Regulating wildlife conservation and food safety to prevent human exposure to novel virus

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ABSTRACT

Epidemiological investigation suggested that the current outbreak of COVID-19 virus was associated with a seafood market, and COVID-19 has been identified a probable bat origin. Similar to SARS event in 2003, such a zoonotic disease showed an animal-to-person and even more serious person-to-person spread, and posed a significant threat to the global health and socio-economic development. We analyzed the association of both outbreaks with wildlife diet in China and proposed suggestions for regulating wildlife conservation and food safety to prevent human exposure to the novel virus, including increasing social awareness of hazards in eating wild animals, strengthening legislation on eating and trading of wild animals, improving the standards for food safety, and establishing market supervision mechanism. Regulatory intervention is not only critical for China but also for other countries where wildlife hunting is prevalent to prevent from novel virus exposures.

The current outbreak of Novel coronavirus pneumonia (COVID-19), which was first reported from Wuhan of China on 31 December 2019 and can cause severe respiratory disease (Huang et al. 2020), has spread rapidly around the globe. As of 30 January 2020, 83 cases had been diagnosed in 18 countries except for China, at that time COVID-19 was declared by World Health Organization (WHO) a Public Health Emergency of International Concern (PHEIC). Epidemiological investigation suggested that this outbreak was associated with a seafood market in Wuhan, and COVID-19 has been identified a probable bat origin (Wu et al. 2020; Zhou et al. 2020). This can be reminiscent of another outbreak, Severe Acute Respiratory Syndrome (SARS), which emerged in Guangdong, China, at the end of 2002. Bat was identified as the natural reservoir host of SARS coronavirus 15 years later (Hu et al. 2017).

Both SARS in 2003 and COVID-19 this time showed the zoonotic sources of virus that can cross species to infect humans (Li et al. 2005; Chan et al. 2020). Such emerging infectious diseases which showed an animal-to-person and even more serious person-to-person spread were caused by human exposures to viruses through a series of trading, marketing, or consumption of the infected animals. Viral spill-over from intermediate hosts infected by bats had a close relationship to the special dietary habit of some Chinese people, especially in southern China. China has a long history of food culture and a prosperous catering industry. Prevalence of eating wild animals in ancient times was a supplement for protein due to insufficient intake. But nowadays, it becomes a weird dietary to meet the curiosity of some people, and even a symbolic of some Chinese Yuppies or tyrants because of the rarity and high price of the wild animals. Another infectious disease caused by Avian influenza A (H7N9) virus, which was found in March 2013 in China, showed human exposure to live poultry or potentially contaminated environments, especially markets where live birds were sold. Most of the zoonotic infection risk was associated with eating and trading of wild animals, which can pose a significant threat to the global health and socio-economic development. Regulating wildlife conservation and food safety to prevent human exposure to novel virus is of global significance.

Outbreaks of viral infections posed a significant threat to public health. In November 2002, clusters of pneumonia with unknown cause were reported in Guangdong province of China, now known as the SARS-CoV outbreak, and the number of cases of SARS increased substantially in the spring of 2003 in China and spread globally later (Zhong et al. 2003). The mortality in China caused by SARS constituted 90.62% of the total death in the globe, with a mortality rate of 10.18% (Fig. S1). The mortality rate caused by H7N9 reached 37.89% from 2016 to 2018 (Fig. S2). As of 27 February 2020, COVID-19 has caused infections in 46 countries outside China and a cruise...
ship currently in Japanese territorial waters, with 3664 confirmed cases and 57 deaths mainly in the Republic of Korea, Italy, Japan, Iran, France, Philippines, and the international conveyance "Diamond Princess" (Fig. S3). In the meantime, the situation in China was much more serious; as of 27 February 2020, the number of confirmed cases and deaths increased from 1 to 78,630, and 1 to 2747, respectively. The number of suspected cases increased from 54 to 28,942 from 20 January 2020 to 8 February 2020, and since then showed a decreasing trend (Fig. S4). The results indicated that COVID-19 is more serious than SARS and H7N9 in terms of spread speed and scope.

Extraordinary public health measures have been taken in and outside China to reduce further spread of the COVID-19 outbreak (Wang et al. 2020). Currently, many foreign airline companies like United Airlines, Air Canada, and British Airways have cutoff or reduced their flights to Wuhan and even to other major cities in China (Fig.S5). Although WHO has not recommended any international travel restrictions so far (WHO 2020), the local government in Wuhan has announced the suspension of public transportation on 23 January 2020, with closure of airports, railway stations, and highways in the city, to prevent further disease transmission (People’s Government of Hubei Province 2020). In China, passenger volume of railway presented a decreasing trend from 27 January 2020 to 2 February 2020 and is down about by 62.2%—74.4% year-on-year. Passenger volume of civil aviation, highway, and waterway has also declined with more than 70%, 85.6%, and 90.2% on a year-on-year basis on 29 January 2020 (Fig.S5). Emigration ratio from Wuhan to other provinces presented a decreasing trend after 23 January 2020 (Fig.S6). The suspension of transportation helped a lot to prevent the virus spread from person to person, with the number of newly confirmed cases presented a decreasing trend both in and outside of Hubei Province of China (Fig. S7).

The impacts of such an epidemic on social economy will be huge (Sands et al. 2016), especially on services such as transportation, cultural tourism, hotel and catering, and entertainment (Fig. S8–S9). The mismatch between supply and demand in the market caused by infectious diseases has led to huge employment consequences (Lee and Warner 2006). Uncertainty about the future of the epidemic and fear of its international spread could also reduce confidence in economic development (Smith 2006). The SARS event led to a decline in consumption, imports, exports, and investment (Fig.S10–S12), and many enterprises faced liability crisis (Fig.S13). It was estimated that the SARS outbreak cost China between 12.3 USD billion and 28.4 USD billion, with GDP estimated to have fallen by 2% in the second quarter of 2003 and 1% for the whole year (Fig.S14). At the same time, global economic loss was estimated to be between 30 USD billion and 100 USD billion (Qiu et al. 2018). The H7N9 had a milder economic impact than SARS, and China’s poultry industry suffered more than 40 billion yuan from the outbreak. However, the economic impact was minimal on a global scale (Qiu et al. 2018).

Similar to SARS, COVID-19 also started at the end of the year, but it attracted the governmental attention relatively earlier. Since the Chinese New Year is early February in 2020, the impact on the real economy is likely to begin in the first quarter. Travel rush after the Spring Festival holiday has postponed; however, the number of passengers carried by all kinds of transportation means has dropped sharply. Revenues of film box office, tourism, and catering industries have also dropped significantly due to the restrictions. According to the China Movie Data Information Network (n.d), the total revenue of film box office during the 2019 Spring Festival season was 5.86 billion Chinese yuan, accounting for 9% of the whole year. However, due to the impact of the epidemic, the demand for watching movies in 2020 Spring Festival dropped sharply, and all the large cinemas have suspended business due to the COVID-19 outbreak, which will cause a huge loss of the revenues from film box office during the 2020 Spring Festival. It was reported that more than 20,000 employees of Xibei Restaurant Group were unemployed, and daily revenue was only 5–10% of a normal level. At present, various departments of the Chinese government have worked out emergent policies and measures to hedge against the impacts of the epidemic, especially to help the affected enterprises and workers (Table S1). In order to solve the problems occurred in the course of epidemic prevention and control, the Chinese government has fostered new areas of economy, such as online shopping, online food order and delivery, online entertainment, and other forms of digital economy.

Since such an epidemic is associated with the consumption of wild animals and has frequently happened in China in recent years, it is essential to take precautionary actions to cutoff or reduce human exposure to the novel virus. In addition to the prevention and control measures recommended by WHO and National Health Commission of the People’s Republic of China (NHPCPC), more efficient regulatory actions should be taken for prevention at source.

1. Increase social awareness of hazards in eating wild animals. An announcement about bans on the trading of wild animals, including warning about the health risk of eating wild animals, was released by the State Administration for Market Regulation, Ministry of Agriculture and Rural Affairs, and National Forestry and Grassland Administration on 26 January 2020 in China.
However, this announcement was only valid before the end of this outbreak. It was exactly the same way to deal with the SARS event in 2003, so such a tragedy occurred again 17 years later. The painful lesson of eating wild animals has not prevented some Chinese people from changing the notion that wild animals, especially rare ones, are tonic medicines for human body. In fact, most of the zoonosis were caused by viruses from wild animals and passed into humans through the process of killing and eating infected animals. Social awareness of hazards in eating wild animals, reducing contacts with wild animals, and respecting wildlife as an equal living being as human life in the natural ecosystem should be further enhanced. As Internet and social media applications have skyrocketed nowadays, social media could be useful tools for promoting public awareness and health education to completely eradicate the risks from eating wild animals.

(2) Put prohibition of eating wild animals on legislation agenda, making it clear about serious punishment of the legal violation, including sentence to life prison. The currently effective Law of the People’s Republic of China on the Protection of Wildlife (2018) was formulated for the purpose of protecting the rare and endangered terrestrial and aquatic wildlife, as well as important terrestrial wildlife with ecological, scientific, or social values, whereas general wildlife, which was an integral part of the natural ecosystem, was not included in the scope of protection. While hunting, killing, purchasing, transporting, and selling of the rare and endangered wildlife were addressed as illegal according to the Criminal Law of the People’s Republic of China (2017), eating and consumption of wildlife was not mentioned. However, great demands for wild animals can stimulate the trading market, and the whole process should be suppressed and controlled at the source. It should be amended in the Criminal Law and the Law on the Protection of Wildlife that eating and consumption of all the wild animals is related to alleged criminal behavior and should be seriously punished or be sentenced to prison. Criminal liabilities for eating, killing, processing, transporting, and selling the unauthorized animals should be defined clearly. Only severe penalty exceeds the pleasure and vanity acquired by eating wild animals, the general public, especially those who have such a weird consumption hobby, will be awaken to the alarm signals from SARS and the current event, and such a public health incident of global impacts will be prevented and avoided.

(3) Improve the standards for food safety, including regulatory standards for ill and dead livestock transactions. The primary risk factor for humans is exposure to infected wild animals, dead and ill poultry, or contaminated environment such as poultry markets. Slaughtering, defeathering, handling carcasses, and preparing for consumption will pose health risks to humans through contacts with affected poultry or wild animals. While food safety was stressed repeatedly during the spread of this outbreak, preventive actions should be taken earlier. A major food safety bill signed into law in January 2011 gave the U.S. Food and Drug Administration new powers and aims to shift the focus from response to prevention of food-borne illness (Stokstad 2011). However, consumption of live poultry and livestock, and epidemic prevention of wild animals were not included in the current Food Safety Law (2018) and Animal Epidemic Prevention Law (2015) of the People’s Republic of China, which should be further updated and specified in detail. Moreover, marketing, processing, transportation, and trading of animals that are sick or dead unexpectedly should be legally prohibited. Zoonotic disease prevention can be achieved by the enhanced and standardized surveillance and control in animal quarantine, production and processing, and storage and transportation. Slaughtering and primary processing of the livestock and poultry can be centralized in slaughtering houses authorized by a marketing supervision organization. Improved legal enforcement, real-time online monitoring, and enhanced processing technology will help to ensure food safety.

(4) Strengthen market supervision and monitoring mechanism. It is difficult to completely ban the consumption of wild animals solely through the improvement of people’s awareness; an effective and feasible market supervision system is needed to ban the possibility of eating wild animals. Wild animals may enter the circulation market because there is no specific law currently. To completely eradicate the circulation of wild animals in the market, a list of permitted edible animals should be developed first. For that, the animals that are authorized to be sold in the market should have an identification code, which can be checked by online monitoring in the whole process of slaughtering, processing, transporting, selling, and consumption so that the sources can be easily identified and controlled in case of any emergencies. Regular and flight inspection should be taken especially for agricultural products and seafood markets. The administrative supervision department
should take the initiative to investigate any illegal activities in the market and bear the responsibility for malfeasance. All-round supervisions from public consumers, business, governmental departments, and non-governmental organizations should be strengthened as an entity for the improvement of public health.

Since such an epidemic could break out and spread in any country, and once it happens, the impacts on the global health and socio-economic development are extremely large. International communication, cooperation, collaboration, and even convention should be further reviewed and strengthened for the conservation of wildlife, prevention of epidemic disease, construction and effective operation of the public health system, and improvement of relevant policies and regulations. Interdisciplinary science including conservation biology, ecosystem ecology, epidemiology, public health, medical research and development, social sciences, law, and crisis management need to be integrated to provide an integrated cycle of prevention, preparation, response, and recovery (Bedford et al. 2019). Only in this way can the ecosystem and human health be well ensured and such a global epidemic be prevented.

Author Contributions
YL conceived the idea and study design, JY, XC and HC collected and analyzed data and drafted the paper, YL and JY revised the paper.

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Data and Materials Availability
All data needed to evaluate the conclusions in the paper are presented in the Supplementary Materials.

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