation site for suspected plague in the Moscow barracks of Harbin [2,4,5]. Japan cooperated with Russian and Chinese authorities in their mitigation efforts [1,4-6,15]. With no cure available, stopping transmission became the key aim of these efforts. Similar to the recent COVID-19 pandemic, these measures included isolation, quarantine, and "plague passports." Those with suspected cases and those who had been in contact with infected people were quarantined on train carriages. They were released if no symptoms developed within five to ten days and given a wire wristband fastened with a lead seal declaring they

were plague free [2, 4,5]. In the case of deaths at home, the entire household was immediately isolated, and contaminated property was burned to prevent infection [1-2, 4-6, 14]. Sanitary zones were established, and police monitored the population.

A local Chinese-Malayan physician educated at Cambridge University, Wu Lien-Teh (Wu Liande) (1879-1960), received imperial permission to cremate patients' dead bodies (**Figure 3**). Wu Lien-Teh also conducted post-mortem examinations on plague victims after human dissection was legalized by presidential mandate. He confirmed that the plague was pneumonic, not bubonic, as it was at first assumed. With no remedy against the disease, the only way to defeat it was through education. Thus, he recommended everyone wear face masks [1,2,5,6,12,14].

The Mukden Conference and Eradication of the Epidemic

During the first decade of the 20th century, before establishment of the World Health Organization, disease response was up to individual nations. The Great Manchurian Plague served as a “sanitary awakening” [16]. Recognizing the need for a multinational medical response to outbreaks such as the plague, several countries participated in the Mukden Conference, the first international scientific congress held in China in April 1911 [5,6,11,17,18]. Participants included the United States of America, Great Britain, Germany, France, Italy, Mexico, Netherlands, Austria-Hungary, Russia, Japan, and China. Thirty-three official representatives attended (**Figure 4**). Professor Kitasato chaired part of the conference, and Wu Lien-Teh served as its presider [5,6,18]. Influential delegates included Dr. Richard Strong (1872-1948) from the United States, Dr. Daniil Zabolotny (1866-1929) from Russia, and Dr. Reginald Farrar (1861-1921) from Great Britain [6,19].

Modes of contagion, as well as asymptomatic patients and super-spreaders, were among the main topics discussed. The Mukden Conference motivated the

establishment of the North Manchurian Plague Prevention Service in 1912. For the first time, China was embracing a Western approach to medical care, with the intention of promoting public health during the first years of Chinese Republic (1912–1949) [1,2,5,6,11,19].

In addition to the dire public health consequences, the plague outbreak in Manchuria devastated the Chinese economy, especially the fur and soybean trades, due to the port and railway closures [4, 20]. Still, these strict closures and protocols (e.g., quarantine, mask use) led to significant reductions in transmission in most regions of China. Closing of the Dalian port also prevented expansion of the disease to Japan, Korea, and Hong Kong [4,5].

The last case of the Manchurian plague was recorded on March 1, 1911. Everything, including the South Manchurian Railway, reopened. As a result of Wu Lian-Teh's drastic measures, the epidemic was declared over by the end of April 1911. The region returned to normal, and subsequent cases of the plague were successfully confined to hospitals [4,5].

Conclusion

The Great Manchurian Plague occurred at a crucial moment and in a geopolitically important area. China, Russia, and Japan had imperial aspirations to dominate the region, but the disease outbreak forced them to work together. With a mortality rate near 100%, the outbreak claimed the lives of more than 60,000 people in the region. Despite or perhaps because of these dire public health consequences, the Manchurian Plague served as an incentive for China to embrace new approaches to medical care. Similar to the COVID-19 pandemic, this widespread and deadly

outbreak served as a reminder that swift and cooperative responses are critical approaches in addressing global public health issues.

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CONFLICT OF INTEREST

None to declare

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Figure 1 - The personal protection equipment worn during the 1911 plague epidemic in Manchuria. Credits: Institut Pasteur/Archives Henri Mollaret.



Figure 2 - Tarbagan marmot.



Figure 3 -Dr. Wu-Lien Teh. Source: Library of Congress Prints and Photographs Division Washington, D.C. Reproduction Number: LC-DIG-ggbain-14227 (digital file from original negative).



Figure 4 - Delegates to the International Plague Conference Mukden 1911.

Source: Centre for Research in the Arts, Humanities and Social Sciences (CRASSH, The University of Cambridge).

