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The Establishment of the Concept of *Shu Yi* and Its Significance in the History of Knowledge

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Abstract

Plague is one of the severe infectious diseases which has had a huge impact on human society throughout history. Although there is abundant research on the disease, few studies focus on the concept of plague itself. It is generally believed that *Shu Yi* was first coined by Chinese doctors in the late 19th century, and it was closely related to the introduction of new medicine. This statement is not accurate, because plague was prevalent in Yunnan and Guangdong provinces in the late Qing Dynasty. At that time, people had already recognized the relationship between the outbreak of plague and the death of rats, and gradually named the epidemic disease as *Shu Yi*. This name was used by literati and doctors by coincidence. As the epidemic became more and more serious, more related works were widely disseminated, and *Shu Yi* changed from a folk name to a formal name. Later, with the help of the government's active introduction of modern health and epidemic prevention mechanisms and the implementation of rodent control measures, *Shu Yi* became more popular and gradually recognized by all walks of society. The emergence and prevalence of *Shu Yi* created the history of zoonosis in China, and thus formed a new paradigm of naming human epidemics after related animal names.

Keywords: Disease naming; History of knowledge; Plague; Zoonotic disease

1 Introduction

Plague is a severe infectious disease caused by *Yersinia pestis*, which is commonly seen in glires such as rodents and marmots. It is a natural pathogenic disease, and is also a zoonotic disease.[1,2] Plague is one of the two major Class A infectious diseases in the International Law on the Prevention and Control of Infectious Diseases, and it has greatly impaired human life and society throughout history. Plague has been known by many different names in history due to its long history, such as the Black Death, *He Wen* (核瘟), and *Bai Su Du* (百斯笃), etc. Plague is a universal term referring to this disease in the world today. It is generally believed that *Shu Yi* (鼠疫), which literally means the plague, is the traditional Chinese name referring to the plague, while the Black Death is the traditional Western name. Therefore, some contemporary scientists who study infectious diseases believe that these two different names reflect the different origins of understanding of epidemics between China and the West.[3] From the perspective of Chinese disease history, *Shu Yi* seemed not to be a traditional Chinese concept. In the 1930s, Chen Bangxian (陈邦贤) pointed out in the revised version of *History of Chinese Medicine* that "the name *Shu Yi* was coined after the introduction of Western medicine."[4] From this point of view, *Shu Yi* was not a traditional Chinese concept, but a new medical concept. Therefore, the establishment of the concept and the word *Shu Yi* need further research.

Due to the influential impact of plague on human history, international historians have done much research on the history of plague. The research on the history of plague is also a popular topic in the study of Chinese medical history of diseases. Since the 1950s, no less than 6 monographs on the history of plague have been published,[5–10] not to mention research essays and papers on the same topic. These monographs mainly discussed the situation of the epidemic, its impact and the social response in Chinese history, especially in modern times. A part of this research discussed the relationship between the names of diseases and plague such as *E He* (恶核) and *Ge Da Wen* (疙瘩瘟),[11–14] but only a few of them paid attention to the history of the concept of plague itself. Wu Wenqing (吴文清) discussed the establishment of the name from the perspective of traditional Chinese medicine in *Research on Major Innovations in Modern Chinese Medicine* edited by Zhu Jianping (朱建平). Cao Shuji (曹树基) and Li Yushang (李玉尚) discussed the emergence of the name *Shu Yi* by searching comparative and systematic historical materials. These studies clearly showed that *Shu Yi* first originated in *Zhi*

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Shu Yi Fa (《治鼠疫法》 *Formulas for Treating Plague*) authored by Wu Xuanchong (吴宣崇) published around 1890. Before this concept appeared, there were many folk names such as *Yang-tzu Bing* (痒子病) and *He Wen* referring to the disease. However, *Shu Yi* became popular after that.[15,16] Although these studies have clearly pointed out the origin of the concept of *Shu Yi* and its coexistence with a variety of related concepts at that time, they have not made a systematic research on the process from which the concept was established. They also failed to specifically explore its internal reasons and logic. However, there are exceptions. For example, Carol Benedict (班凯乐) wrote an early monograph on modern plague, but it did not pay much attention to the establishment of *Shu Yi*. She did notice that the concept had been used in Chinese medical history at the end of the 19th century, revealing the historical and cultural implications behind the concept from the perspective of comparing Chinese and Western cultures.[17] Christos Lintris, expert on the history of plague, focused on transmission of plague between humans and animals. He did research on the third plague pandemic on the Sino-Russian borders by sorting out research and interpretations by different disease experts on the basis of ethnography. Lintris' work highlighted the importance of understanding rats as the host animal of *Yersinia pestis* by the indigenous people where the epidemic occurred.[18] It further showed the tension and even confrontation between indigenous local knowledge and colonial medical knowledge.[19] Although his research did not discuss the concept of "plague" itself in the Chinese context, it revealed the role of the visual medium "rat" in establishing the concept of plague as a disease and its non-negligible position in the local language network.[20] This reminds us that *Shu Yi* is not as simple as a new vocabulary in Chinese, but also contains cognition of disease and complex relationships between different knowledge systems. The name requires further exploration. It is worth noting that names of similar diseases such as *Kuang Quan Bing* (狂犬病 rabies), *Qin Liu Gan* (禽流感 bird flu), *Zhu Liu Gan* (猪流感 swine flu), and *Hou Dou* (猴痘 monkeypox) are also new names that appeared in modern times after *Shu Yi*. In other words, the naming process of *Shu Yi* might create a new way of naming diseases by referring to human diseases in the name of animals. From the perspective of history of knowledge, *Shu Yi* is not only a new disease name but also a new way of naming diseases reflecting the evolution of plague cognition. Therefore, what is the significance of the emergence and popularity of this concept?

In response to the research questions above, this article aims to discuss the emergence and popularity of the concept *Shu Yi* and its significance on the basis of existing research, from the dual perspectives of history of concepts and knowledge.

2 The establishment of the concept *Shu Yi*

Plague, as a severe zoonotic infectious disease, has had a long history of harming the human world, especially in the European Middle Ages. Called the Black Death, plague had a profound impact on the demographic and historical evolution of Europe. In China, though plague was deeply related with many major epidemics in ancient history and other diseases such as *E He* and *Ge Da Wen* in historical records, there existed great controversies in the academic circles as to whether some of the great pandemics recorded in history before the 18th century could be plague. However, there was little objection to the existence of plague epidemic in Yunnan province in the late 18th century.[21] It is an indisputable fact that plague did not attract attention from the Chinese medical community until the late 19th century. Plague is a dangerous disease with obvious symptoms and strong contagiousness. It is often accompanied by special phenomena such as the death of rats. Despite this, medical records describing symptoms and characteristics of plague were hard to find in traditional Chinese medical classics, not to mention a dedicated focus on plague. Existing studies believe that Wu Xuanchong's *Zhi Shu Yi Fa* published in the seventeenth year of Guangxu (1891) was the first monograph on the treatment of plague in China. After that, a large number of books were published on the same topic.[22–31]

Plague is an infectious disease caused by *Y. pestis*. Its most notable feature in Chinese language is that the name *Shu Yi* indicates the relationship between the disease and rats. Almost all existing research believes that the emergence of the concept of *Shu Yi* began with Wu Xuanchong's *Zhi Shu Yi Fa* published in the 17th year of Guangxu (1891).[4] The original edition of this book is no longer in existence. In the 20th year of Guangxu (1894), plague spread out in Guangzhou. To deal with the disease, Chen Zhaoxiang (陈兆祥), a doctor from Panyu reprinted the book and titled it as *Ji Jiu Shu Yi Chuan Ran Liang Fang* (《急救鼠疫传染良方》 *Fine Formulas for Emergency Plague Infection*).[32,33] At that time, Luo Rulan (罗汝兰), a Confucian doctor from Shicheng, was also looking for a cure for the plague. In the winter of 1894, Luo got the book. Based on his own experience and thinking on the epidemic, Luo made additions, deletions, and revisions to Wu's work and compiled *Shu Yi Hui Bian* (《鼠疫汇编》 *A Compilation of the Plague*). The book was influential and was republished more than five times in seven years.[34] Physicians in the Republic of China regarded the establishment of *Shu Yi* as a manifestation of the development of Chinese medicine. For example, Li Jianyi (李健颐) believed that "the origin of the epidemic was India and the former Asia, and it was passed on to various European states. It spread to China during the Qianlong period of the Qing Dynasty. The famous Chinese doctors knew that the epidemic was

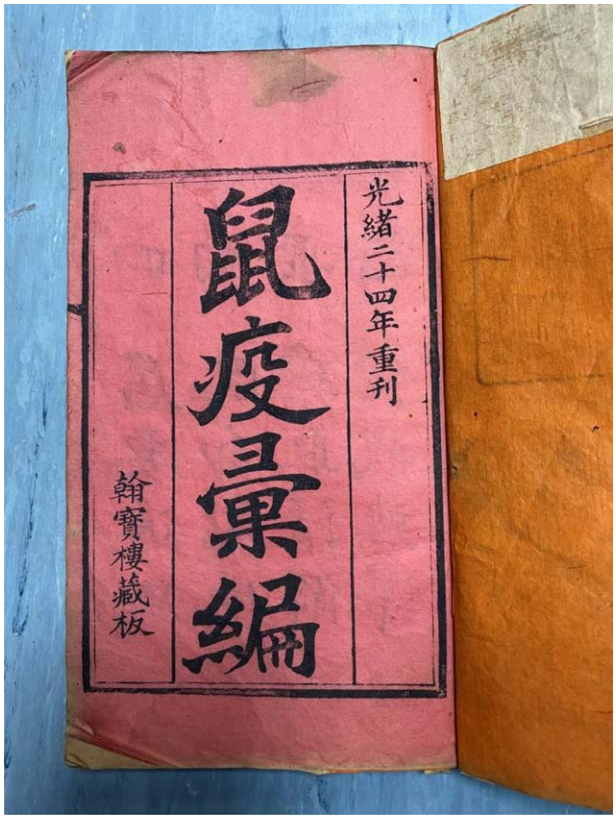

Figure 1 Front cover of *Shu Yi Hui Bian* (*A Compilation of the Plague*) edited and published by Ruo Rulan, 1898 version, collected in Guangzhou University of Chinese Medicine. (source from: http://m.stdaily.com/index/kejixinwen/2020-06/13/content_956016.shtml).

caused by rats, so it was named *Shu Yi*."[35] However, Chen Bangxian believed that "after the introduction of new medicine, the name *Shu Yi* came into existence."[4] Contemporary researchers believe that the books mentioned above were the earliest naming of plague by Chinese doctors,[36] because these literatures were the earliest ones recording plague in Chinese history. However, it was only an assumption if the naming of *Shu Yi* was regarded as a conscious new means of naming a new disease by Chinese doctors. An article titled *Shu Yi Yuan Qi* (《鼠疫原起》 *The beginning of the plague*) in Wu Xuanchong's book *Zhi Shu Yi Fa* recorded the situation as follows:

> "In the winter of the 16th year of GuangXu (1890), *Shu Yi* broke out. Rats died before *Shu Yi* broke out. People were invaded by epidemic qi and caught the disease, and they would suffer rat sores and scrofula. Those who were mildly ill would die in three to five days, and those who were severely ill would die in an instant. The doctors could find no cure. Only one or two in ten people could survive the epidemic by removing the buboes, being treated by acupuncture, and taking cold and bitter decoction to clear heat. The disease first broke out in Annan in the Tongzhi period, then it extended to Guangxi, and finally to the coastal city of Leilian area and cities attached to Wuchuan.... The cities in the Leilian area and Guangxi had suffered the disease for the past 20 years. The epidemic usually started in November and ceased in May. It was more severe in the cities than in the countryside. As the epidemic developed, it was feared that Gaozhou could inevitably suffer from future epidemics. I don't know medicine, so I have no way to analyze the formulas. However, I heard some experiences on the avoidance and treatments of the plague from my friends, so I will describe them later."[37]

According to the quotation above, the plague broke out in Wuchuan in the 16th year of Guangxu (1890), and it had been prevalent in the Leilian area of western

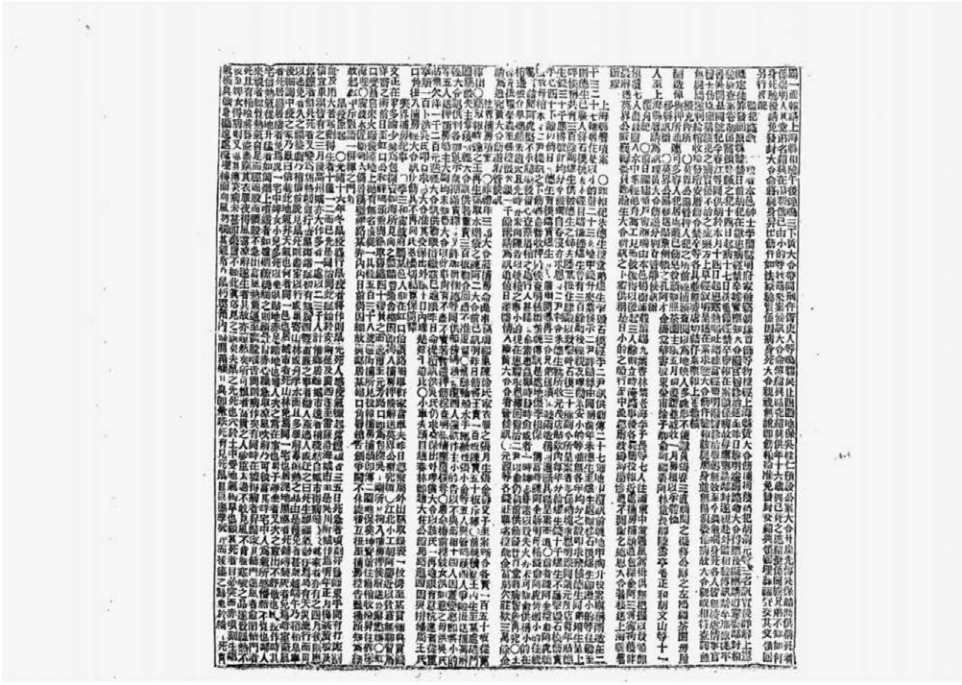

Figure 2 *Shu Yi Yuan Qi* (*The beginning of the plague*) from Shen Bao, on June 16, 1898, 3rd section. (source from: Shen Bao Database).

Guangdong for 20 years. Wu Xuanchong did not know medicine himself because he was a local gentry and not a doctor. Therefore he could only record the experience and treatments he heard from his friends. According to current research, Wu Xuanchong, courtesy name Cunfu (存甫), was born in Wuchuan. He became a student of the imperial academy in the eighth year of Guangxu in the Qing Dynasty (1882), and was the grandson of Wu Maoqing (吴懋清), a successful candidate in the imperial examinations at the provincial level and a local gentleman in Wuchuan.[38] If he had coined the name *Shu Yi*, it was hard to imagine that a literati who did not know medicine would directly call a local pandemic in a new name without any explanations. It is also difficult to understand that Luo Rulan, who was a student of the imperial academy and a medical practitioner in Shicheng, would pose no objection to the name *Shu Yi* after he "met Wu Xuanchong, a friend of his in Wuchuan county" and read his book *Zhi Shu Yi Fa*.[22] Furthermore, Luo directly used the term by titling his book *Shu Yi Hui Bian*. According to common sense, *Shu Yi*, though it had not been seen in the records, should be a relatively common name used by the local people. This could be well confirmed from a note written by Jin Wuxiang (金武祥) in the late Qing Dynasty:

> "In the spring of Jiawu year(1984), I returned to eastern Guangdong once again. The epidemic prevailed in a timely manner, and it lasted for several months. Tens of thousands of people died. Before the epidemic outbreak, local families witnessed the death of rats, and people fell ill once they touched the pathogenic qi. The local people called the epidemic *Shu Yi*."[39]

According to the note, *Shu Yi* was not yet a formal written name. However, it has been a commonly used term by local people in both western and eastern Guangdong. In the two earliest monographs on plague written by Wu Xuanchong and Luo Rulan, both of them regarded plague as *Shu Yi*. For example, Wu wrote, "Rats died before the outbreak of plague. People were intruded by epidemic qi and caught the disease, and they would suffer rat sores and scrofula."[40] Luo mentioned that "rats died and the plague broke out; therefore, it got the name *Shu Yi*."[41] The notes showed the relationship between "death of rats" and "outbreak of plague." Although this way of naming did not conform to the general rules of Chinese traditional disease naming,[42,43] it was very possible that ordinary people noticed the obvious connection between rats and the plague, and further named the disease as *Shu Yi*, a concise word describing the characteristics of the disease in Chinese.

Many names for plague existed in Yunnan and Guangdong at that time, and *Shu Yi* might not have been the common name. The relationship between the death of rats and the outbreak of plague had already been noticed as early as the late Qianlong period. Some literati had noticed the strange epidemics related to the plague in Yunnan at the time.[36] For instance, a famous poet Shi Daonan (师道南) finished his work *Death of Rats* (《鼠死行》) in the first year of Jiaqing (1796), describing rats appearing in houses at daytime and died spitting blood. The poem was later included in *Dian Nan Shi Lue* (《滇南诗略》 *Poems of Southern Yunnan*) complied by Yuan Wendian (袁文典) and Yuan Wenkui (袁文揆), and Bei Jiang *Shi Hua* (《北江诗话》 *Poems and sayings of Beijiang*) written by a famous scholar Hong Liangji (洪亮吉).[44] This showed that the connection between the epidemic and death of rats had attracted more attention from literati and scholars. Despite this, people seem to be more used to calling the plague by the symptoms of the disease according to historical records and research by the later generations. The plague in the 19th century was mostly bubonic plague, which not only was followed by the death of rats but also showed symptoms of swollen lymph nodes. Therefore, it was more frequently called as *Yang-tzu Bing* or *Li-tzu Bing* (疬子病).[45] References could be found in an report on the plague in Yunnan written in English in 1878. It started by "The sickness known in Yunnan under the name of *Yang-tzu*..."[46] However, that few records of plague or rat plague could be found in previous literature did not mean that the local people do not use *Shu Yi* or *Shu Wen* (鼠瘟). Although ancient classics used *Niu Wen* (牛瘟 cattle plague), *Ma Yi* (马疫 horse plague), *Zhu Wen* (猪瘟 Swine fever) and other terms, these were names for livestock plagues different from human plagues and using such terms could cause ambiguity. The way of naming diseases based on their symptoms was more common, and relatively easier to accept and adopt. Furthermore, such naming might cause less misunderstanding. However, with the repeated outbreak of plague, people were more accustomed to referring to the plague by *Shu Yi*. Thus, the term *Shu Yi* naturally became more and more popular among the people. It proves Lintris' viewpoint that recognizing the plague contributed to knowing the disease, and it also shows the difference between folk and mainstream medical knowledge systems.[18,19] But, both Wu Xuanchong and Luo Rulan naturally adopted the folk name *Shu Yi*. From this point of view, there is no strong confrontation between folk and mainstream medical knowledge systems.

In summary, *Shu Yi* had appeared in formal texts since the early 1890s. It had nothing to do with the introduction of Western medicine, and was not a theoretical innovation of Chinese doctors. It was but a coincidence of scholars and doctors such as Wu Xuanchong and Luo Rulan, who chose the same folk name referring to plague. With the increasing prevalence of plague at the end of the 19th century, their works gained increasing attention. Therefore, *Shu Yi* gradually changed from a folk name to a formal name.

3 The popularity of *Shu Yi* and its reasons

After the name *Shu Yi* appeared in various medicinal books and classics, it did not receive immediate attention and wide acceptance. The term "was not widely accepted during the Guangxu period...it was until very late that *Shu Yi* was widely accepted."[47] From a national perspective, whether the concept was widely accepted or not was not should give way to another question, that the local names of the epidemic had not received enough attention from the domestic cultural circle. A notable example was that a plague of widespread influence broke out in Guangdong and Hong Kong during the Guangxu Jiawu year(1894). At that time, *Shu Yi Hui Bian* by Luo Rulan had been republished many times. Chen Zhaoxiang republished the book under the title *Ji Jiu Shu Yi Chuan Ran Liang Fang*. Jin Wuxiang, an imperial messenger who traveled to Guangdong, also used *Shu Yi* to record the situation of the epidemic. Although *Shu Yi* was already used frequently to refer to plague at the time, the dominant media of China did not turn to it. One of the most influential media sources in China, *Shen Bao* (《申报》) had a series of detailed report on the epidemic, and reporters employed words such as *Yi* (疫epidemic)、*Shi Yi* (时疫 seasonal epidemic)、*Yi Li* (疫疠 epidemic disease) to refer to the plague.[48] A small proportion of reports mentioned that local people called the plague as *Yang-tzu* (痒子) and *Li-tzu* (疬子).[49–53] But none of the reports used *Shu Yi* or related words. The following year, however, when reporting the epidemic in Fuzhou, *Shen Bao* used the term *Shu Wen* in the reports twice in a row, namely, "*Shu Wen* is prevalent in Fuzhou, and the epidemic is spreading,"[54] "According to the people in Fujian, *Shu Wen* came before the epidemic qi, which is the same to last year's Guangdong."[55] Although in terms of content, *Shu Wen* in these reports referred undoubtedly to the plague, the meaning of *Shu Wen* was not the plague, but the disease prevalent among rats. Two years later, *Shu Wen* was also used in reports and commentaries referring to this epidemic, but its meaning had changed from the disease prevalent among rats to the plague. A comment wrote that, "People believed that this epidemic was similar to the outbreak of *Shu Wen* in Fuzhou the year before. The death rate approached over 80%. Within a few months, as many as 20,000 to 30,000 people died."[56] Later, *Shu Yi* was also used directly to refer to the epidemic. Another report wrote that, "There was a strange epidemic outbreak in Guangdong the year before last. Local people called it *Shu Yi*, which killed countless people."[57] In the next year, *Shen Bao* published the full text of *Shu Yi Yuan Qi* by Wu Xuanchong.[58]

The publication of this article contributed conductively to people's attention to the concept of *Shu Yi*. Since then, the term began to appear more and more in the newspapers and magazines, such as *Shen Bao*. The author's search results of the terms used for plague in the newspapers and magazines from late Qing Dynasty to the Republic of China (see Tables 1–3 for details) showed that before the 20th century, in addition to the general terms such as epidemic and severe epidemic, the usage of *Shu Yi* was roughly equal to concepts such as *He Wen* and *Yang-tzu*. However, after entering the 20th century, *Shu Yi* gradually took the advantage, and after 1910, the usage of *Shu Yi* had an overwhelming advantage.

Table 1 Search results of *Shu Yi* in Shen Bao database

Year\usage of terms	*Shu Yi*	*Shu He*	*Shu Wen*	*He Wen*	*Yang-tzu*	*Bai Si Du*	*Hei Si Bing*
1884–1899	11	1	3	0	7	0	7
1900–1909	19	1	5	2	1	1	2
1910–1919	1971	35	32	64	2	85	89
1920–1929	472	10	0	1	0	45	18
1930–1939	567	0	5	9	0	19	23
1940–1949	365	0	0	0	0	1	33

Data description: Shen Bao database is used as the retrieval tool. *Shu Yi*, *Shu He*, *Hen Wen*, *He-tzu Wen* (核子瘟), *Yang-tzu*, *Bai Si Du*, *Pei Si Tuo* (配斯脱) and other keywords are used, and the search period is limited from 1872 to 1949. The results above remove one entry under *Shu Yi*, eight entries under *Yang-tzu* and 18 entries under *Pei Si Tuo* which are irrelevant to the plague. *Shu Yi* appeared in the Shen Bao in 1897. It is put in the 1884 to 1899 column, which does not mean that the concept of "plague" appeared in the *Shen Bao* since 1884. It indicates that words referring to infectious diseases caused by *Yersinia pestis* had existed, such as *Yang-tzu* and so on.

Table 2 Search results of *Shu Yi* in Index of National News Papers and Journals

Year\usage of terms	*Shu Yi*	*Shu He*	*Shu Wen*	*He Wen*	*Yang-tzu*	*Bai Si Du*	*Hei Si Bing*
1897–1899	2	0	0	0	0	0	1
1900–1909	33	0	4	2	0	4	9
1910–1919	1023	2	6	7	0	55	8
1920–1929	486	0	0	0	1	29	11
1930–1939	1293	0	0	0	0	98	30
1940–1949	1199	0	0	0	0	3	60

Data description: Index of National News Papers and Journals is used as the retrieval tool, and data in English is excluded. *Shu Yi*, *Shu He*, *Hen Wen*, *He-tzu Wen*, *Yang-tzu*, *Bai Si Du*, *Pei Si Tuo* and other keywords are used, and the search period is limited from 1833 to 1949 for precise results. The results above remove four entries under *Pei Si Tuo* which are irrelevant to the plague.

Table 3 Search results of *Shu Yi* in Ta Kung Pao database

Year\usage of terms	*Shu Yi*	*Shu He*	*Shu Wen*	*He Wen*	*Yang-tzu*	*Bai Si Du*	*Hei Si Bing*
1902–1909	11	3	5	2	0	0	5
1910–1919	372	0	5	5	1	65	18
1920–1929	156	0	1	0	0	28	9
1930–1939	309	0	1	0	1	19	21
1940–1949	651	1	0	0	0	2	41

Data description: Ta Kung Pao database is used as the retrieval tool. *Shu Yi*, *Shu He*, *Hen Wen*, *He-tzu Wen*, *Yang-tzu*, *Bai Si Du*, *Pei Si Tuo* (配斯脫) and other keywords are used, and the search period is limited from 1902 to 1949. The results above remove 1 entry under *Shu Yi* and 1entry under *Pei Si Tuo* that are irrelevant to the plague.

The results obtained from the big data search indicated that, by the 1910s, *Shu Yi* had been fully established as a common and formal word referring to the plague. More references could be retrieved from the dictionaries of the time. After Robert Morrison compiled *A Dictionary of the Chinese Language* in the early 19th century, foreign missionaries and scholars had compiled and published a series of English-Chinese and Chinese-English dictionaries from that time to the early 20th century. These dictionaries regarded the Chinese equivalents of pest and plague as *Wen Yi* (瘟疫), *Shi Yi* or *Yi Zheng* (疫症). It was not until the publishing of *Deutsch-Englisch-Chinesisches Fachwörterbuch* (*German-English-Chinese Dictionary of Technical Terms*) complied by Richard Wilhelm in 1911 that pest was translated into Chinese as *Shu Yi*.[59] And the *English-Chinese Dictionary of the Standard Chinese Spoken Language and Handbook for Translators* published in 1916 complied by German Sinologist He Meiling (赫美玲) translated pest into Chinese as *Shu Yi*.[60] However, there were still no entries for *Shu Yi*, *He Wen*, *Hei Si Bing*, etc., in the Chinese-English dictionaries. The first entries for these names came from *Ci Yuan* (《辞源》 *The Source of Words*), the first major Chinese dictionary linguistically structured around words. The Commercial Press began compiling the dictionary in 1908 and published the first edition in 1915. Entries and explanations related to plague were as follows:

> "*Shu Yi*, or *Hei Si Bing*, is infected by rodents parasitized by fleas. The patient has a strong fever and the body develops buboes, so it is also known as *He Wen*. Black spots appear on the surface of the human body after death, so it is also known as *Hei Si Bing*. Also see *Hei Si Bing* entry.
> *Hei Si Bing*, or the pest, is the most contagious. It is also called *Shu Yi* because rats are the vector of this disease. The Japanese translation of the disease is ペスト, which is triggered by the *Bai Si Du* bacteria. The bacteria invades the blood and spreads throughout the body. Those suffering swollen and painful lymph glands are diagnosed as Gland *Bai Si Du*; those with red phlegm and pneumonia are diagnosed as Lung *Bai Si Du*; those with sores and boils are diagnosed as Skin *Bai Si Du*. The epidemic could trigger severe fever, and very few people could be completely cured. The patient's excrement is highly contagious, so it should be avoided.
> *He-tzu Wen* is the plague. Also see *Shu Yi* entry.
> *Bai Si Du*, or the pest, is also known as *Shu Yi*. Also see *Hei Si Bing* entry."[61]

Ci Yuan was the first large-scale dictionary compiled by the Chinese, and enjoyed a high authority. It took *Shu Yi* and *Hei Si Bing* as entries. Therefore, from a linguistic point of view, these names were obviously regarded as the most common and formal words at that time. But, *Shu Yi* is a native word. So, it could be predicted that its usage should be much higher than that of *Hei Si Bing*. *Shu Yi* quickly became the most popular and standard term among the many related words. Apart from the fact that it is a local word, what are the reasons and opportunities behind its popularity?

As mentioned earlier, Wu Xuanchong and Luo Rulan highlighted two characteristics of the plague in the name of *Shu Yi*, namely, rats died and the plague broke out, and patients would suffer "red and swollen glands, and develop buboes."[41] These two characteristics had been recognized by local people in Yunnan since the end of the 18th century. Before the concept of *Shu Yi* appeared, people in Yunnan called it by names such as *Yang-tzu Wen* or *Yang-tzu Bing*. *Yang-tzu* was not a commonly used word in ancient Chinese, and its meaning was confusing. According to the investigation by doctors in Yunnan during the period of the Republic of China, *Yang-tzu* referred to the testicles of a sheep in the local language. Patients of plague would develop swollen lymph nodes in their groin, armpit or neck, etc., which resembled the testicles of a sheep.[62] *Yang-tzu* was a disease name that expressed the characteristics of the disease, and it had the same meaning with *He Wen* commonly used later. In the works on the plague that had appeared since the 1890s, in addition to the concept of *Shu Yi*, terms such as *He Wen*, *Shu He* (鼠核), *He Zheng* (核症), and so on appeared from time to time. For example, Huang Zhongxian (黄仲贤) stated at the beginning of his work *Shu Yi Fei Yi Liu Jing Tiao Bian* (《鼠疫非疫六经条辩》 *Systematic Differentiation of the Six Classics of Plague being Non-Pandemic*) published in 1909 that, "*Shu Yi*, or *He Zheng*, began in Guangzhou in the Jiawu year (1894), and later spread to villages and counties nearby."[63] *Shu Yi Jue Wei* (《鼠疫抉微》 *Elaborations on Plague*) published by Yu Botao (余伯陶) also mentioned that "*Shu Yi* was called *He Yi* at first," and listed the death of rats or the presence of buboes as the two necessary conditions for the diagnosis of plague.[64] *Yang-tzu*

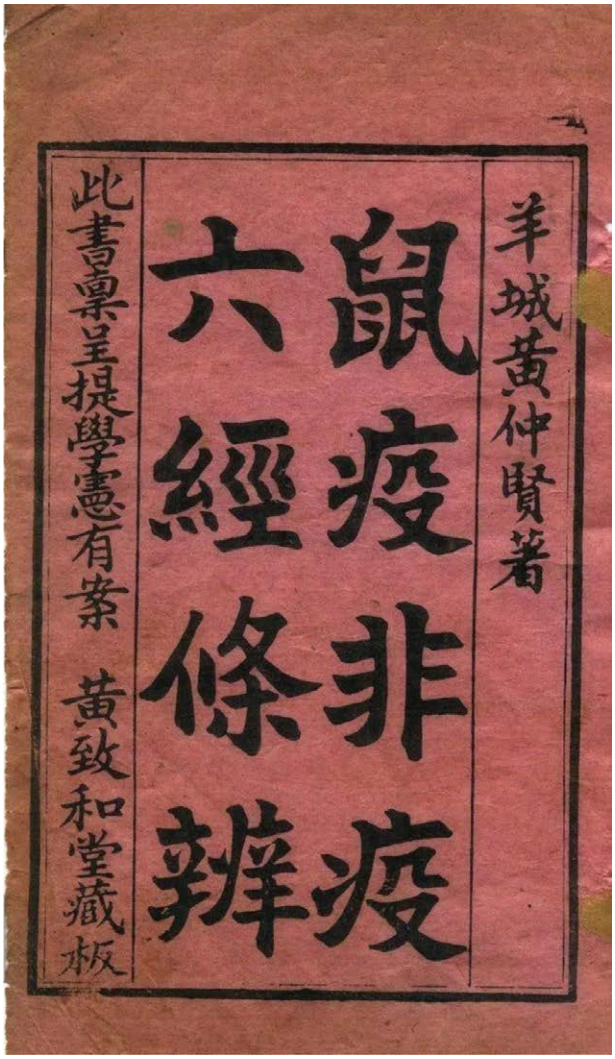

Figure 3 Front cover of *Shu Yi Fei Yi Liu Jing Tiao Bian* (*Systematic Differentiation of the Six Classics of Plague being Non-Pandemic*) complied by Huang Zhongxian, 1909 version, collected in Beijing University of Chinese Medicine. (source from: http://szyyj.gd.gov.cn/zwgk/xxgkml/5/content/post_3088044.html).

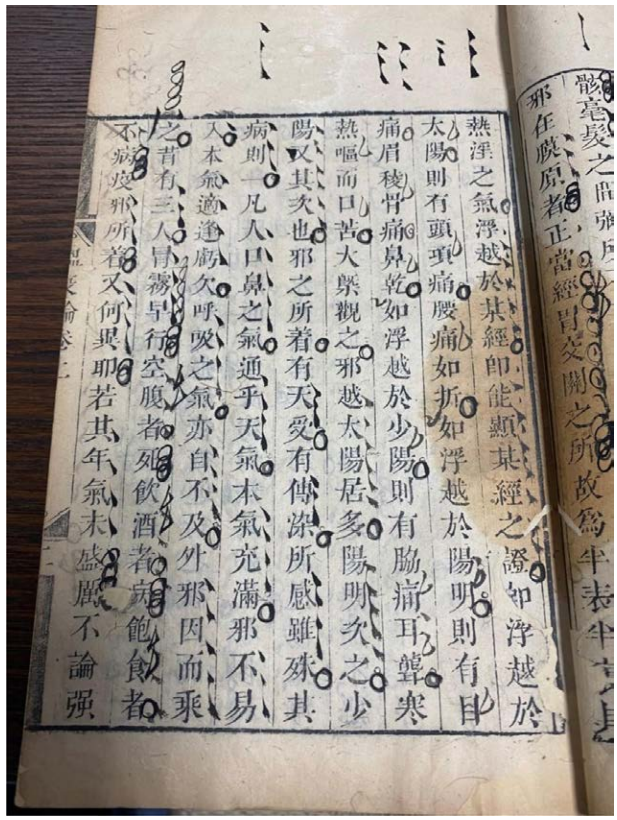

Figure 4 *Wen Yi Lun* (*Treatise on Warm-Heat Pestilence*) compiled by Wu Youxing, 1715 version, collected in Guangzhou University of Chinese Medicine. (source from: http://m.stdaily.com/index/kejixinwen/2020-06/13/content_956016.shtml).

was a local dialect. It was difficult to understand, and the diction was not elegant and tame. So, with the rise of concepts such as *Shu Yi* and *He Wen*, *Yang-tzu* was quickly ignored. After the 20th century, *Yang-tzu* nearly disappeared from newspapers and magazines, except that local chronicles in Yunnan still used this concept from time to time.

Shu Yi took the place of other terms such as *He Wen*, *He Zheng*, etc., and became the most popular standard term referring to plague at that time. The reasons behind this phenomenon lay in three aspects. First, the concept of *Shu Yi* was frequently used in influential medicinal works and classics by famous scholars, namely Wu Xuanchong, Luo Rulan, etc., by coincidence. Second, *Shu Yi* could be closely related to the characteristics of the epidemic prevention and treatment. Finally, the acceptance of *Shu Yi* was deeply rooted in the background of the era when China was actively introducing a modern health and epidemic prevention mechanism. These aspects promoted the acceptance of *Shu Yi*. Plague was a severe infectious disease, and was very dangerous. Before the invention of antibiotics, it not only had a high fatality rate but also had no treatments both at home and abroad. Therefore, in the face of the epidemic, the colonial institutions such as the British Hong Kong authorities and Shanghai Municipal Council focused on public health measures, including cleaning, disinfection, quarantine, isolation, etc. They encouraged catching and killing rats to control the epidemic.[65,66] These methods revealed the deepening influence casted by the West and Japan on China at the end of the 19th century and the beginning of the 20th century. At the same time, Chinese society began to pay attention to the concept and system of modern health and epidemic prevention, and commenced to introduce this mechanism gradually. There existed objections, particularly from TCM practitioners who believed that the plague could be cured.[67,68] Nevertheless, the strategies and measures employed by the colonial institutions were generally recognized by the official and mainstream society. For example, in 1903, an instruction from the Tianjin Municipal Health Bureau pointed out:

> "The Bureau found that plagues had broken out in the Shanhaiguan area of Yingkou. The epidemic came from rats. When the rat died, the fleas and worms on the rat's body turned to bite people. As soon as the patient

Figure 5 One Health: balance between healthy humans, healthy animals and safer environment. Source from: https://www.sohu.com/a/417993993_696850.

> was bitten, his skin was swollen and developed buboes, and the pathogenic qi intruded the human body. In no time, the patient would suffer severe fever, and would die without proper treatment in time. The epidemic was called *Shu He Wen*....It should be noted that the way to prevent the epidemic is nothing more than catching rats and cleaning. Catch rats to clear the source of the epidemic, and clean the environment to prevent the outspread of the epidemic."[69]

At the same time, newspapers and magazines used colloquial language and pictures to vigorously publicize preventing and controlling the plague by catching and killing rats. For example, in 1908, a report in the *An Hui Bai Hua Bao* (《安徽白话报》 Anhui Vernacular News) stated that:

> "There are many kinds of diseases, but the plague is the most dangerous....So foreigners regard the plague as the strongest enemy, and the only way to control it is to get rid of rats. Compared to the westerners, Japanese are no less cautious about it. When the people caught a mouse and sent it to the police, the police would award him fifty cents of money and a certificate.... So the Japanese people did their best to catch rats, because they can make money for themselves and make contributions to the society at the same time.... Now the Tianjin Patrol Bureau knows that the plague is a serious problem and must be prevented. So it also awards ten cents to people who catch a mouse, in order to bury it at any time."[70]

Since catching and killing rats were important strategies for the prevention and control of plague, *Shu Yi* was undoubtedly the most favorable choice to directly associate the name of the disease with rats. In addition, the word was concise and clear in Chinese language, and it also conformed to the Chinese word-formation habits. For these reasons, it was not surprising that *Shu Yi* stood out among many words and became a commonly used word.

Shu Yi had also been recognized by the scientific community with its increasing usage. After the plague outbreak in northeast China in 1910, Ding Fubao (丁福保), a famous literati and an influential medical scientist at the time, published a series of long scientific article *Shu Yi Bing Yin Liao Fa Lun* (《鼠疫病因疗法论》 *On the Etiology and Therapy of Shu Yi*) in *Eastern Times* (《时报》), *Sin Wan Pao* (《新闻报》), and *Ta Kung Pao* (《大公报》). The article started by explaining the name of the epidemic:

> "The etiology of pest is caused by the infection of the rodents, hence it is named *Shu Yi*. It is also well known as the Black Death, because the human body turns black after death. It is also named as *He Yi* or *Yi-tzu Wen* by ordinary people. Anyone who suffers from this disease will develop swollen lymph nodes or buboes all over the body. Buboes used to be translated as *He*(核), meaning kernel, pit, or nutlet in the fruits. The shape of buboes is similar to these and thus gets the name....The cause of *Shu Yi* is due to the pest bacteria, which the lice and fleas on the rat's body contain it, and it is transmitted to humans by sucking and biting humans."[71–73]

On the basis of Ding Fubao, Li Xianglin (李祥麟), a medical doctor who studied in Japan, further discussed the history and diagnosis differentiation of the plague. He wrote that "*Shu Yi* is called Plague or Pest in the West. There are other names such as *Li-tzu*, *Yang-tzu*, *He-tzu Wen*, *Hei Si Bing*, etc. in our country."[74] After that, Wu Lien-The (伍连德), the plague fighter who enjoyed a wide reputation in the international medical community, also mentioned in his academic essay that "*Shu Yi* is more appropriate" compared to other names.[75] These quotations showed that *Shu Yi* had been recognized by the scientific community. Academic endorsement by famous scholars undoubtedly contributed to establish this term as a common standard term.

4 The importance of the concept of *Shu Yi* from the perspective of history of knowledge

Shu Yi has appeared in literature as early as the 1890s as mentioned above. However, this term should have existed in the folk society of Guangdong and Guangxi for many years. The local literati chose this term as an unintentional respect for local customs. Therefore, *Shu Yi* was neither an invention of Chinese doctors, nor a deliberate choice with theoretical consciousness, and it had nothing to do with the introduction of new medicine. The concise and clear term that showed the characteristics of the disease should appear in folk society. However, from the perspective of traditional Chinese disease naming, this disease name was very unusual. There were no definite rules for naming diseases in ancient China. So, the names of the diseases were highly arbitrary, and experienced accumulation and changes in the long-term historical evolution, thus resulting in various and messy disease names. In fact, there were generally rules to follow, such as naming the disease by its symptoms, conditions, etiology, disease location, disease nature, and mechanism of the diseases.[42] Calling the disease by the names of animals suffering the same ones

with human beings was not included in the rules. Of course, there were disease names for animals, especially livestock diseases in ancient times, such as *Niu Yi* (牛疫 cattle plague), *Ji Wen* (鸡瘟 chicken plague), *Ma Yi*, and so on. However, these names referred to the diseases of animals themselves, and they were mostly concerned with livestock and poultry closely related to human life. By the Ming and Qing dynasties, the medical community had realized that whether it was a human or an animal, the disease was caused by the epidemic qi, pathogenic qi, and miscellaneous qi. Wu Youxing (吴有性), a famous medical scientist in the late Ming Dynasty, mentioned in his work *Wen Yi Lun* (《温疫论》 *Treatise on Warm-Heat Pestilence*) that:

> "The invisible qi which is biased towards animals, such as cows, sheep, chickens and ducks, could cause pestilences. Therefore, not just human beings suffer pestilences. However, in some cases, cows are sick but sheep is not sick, chickens are sick but ducks are not sick, people are sick but animals are not sick. The reasons behind them lie in different pathogens of different qi. Knowing that different qi could cause different diseases, this qi is thus called miscellaneous qi."[76]

Guo Huaixi (郭怀西), a veterinary scientist in the Qing dynasty, also said: "The epidemics were triggered by pathogens from the four seasons.... Because the diseases were much alike and contagious, they were named as epidemics. Epidemics to human beings were similar to warm diseases to animals."[77] And people at that time were also aware of the contagious nature of the epidemic, and even mentioned the possibility of humans infecting livestock. For example, Zhang Zongfa (张宗法) of the early Qing dynasty said: "Human epidemics infect people, and animal epidemics infect animals. This is to say that epidemics would infect their likely beings. But, hog plague can infect cattle, and cattle plague can infect hogs. Therefore the epidemics need to be avoided."[78] Li Nanhui (李南晖) later also mentioned that, "The epidemic comes from the unhealthy miscellaneous qi in the four seasons of heaven and earth....If the cattle suffer, the horse will inevitably be infected." He further said that, "The epidemic spreads to villages and towns, and infects both humans and animals. All lives should avoid that. If the cattle and horses are infected, hogs must avoid them."[79] These discussions showed that the medical community had already had detailed and reasonable observations and discussions on the epidemic infection across humans and animals. But, it should also be noted that scientists who discussed this issue were veterinary scholars except Wu Youxing. General medical literature paid little attention to this issue, and did not further point out the transmission of animal diseases to humans or explore the relationship between human and animal diseases. Therefore, ordinary people not only paid seldom attention to animal diseases, especially those that were loosely connected to people's livelihood, but also felt that animal diseases were not directly related to human diseases. It was natural that names of animal diseases were not used to refer to the name of human disease.

Differentiating diseases of animals and those of human beings also occurred in the West. Modern medicine regards the comorbid disease between humans and animals as Zoonosis. It is generally believed that this concept was first coined by Rudolf Virchow, a famous German pathologist in the 19th century. When he was studying pig Trichinella, he recognized the connection between animal diseases and human health, and proposed this concept to refer to the animal diseases transmitted to human beings.[80,81] However, zoonosis aroused the attention and systematic research of the medical community after the 20th century. It was not until 1930 that the first monograph discussing zoonotic diseases in details appeared, which was *Diseases Transmitted from Animals to Man* compiled by Professor William T. Hubbert and others.[82] In 1959, zoonosis was clearly defined by the World Health Organization as "any disease or infection that is naturally transmissible from vertebrate animals to humans."[83] Furthermore, the American epidemiologist Calvin Schwabe integrated human and animal health into one in 1964 and proposed the term "Onemedicine." The term was based on the common knowledge of science of anatomy, physiology epidemiology and etiology. It emphasized the similarities between veterinary medicine and human medicine, and believed that there was no paradigm difference between the two disciplines of human medicine and veterinary medicine.[81,84] With the deepening research into epidemiology and public health, the importance of research on zoonotic diseases was recognized. Existing research showed that zoonotic diseases accounted for 60% of all known infectious diseases. Furthermore, in recent years, 75% of new human infectious diseases come from animals, which has become a major driver of emerging and re-emerging infectious diseases.[85]

In the context of knowledge evolution, it could be concluded that *Shu Yi*, which was a disease name established by various coincidences, inadvertently created the history of zoonosis in China. With the widespread acceptance of this traditional while peculiar disease name, it not only promoted physicians to pay more attention to and think about the relationship between human and animal diseases either consciously or unconsciously but also led to continuous appearance of similar disease names which are popular today. As a result, many medical works and newspaper reports discussed the relationship between *Shu Yi* and rats from time to time. Despite this, some people still had doubts about the transmission of the disease between humans and rats, and posed objections. Huang Zhongxian argued in his work *Shu Yi Fei Yi Liu Jing Tiao Bian* that, "The title of the book argues that *Shu Yi* is not an epidemic. *Shu Yi* is a disease among rats; however, an epidemic refers to the disease of

people, not the disease among animals."[86] Du Ziliang (杜子良) argued that rats was wronged for. He wrote that:

> "Westerners take *Shu Yi* too seriously. They believe that if there were no rats in the world, the epidemic would not break out. This shows their eagerness and confidence to destroy the epidemic, but it is only self-disturbing, which does not make up the fact. Rats are only one animal species that is infected by the epidemic. Among the six animals, which are horses, cattle, sheep, chickens, dogs, and hogs, they are all susceptible to the disease. But Western medicine does not care about them. They only do research on rats, so I feel that rats are treated unfairly."[87]

These statements might seem unreasonable. However, they promoted the scholars to pay more attention to the correlation and relationship between humans and animals in the epidemic system. More discussions believed that *Shu Yi* was a zoonotic disease which infected both humans and rats. Scholars began to think about the impact of animal diseases on humans, thus promoting the development of zoonosis in China. For example, a commentary in 1915 pointed out that:

> "The epidemic is triggered by pathogenic qi of heaven and earth, which is what Westerners call bacteria. There are different types of bacteria, and each of them contains a poisonous substance floating in the wind. The wind blows around a certain county or a village. The epidemic qi prevailed, and both people and animals will fall ill when they are invaded, though their symptoms would be different. There are diseases in which mules and horses fall ill when the cattle and sheep do not, or chickens and dogs will be sick while fish and shrimp are not. There exist diseases which make people ill, but not the animals. So do the opposite ones, and the diseases which make both people and the animals ill. Such is *Shu Yi*, an epidemic that transmits across humans and rats. The source of the epidemic could either be infected humans or infected rats. This epidemic is called the plague in other countries. But what is the reason that both humans and rats are infected? Rats appear in the families of patients, and they steal the patient's food and eat it, so the rats are infected. The infected rats are thirsty and anxious, and they run around without fear. They drink water whenever they find it, and if they drink too much, their abdomens will become bloated and the rats die. The bodies of dead rats are in the dark places, and people could not find them. After a period of time, maggots gather on the dead bodies, and unleash an unbearable smell as well as poisonous bacteria. The rats like to stay with their kind, so they infect each other and run into families. This is why the rats become the medium for the infection of the epidemic. The healthy people could suffer the pathogenic qi."[88]

At the same time, with the popularization of *Shu Yi*, the name of *Kuang Quan Bing* also appeared. By 1911 at the latest, *Kuang Quan Bing* began to appear in the newspapers.[89] Nowadays, *Feng Niu Bing* (疯牛病 mad cow disease), *Qin Liu Gan*, *Zhu Liu Gan*, and *Hou Dou*, etc., have long become common names.

5 Conclusion

Various diseases and pandemics have accompanied the development of human society, and zoonotic diseases such as the plague have a very long history. Nevertheless, human beings who look down on the world with the mentality of the superior spirit of all things always tend to regard their own diseases as a relatively closed system, at least before modern times. Human beings do not realize that their species are just a member of nature after all. Like animals, they are exposed to extremely complicated pathogenic microorganisms, and human beings and animals may also infect each other. As is mentioned above, existing research has shown that zoonotic diseases are not only diverse, but also very harmful to humans. In recent years, at least 2.5 billion people are infected and 2.7 million people die annually due to zoonotic diseases.[90] Therefore, from the perspective of natural ecosystems, paying more attention to such diseases and gaining a more comprehensive understanding of the relationship between humans and animals are indeed issues that humans must face now. Just as Barbara Natterson-Horowitz and Kathryn Bowers mentioned at the last of their work *Zoobiquity*:

> "Our essential connection with animals is ancient, and it runs deep. It extends from body to behavior, from psychology to society—forming the basis of our daily journey of survival. This calls for physicians and patients to think beyond the human bedside to barnyards, jungles, oceans, and skies. Because the fate of our world's health doesn't depend solely on how we humans fare. Rather, it will be determined by how all the patients on the planet live, grow, get sick, and heal."[91]

Therefore, on the basis of Onemedicine, the international academics further put forward the concept of One Health, which involves human, animal, food, environment, urban planning and many other aspects. One Health is a global expansion strategy aiming to promote interdisciplinary and cross-regional collaboration and communication. It is dedicated to combining human medicine, veterinary medicine and environmental science to promote human and animal health, as well as maintaining and improving the ecological environment. Global public health departments and academia promote this concept by establishing relevant institutions and promoting academic research, further implementing the ideal in specific practices such as public health construction and epidemic prevention.[92]

In this context, from the perspective of the evolution of knowledge about zoonotic diseases in China, the establishment of *Shu Yi*, which may be a creation by coincidence, opened up a new field of disease cognition inadvertently. Its significance in the history of knowledge deserves more attention and elucidation. Furthermore, compared with the international academic community, there is still a considerable gap in domestic attention and

research on zoonotic diseases and One Health, both in terms of quantity and depth.[93] The human beings have already stepped into an era of comorbidity, yet most of the species lack general awareness. Therefore, a refocus on the concept of *Shu Yi*, and excavating its intellectual historical significance have more academic value and practical significance.

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Ethical approval

This study does not contain any studies with human or animal subjects performed by any of the authors.

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YU Xinzhong and TIAN Yu did the research and wrote the article.

Conflicts of interest

The authors declare no financial or other conflicts of interest.

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