Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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First respiratory transmitted food borne outbreak?

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ABSTRACT

The world is faced with a remarkable coronavirus outbreak with epicentre in Wuhan, China. Altogether 40554 cases have been confirmed globally with novel coronavirus (SARS-CoV-2) until February 10, 2020. Rigorous surveillance in other countries is required to prevent further global expansion of the outbreak, but resolving the exact mechanism of the initial transmission events is crucial. Most initial cases had visited Huanan South Seafood Market in Wuhan selling also various exotic live animals. Based on the limited initial human-to-human transmission and timely clustering of cases in Huanan market among elderly men, coupled with knowledge that coronaviruses are derived from animals and relationship of SARS-CoV-2 to bat coronavirus, zoonotic transmission in the first instance is probable. To target the actions, similar epidemiological actions to human cases are needed with animal or food exposures. According to current information, an exceptionally wide contamination of seafood market might explain the initiation of the SARS-CoV-2 outbreak. Seafood tanks, air contamination by live animals or rodents are possibilities, but sold animals normally come from various sources. The mode of transmission may become clearer in future: usually in outbreak investigations, hindsight is easy, but for now information about the initial source of this outbreak is limited.

1. Main text

The world is faced with a remarkable outbreak once again, this time starting in Wuhan, China. Altogether 40235 people have been confirmed in China with infection of novel coronavirus (SARS-CoV-2) until February 10, 2020 (National Health Commission of the People's Republic of China, 2020; World Health Organization, 2020). A proportion of around 15% of those infected have been severe cases, and 909 cases mostly elderly patients with background illness have died. Cases have also been reported from other Chinese provinces and with > 300 cases outside China. Currently, the person-to-person transmission is considered the main mode of transmission and rigorous surveillance in other countries is required to prevent further global expansion of the outbreak (Thompson, 2020, Imai et al., 2020). Resolving the exact mechanism of the initial transmission events is crucial in preventing this type of outbreaks from occurring. Most but not all initial cases had visited Huanan South Seafood Market in Wuhan. In addition to seafood, live and slaughtered chicken, pheasants, bats, marmots, deer, snakes and organs of rabbits and other wild animals are sold (National Health Commission of the People's Republic of China, 2020; World Health Organization, 2020). Consumption of exotic animal meat is common in China, and it is believed to have health boosting effects.

Based on the limited initial human-to-human transmission and clustering of cases in Huanan market among elderly men in December 2019, coupled with knowledge that coronaviruses are derived from animals and relationship of SARS-CoV-2 to bat coronavirus, zoonotic transmission in the first instance is probable. The epidemic curve suggest several days to few weeks of exposure (Huang et al., 2020). Worryingly little information has been released on animal or food exposures or trace back this far apart from genomic sequences. Among the initial cases, there was only few person-to-person transmission events within the same households reported, this mode of transmission has become more evident later (Wang et al., 2020). Transmission to health care workers has been reported (Wang et al., 2020). Cases have been confirmed also outside Wuhan in China. Outside China, 319 cases in 24 countries have been reported. However, already the source of some initial cases was not known with no visit to Huanan or other animal markets, suggesting either an unknown source or person-to-person transmission (World Health Organization, 2020).

Cases have been detected in health care workers, like with SARS (severe acute respiratory syndrome) and MERS (Middle East respiratory syndrome)-corona virus outbreaks (Grant et al., 2019; Wang et al., 2020). SARS caused a major outbreak in the beginning of 2000s mostly in Asia, the source was civet cats. MERS transmits from camels to humans in Middle East. The source for both may be originally bats (Cui

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et al., 2019). The novel SARS-CoV-2 is closely phylogenetically related to SARS coronavirus with 89% similarity. The genetic code for SARS-CoV-2 was sequenced and published in a record time and relation to other coronaviruses known in days. The authorities in China have taken action in a timely manner under the pressure from (social) media and with the help of World Health Organization.

As most cases had visited a common seafood market within limited time period, an animal originated outbreak has been suspected. The main symptoms in patients have been fever and respiratory related symptoms, therefore, the mode of transmission needs to be respiratory, quite unlikely oral via food. Those infected initially were mostly elderly men, possibly reflecting age and gender structure of the market workers, smoking may also have played a role. Additionally, some cases have reported visiting a different seafood market, but not Huanan market. Coronavirus positive environmental samples (33/585) have been reported in the media in the wildlife end of the market environment, yet no findings have been reported from market animals this far (Cohen, 2020). There were also some earlier media rumors of the positive environmental samples from the seafood section of the market, but these have not been confirmed. A snake coronavirus has been suspected to be similar to SARS-CoV-2 sequence (Ji et al., 2020), however, this has been criticized later (Sciencenews, 2020). Most recent sequence similarity has been from pangolins (Nature, 2020).

The comparison of genetic sequences will not be enough to resolve and provide credible evidence of the source. To target the actions, similar basic epidemiological actions to human cases need to be taken with animal or food exposures. The data needs to be carefully described in terms of time-place-person (animal/food) (Jalava et al., 2018; Morgan, 2019). To resolve the outbreak, environmental epidemiologists interview the human case patients carefully and possibly other seafood market visitors about their activities in the market and exceptional events they may have observed or taken part in. As there were a high number of cases during the early stages of the outbreak, the exposure may have been substantial, and possibly all within a limited time period. This would indicate highly viremic animals or perhaps contaminated food or seafood animal environment. Furthermore, a roof above the market area may cause a restriction in air exchange, possibly increasing the risk of infection through droplets or aerosols. Of live animals, the most suspected reservoir hosts are those particularly ill (although coronavirus infection does not necessarily cause clinical illness in animals), highly stressed or noisy animals. Various animal events (cock fights etc.) might also come into question as they may lead to an increase in size of the pathogen reservoir. Obviously, a human super spreader remains a possibility.

The local authorities will also check the storage conditions carefully, since it is possible that the seafood or the container water has contaminated e.g. by bat excreta in an untidy warehouse or handling of fish or other seafood in the market place. Also, the origin of the fish and other seafood and trace back must be carefully conducted to reveal if the same seafood or other animals delivered to Huanan market were also delivered to other animal markets (where other potential cases have visited). A possible access of bats to warehouses would need to be prohibited. It is a well-known food hygiene fact that one of the major risks in large food processing facilities is unhygienic upper structures (ceiling, roof). If e.g. listeria is isolated from high hygiene areas, the regular wash and cleaning of upper structures are controlled. Nice thing about food trace back is that it is almost always possible, yet laborious, to reconstruct afterwards (in comparison to human movements) as money follows the lots of animals, documentation, taxation and selling spots in the market (Keto-Timonen et al., 2019; Self et al., 2019). Finding out the route of transmission is of uttermost importance to implement effective prevention methods (Jalava et al., 2018). Assuming that this outbreak is indeed due to contaminated food, then it represents a clear example as to why food control is important. This conclusion is by no means restricted to China.

Resolving the outbreak in this situation is extremely challenging due to the high media interest and political pressure. The prevention of expansion of the outbreak requires other measures (Thompson, 2020). Often during the outbreak investigations, the information flow between health and food control authorities faces unplanned walls. Unfortunately animals, information and documents mysteriously may go missing, as the financial and juridical responsibilities may be of major concern. Additionally, epidemiologists must consider why the outbreak occurred right now and why in China. According to current information, an exceptionally wide contamination of seafood market might explain the SARS-CoV-2 outbreak. Seafood and fish tanks, air contamination by live animals or rodents are a possibility, but sold animals normally come from various sources in different vendors. The mode of transmission may become clearer in future as the outbreak is studied more by researchers: usually in outbreak investigations, hindsight is easy, but for now information about the initial source of this outbreak is limited.

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Declaration of competing interest

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Appendix A. Supplementary data

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