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Controlling Ebola: what we can learn from China's 1911 battle against the pneumonic plague in Manchuria



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SUMMARY

The pneumonic plague, which spread across Northeast China during the winter of 1910 and spring of 1911, caused numerous deaths and brought about severe social turmoil. After compulsory quarantine and other epidemic prevention measures were enforced by Dr Wu Lien-teh, the epidemic was brought to an end within 4 months. This article reviews the ways in which the plague was dealt with from a historical perspective, based on factors such as clinical manifestations, duration of illness, case fatality rate, degree of transmissibility, poverty, inadequate healthcare infrastructure, and the region's recent strife-filled history. Similarities were sought between the pneumonic plague in Northeast China in the twentieth century and the Ebola virus outbreak that is currently ravaging Africa, and an effort made to summarize the ways in which specific measures were applied successfully to fight the earlier epidemic. Our efforts highlight valuable experiences that are of potential benefit in helping to fight the current rampant Ebola epidemic in West Africa.

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1. Introduction

Epidemics have played a significant role during the last one thousand years of human civilization. In the fourteenth century, the Black Death killed a quarter of the population of Europe. From the fifteenth to the eighteenth century, smallpox swept through the whole of Europe. Moreover, between 1840 and 1862, cholera devastated populations worldwide. Many epidemics have taken place since the beginning of the twentieth century, including Spanish flu, HIV/AIDS, severe acute respiratory syndrome (SARS), bird flu, and the Ebola outbreak currently raging in West Africa. The Ebola virus is especially deadly, given its high fatality rate and transmissibility.

Occurring from October 1910 to April 1911, the pneumonic plague epidemic in Northeast China has been termed the worst epidemic of the twentieth century, as it was a disaster in terms of the lives of the people and the economy of Northern China. Even though it occurred nearly one hundred years ago, for many researchers, the disastrous pneumonic plague that took more than 60 000 lives remains worthy of study. It was this pneumonic plague epidemic that really instigated the earliest scientific epidemic prevention work

in modern China. Analysis of the organization and management efforts, including medical care, epidemic prevention, and effects of quarantine, provide important information for later generations.

The recent outbreak of Ebola in West Africa presents many similarities to the plague that happened in Northeast China (Manchuria) in the twentieth century, such as issues related to the economy, culture, health systems, and other background environments. For example, Manchuria had been suffering wars and poverty, and the health infrastructure was inadequate, just like the West Africa of today. A further similarity is that the particularly devastating courses of these two epidemics have been attributed to the biological characteristics of the virus. It is more likely that these are the result of the combination of dysfunctional health systems, international indifference, high population mobility, local customs, densely populated capitals, and a lack of trust in the authorities following years of armed conflict.

Summarizing the successful experiences in fighting the pneumonic plague in Northeast China a hundred years ago is of relevance in the effort against the current spread of Ebola in West Africa.

2. Wu Lien-teh's fight against pneumonic plague

In the autumn of 1910 and spring of 1911, a deadly disease broke out in Fuchiatien (Fujiadian, now Daowai District of Harbin), the Chinese sector of Harbin in northern Manchuria. Those who

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were infected with the disease exhibited symptoms such as coughing with blood-streaked sputum and a purplish skin discoloration; death followed within a few days. The first victims of the pneumonic plague were marmot trappers and fur traders in Manzhouli, along the Siberian border. The plague spread rapidly, especially in the Harbin area; in two provinces – Jilin and Heilongjiang – a total of 39 679 people died, accounting for 1.7% of the population of the two provinces.¹ At that time, Japan and Russia were on the ground, controlling the plague epidemic, and were attempting to infringe upon the territorial sovereignty of Northeast China.

In this complex situation, the Chinese government instructed Wu Lien-teh to head for the plague-affected areas. By strengthening railway quarantine, controlling traffic, isolating the epicenter of the plague, cremating victims' bodies, and many other measures, and by facilitating collaboration between the Chinese and foreign governments and doctors, Wu Lien-teh finally quelled the pneumonic plague. It was the largest infectious disease to spread through China in the twentieth century, occurring over less than 4 months. This was the first ever recorded cooperation between scientific prevention experts and government bodies to effectively control a large plague in China.

Wu showed tremendous leadership during the time when he was in command of the Manchurian plague control efforts, gaining him international fame.^{2–5} His University of Cambridge, Liverpool School of Tropical Medicine, and Pasteur Institute training enabled him to mediate the medical approaches of Chinese and Western scientists. As a Chinese official abroad, he identified with China's quest for modernity through Western medicine. Wu Lien-teh founded the Binjiang Medical School (the predecessor of Harbin Medical University) based on the Northeast Epidemic Affairs Department and the equipment and technology of Binjiang Hospital in September 1926.

3. Summary of the plague experience to help support the control of Ebola

3.1. Comparison of backgrounds

From the measures adopted by Wu Lien-teh during the fight against the plague, we can see that these historical populations had a systematic and comprehensive understanding of the measures required to treat plague. Although today's society and the conditions of medical care have changed immensely, the Ebola outbreak has been a wake-up call, causing people to think again about the epidemic conditions occurring in a modern society and to refocus on new diseases that threaten global health under these new conditions.

On April 1, 1911, when the plague had not yet been completely extinguished in the Northeast of China, *The North China Herald* (published in Shanghai) published an article written on March 10, sent from the newsletter, which stated that this was the first time in Chinese history that Western methods had been adopted in the fight against plague. Considering their situation, they should be praised; the people had learned a terrible lesson and profoundly believed that these methods could save their lives. As such, it is necessary to learn from past populations, from which we can find the commonalities and understand the implications to deal with the crises of today.⁶

A comparison of the background environment between the pneumonic plague in Northeast China and the Ebola outbreak in West Africa is given in [Table 1](#).

3.2. Experience and implications

The history of the fight against plague has resulted in the accumulation of a wealth of knowledge on epidemic prevention. Systematically exploring history shows not only respect for

traditional culture, but is also an important way to explore the direction of development for the future. Using a variety of measures, applied appropriately, the Northeast China pneumonic plague epidemic, which resulted in as many as 60 000 deaths and shocked the world in the early twentieth century, was successfully halted in less than 4 months. In April 1911, an article published in China's most important church publication, 'Senate Magazine' (*The Chinese Recorder*), also stated that the Chinese people should be commended for using the Western way to combat the plague for the first time.^{7–9}

It can be seen that on the frontline of fighting disease, there is no absolute authority. Combining the essence of Western medicine with the prevailing situation and people's awareness, and putting scientific ideas into practice, is ultimately the key to victory in the battle to prevent epidemics. Wu's study experience brought an outsider's perspective, free from the tradition of China's medical practices. Breaking cultural boundaries, in spite of prejudice and the questioning of foreign experts, and using his solid medical knowledge and clinical experience, he won the battle. His methods have become standard in the control of highly infectious diseases, and some of the measures in his response to the plague are highly indicated for the Ebola outbreak in West Africa.

3.2.1. Heightening of the government's attention – calling for a strong government

Early on during the plague epidemic, the Qing Dynasty did not comprehend the gravity of the situation; it was during this time that Japan and Russia were on the ground controlling the spread of the plague epidemic and attempting to infringe upon the territorial sovereignty of Northeast China. In the face of the complex positions of interest and interactions between China, Japan, and Russia, the Qing government realized that the control of the development of this epidemic was not simply one event, but was a large-scale issue involving the national sovereignty and dignity of the people. The proposals of Japan and Russia were flat-out rejected, and Wu was instructed to head for the plague-affected areas.

Due to the neglect of the Qing government to pay sufficient attention to the epidemic early on, the epidemic was quite rampant and was spreading southward. The severity of the epidemic, the violation of sovereignty, as well as the nation's peril, allowed the central authorities of the Qing Dynasty and local officials to fully appreciate the urgency of the epidemic.^{10–13} Decisively implementing positive responses such as providing relief, tax exemptions, medicines, and other rewards played a very important role in controlling the epidemic, in resuming economic production, and encouraging the people. Seen in this light, in order to effectively control the Ebola epidemic, there is a need for strong government intervention; should the government assume corresponding responsibility and actively organize people to mobilize financial resources, the effects would be immeasurable.

Nowadays, with the rapid progression of the Ebola epidemic, reliance solely on governments for its control constitutes a significant global health problem. This is particularly the case in countries like those in West Africa, in which governments that are relatively weak cannot rely on their own actions alone to win the battle against the Ebola epidemic. The world needs strong World Health Organization (WHO) and United Nations (UN) governance to provide technical leadership and operational support to governments and partners in Ebola control efforts.¹⁴ The Ebola crisis delivers a powerful message regarding the consequences of the weakening of the WHO, once the leading organization in public health policy-making.¹⁵

Today, the WHO is increasingly weak technically, politically, and financially. Failures in leadership have allowed a preventable disease to spin out of control, with extensive harm to social order and human dignity. Ebola has reached the point where it could

Table 1

Comparison of the background environment between the pneumonic plague in Northeast China and the Ebola outbreak in West Africa

	Pneumonic plague	Ebola
Source of infection	In the early twentieth century, driven by economic interests, a large number of sick marmots were hunted. Hunters ate the infected meat and became ill, after which the epidemic spread quickly along the railroad (because the construction of the Chinese Eastern Railway made Harbin an accessible city); the plague virus then impacted on the Northeast Plain.	The epidemic has been caused by the Ebola virus (Zaire species). The mortality rate in people infected by this virus is up to 90%. Poor people searching for resources, looking for the wood used to make carbon or mineral mining, may have acquired the virus when searching for these in the depths of the forest. Local people go into the most remote corners of the forest, which increases the risk of exposure to the Ebola virus.
Transmission routes	Pneumonic plague can spread between people through saliva and air droplets, without the need for a murine transmission vector such as a mouse (originally the public and doctors did not understand its transmission route).	Epidemiologists and virus experts believe the epidemic spread to Liberia from Guinea as a result of travel, because, for example, if someone were to visit the site of a death and then take a bus they could bring the Ebola virus into contact with family members. Infection can spread through close contact with blood, secretions, or other body fluids of the infected animals. Ebola virus can spread between two people, mainly due to the exposure of healthy people to infected blood, secretions, or other body fluids, or by indirect contact with the environment polluted by the contaminated body fluids.
Epidemic area	Fuchiatien (now Daowai District of Harbin), the Chinese sector of Harbin in northern Manchuria, Heilongjiang Province, Jilin Province, Korea, Japan	Guinea, Liberia, Sierra Leone, Nigeria, Senegal, and other West African countries, and Spain and other European countries. The international spread is through modern transport.
Time of breakout	From October 1910 to April 1911; the plague was controlled in 4 short months.	Guinea's first Ebola case was identified in November 2013 when the dry season began. In other countries, outbreaks also started between the rainy and dry season period.
Politics	The Chinese underwent an increasingly severe national crisis; the corrupt Qing government capitulated to turn traitors for personal gain, and there was brutal internal repression of the people's revolution. The imperialist powers ravaged the land of China, carving up China's territory. The northeast was an area of fierce competition for imperialism; it was the place where there was a particularly grave national crisis.	Situations of political unrest and even the use of force to resolve political conflicts. Guinea, Liberia, and Sierra Leone are three countries that have been involved in military crises and decade-long civil wars. Governments failed to play a leadership role in resolving the wars, leading to continued political chaos.
Economy	The economy of the Northeast was relatively backward; there was a large population and a shortage of resources in all respects, particularly medicine. The plague caused panic both related to survival and economic life.	West Africa is one of the poorest regions of the world. More than half of the Guinean population lives below the poverty line, and about 20% of the population are in extreme poverty. With regard to Liberia and Sierra Leone, the United Nations human development index ranks these at 174 and 177, respectively.
Cultural environment	Funeral: the Chinese traditional view was that 'people should have graves in the land'. Social atmosphere: The people suffered the dual pressures of the epidemic and society; there was a pessimistic atmosphere surrounding society.	Funeral: Burial customs are prevalent; at the funeral, people must stroke and kiss the dead body before burial. Social atmosphere: The people are suffering from the pain and turmoil of war.
Health system	The health regime was dispersed with no unity; the professional quality of health administrative staff was low; competent leaders did not pay attention; more importance was attached to treatment than prevention.	Weak systems have not prepared the population to deal with outbreaks; preparation and basic medical resources are very scarce.
Number of deaths	A total of 57 353 people died: 3800 in Changchun and mid-long road; 20 264 in 22 counties and cities in Jilin; 27 434 in 22 cities and counties in Heilongjiang; 5855 in 26 counties and cities in Liaoning.	Up to December 3, 2014, there had been a total of 12 000 cases, with 7000 deaths.
Mortality	89.52% (initially two people died, and then the daily death toll rose to 200 people; at the end of the plague, nobody died.)	71% (90% daily death toll, upwards of 200 people)
Difficulties in epidemic control	There were financial difficulties; there was little preparation for hospital isolation; transportation was difficult; the burning of corpses and isolation of goods was difficult; there was a decentralized regime without a unified health system; the quality of health administrative staff was low; competent leaders did not pay attention; more importance was attached to treatment than to prevention; drugs were insufficient.	Fear of the disease has led to hospital closures and the fleeing of health care workers; laboratory equipment and capacity are weak, and there is a lack of capacity for early identification and diagnosis; there has been a failure to establish effective tracking of contacts and isolation mechanisms; publicity and education have been poor, making it difficult to contact people in poor communities; outbreaks have occurred in densely populated regions; the three major infective countries have resisted border activities.

become established as an endemic infection because of a highly inadequate and late global response. Not only did it take more than 3 months to diagnose Ebola as the cause of the epidemic—in contrast to the recent outbreak in the Democratic Republic of Congo, where it took a matter of days—but it was not until 5 months and 1000 deaths later that a public health emergency was declared, and it was nearly another 2 months before a humanitarian response was put into action.¹⁶ The global community should take responsibility for strengthening skilled manpower and infrastructure capacity in low-resource countries to effectively prevent and control diseases and make the world a safer place. Major failures in governance and leadership could be rectified if lessons are learned from Ebola.¹⁷

3.2.2. National linkage and strengthening international cooperation – format of a quarantine center

During the fight against the plague in the twentieth century, the Qing government, both central and local, began to come to a consensus on the formation of a central health and epidemic prevention organization. Wu showed tremendous leadership in allocating doctors, police, and the general population to perform activities of epidemic prevention, in transforming schools, theaters, baths, temples, and churches into emergency hospitals, and in organizing huge convoys, training sessions, and the mobilization of the people (including specific industry service personnel). Wu Lien-teh became the control center of the entire action against the epidemic. In addition, the Qing government also

actively cooperated with other countries to strengthen disease prevention, including establishing a quarantine partnership with Japan and Russia; foreign physicians were also hired directly to work in prevention.

The continued spread of the Ebola virus threatens West Africa and the rest of the world, making outbreak containment a global health priority. West African countries suffer from poverty and are underdeveloped; as such, they cannot rely on their own strength to control Ebola.^{18,19} They need strong support from the international community in order to defeat the proliferation of the virus. The head of the WHO has called the epidemic the most severe acute public health emergency in modern times. Now that the world has woken up to the danger, the task is to collaborate as a whole to stop the Ebola epidemic.

3.2.3. Isolation prevention system

With the approaching Lunar New Year celebrations, there was a risk of epidemic spread when individuals from plague-affected areas travelled to their hometowns in different regions.²⁰ Dr Wu Lien-teh implemented disease population surveys and the immediate hospital transfer of persons suspected of infection; suspected cases were placed under observation and confirmed cases were placed in quarantine. Eventually, the problem of the densely populated, pestilence-ridden area was overcome. The isolation of principle patients, the wearing of masks, segmented martial law, and disinfection by burning the dead (brought about by Dr Wu Lien-teh) were the main methods used in China to combat SARS in 2003, and are still in use.

In today's fight against Ebola, governments should pay more attention to applying isolation measures; however, whether or not the infected area should be isolated completely from other regions is controversial. Many experts believe that the use of these measures in West Africa would be both wrong and futile. Borders are permeable. People would flee the area by way of bribes because of food shortages or psychological isolation. As the virus has spread unchecked across West Africa, other untraceable emigrants may carry it inside their bodies as they cross borders. Therefore, the WHO recommends that "response activities must be adapted in areas of very intense transmission and particular attention must be given to stopping transmission in capital cities, thereby facilitating the larger response and relief effort. If non-essential movement in and out of a containment area is stopped, ensure that essential movement (e.g. for response providers, essential services) continues unhindered. To facilitate Ebola virus disease (EVD) response, defer mass gatherings until intensity of transmission is reduced."²¹

3.2.4. Strict quarantine system

The Qing Dynasty's first cases of plague occurred in the Chinese territory of Manchuria by the overtaking of Russia's Siberia. On October 26, the first victims of the plague were discovered at Manchuria station. A total distance of 530 miles east of the Dongqing and Zhongdong railroads became the major thoroughfare to Harbin from Manchuria. As a result of social progress, foreign exchange had increased and the opportunity for interactions between countries and regions was also increasing. However, this also increased the possibility of the spread of the epidemic between regions and countries. Therefore, the establishment and implementation of the prevention of infectious diseases was crucial. Medical staff from cosmopolitan centers were selected to conduct quarantine inspections along the main routes of transmission of the epidemic – railway and steamship routes – and to set up a temporary hospital at the station, if necessary, cutting off outbound traffic from the infected area. The development and implementation of this quarantine system was in part to avoid the spread of disease among regions, but also to avoid the spread between countries.^{22–24}

Today, the situation is far from comparable to that with regard to the historical travel/transport system. However, the spread of disease may also have been helped by urbanization and development, which have strengthened transport links resulting in the virus being shuttled from villages to the town and back into uninfected areas. Nevertheless, the WHO has not called for a ban on travel, instead recommending that travelers leaving affected countries be screened on departure for fever and anyone suspected of carrying the virus. A comprehensive travel ban would cause economic hardship, but the situation regarding migrant workers from countries with an increasingly uncontrollable epidemic will increase the risk of the international spread of Ebola.²⁵ Thus, in today's situation of economic globalization, although we cannot completely restrict traffic (as in historical times), we are able to support the strict implementation of precautionary measures, providing the necessary medical treatment for the crew and passengers involved in air travel and those handling cargo shipped to and from affected areas, and imposing strict quarantine for disease prevention and control; we are also able to reduce the isolation and economic hardship suffered by affected countries.

3.2.5. Breaking traditional concepts and practices

In late January 1911, Wu was horrified to discover over 2000 unburied bodies. It was midwinter and the ground was frozen solid, but Wu feared that when spring brought warmer weather, the dead bodies would pose a serious public health risk. It was also thought that rats rummaging among the bodies would spread the infection. Mass cremation was the solution, but the Chinese viewed this as an act of desecration.²⁶ To overcome this problem, Wu invited local officials to visit the burial ground and explained to them the health dangers. He then sent a memorandum to the Emperor. After three anxious days, the Imperial Edict allowing cremation arrived. On January 31, 1911, the Chinese Lunar New Year, the first mass cremation in Chinese history began. Bodies that had previously been buried were also dug up and cremated. Eventually, the mortality figures started to decline and the disease ran its course.²⁷ Dr Wu Lien-teh took decisive measures to cremate corpses and ordered all the civil and military officials to watch, along with countless people. This was the first time in Chinese history that collective cremation burial had ever happened.

In ancient folk culture and contemporary West African countries, local customs related to the handling of illness and funerals (to ask God to chase away ghosts), mean that measures such as isolation and quarantine are not well implemented. These archaic social attitudes and lifestyles have a negative effect on the evasion of such epidemic disasters. The underdeveloped political and economic situation in these countries, in addition to their burial customs, has made it difficult to avoid the limitations in dealing with the Ebola epidemic. This has placed enormous pressure on the governments. In the face of an epidemic and possible death, we must resolutely abandon the shackles of outdated viral prevention systems to avoid the spread of viruses facilitated by the presence of corpses. Although specific practices can be drawn from past experience, we can enforce cremation and inform the public officially of the dangers of the disease through the National Broadcasting Company (NBC), ordering all residents to watch. Seeing the final effects of the disease is likely to have a great emotional impact on the population, and may spur initiatives to abandon folk customs so that the positive role of cremation is recognized in the context of containing Ebola.²⁸

3.2.6. Positive guidance from the public media

The Northeast China plague not only caused numerous deaths, it also impacted on overall survival and economic life. Information was published in a large number of newspapers based on the

national consciousness immunization theory and scientific knowledge on health at the time, both to appease the psychological tension of the populace but also to publicize knowledge of disease prevention and control.

In reports on the battle against Ebola, media interest in the outbreak raging throughout West Africa has not, so far, been discussed widely or studied.²⁹ Coverage of Ebola has, understandably, been prolific, but at times, narrow and unbalanced. To avoid these situations, we need the media to provide a fair and true platform to allow the public to obtain the most time-sensitive information and be able to communicate on an equal footing, like the newspapers during the fight against the plague. We can also learn from contemporary methods such as The Lancet Twitter chat, a small but positive example that can show us the power and potential of social media to inform and assist. During the chat, new ideas emerged from experts and the audience alike. Only in ways such as these can we find valuable messages such as “local solutions to local problems need Africans training Africans”. Scaling up the positive and constructive discussion of informed media communication could remove boundaries between scientists, health professionals, and policy-makers, creating a novel diverse community, giving everyone a voice and an opportunity to contribute. To create the right conditions to defeat Ebola, we need increased global engagement, knowledge, and commitment.³⁰

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