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.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
First respiratory transmitted food borne outbreak?

Katri Jalava\textsuperscript{a,b}

\textsuperscript{a} Department of Mathematics and Statistics (Faculty of Social Sciences), University of Helsinki, Finland
\textsuperscript{b} Department of Food Hygiene and Environmental Health (Faculty of Veterinary Medicine), University of Helsinki, Finland

\textbf{ARTICLE INFO}

\textbf{Keywords:}
2019-\textit{CoV}  
SARS-CoV-2  
COVID-19

\textbf{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 suggests several days to few weeks of exposure (Huang et al., 2020). Worrying 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

\textit{E-mail addresses:} katriyalava@gmail.com, katri.jalava@helsinki.fi.

https://doi.org/10.1016/j.ijheh.2020.113490

Received 31 January 2020; Received in revised form 10 February 2020; Accepted 10 February 2020

© 2020 Elsevier GmbH. All rights reserved.
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 from the seafood section of the market, however, this has been criticized later (Sciencenews, 2020). Most recent sequence similarity has been from pangolins (Nature, 2020). The novel SARS-CoV-2 is closely phylogenetically related 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.

Funding
No funding was received for this study.

Declaration of competing interest
None.

Acknowledgments
I am grateful to Dr. Robin Thompson, University of Oxford for invaluable comments and constructive criticism in drafting this manuscript.

Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijhbeh.2020.113490.

References
Sciencenews, 2020. No, snakes probably aren’t the source of that new coronavirus in China. 2020. https://www.sciencenews.org/article/snakes-probably-not-source-spread-new-coronavirus-outbreak-china. Accessed date: 10 February 2020.
Cohen, J., 2020. New coronavirus threat galvanizes scientists. Science 367 (6477), 492-493. https://doi.org/10.1126/science.367.6477.492. 31 Jan 2020.
Cui, J., Li, F., Shi, Z.L. 2019. Origin and evolution of pathogenic coronaviruses. Nat. Rev. Microbiol. 17, 181-192. https://doi.org/10.1038/s41579-018-0118-9.
Grant, R., Malik, M.R., Elkahlou, A., Van Kerkhove, M.D., 2019. A review of asymptomatic and sub-clinical Middle East respiratory syndrome coronavirus infections. Epidemiol. Rev. https://doi.org/10.1093/epirev/mxz009. Nov 29, 2019.
Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, Y., Yin, W., Li, H., Liu, M., Xiao, Y., Gao, H., Guo, L., Xie, J., Wang, G., Jiang, R., Gao, Z., Jin, Q., Weng, J., Cao, B., 2020. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395(4):564-573. 10 January 2020.
Jalava, K., Kauppinen, A., Al-Hello, H., Räsänen, S., 2018. An outbreak of norovirus infection caused by ice cubes and a leaking air ventilation valve. Epidemiol. Infect. 1-6. https://doi.org/10.1093/infdis/jiy087. 15 April 2019.
Jalava, K., Kauppinen, A., Al-Hello, H., Räsänen, S., 2018. An outbreak of norovirus infection caused by ice cubes and a leaking air ventilation valve. Epidemiol. Infect. 1-6. https://doi.org/10.1093/infdis/jiy087. 15 April 2019.
Koivunen, R., Markkula, A., Halkkalahti, A., Huttunen, R., Räsänen, S., Salminen, S., Heikkinen, A., Paasto, M., Närhimäen, M., Hakkinen, M., Korkeala, H., Jalava, K., 2019. Shopping detail information and home freezer sampling confirmed the role of commercial, modified-atmosphere packaged meatballs as a vehicle for listeriosis in Finland. Front. Publ. Health 7 (216). https://doi.org/10.3389/fpubh.2019.00216.
Cohen, O., 2019. How decision makers can use quantitative approaches to guide outbreak responses. Philos. Trans. R. Soc. Lond. B Biol. Sci. 374, 20180365. https://doi.org/10.1098/rstb.2018.0365.
Nature, news, 2020. Did pangolins spread the China coronavirus to people? https://www.nature.com/articles/d41586-020-00364-2. Accessed date: 10 February 2020.

I am grateful to Dr. Robin Thompson, University of Oxford for invaluable comments and constructive criticism in drafting this manuscript.

Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijhbeh.2020.113490.

References
Sciencenews, 2020. No, snakes probably aren’t the source of that new coronavirus in China. 2020. https://www.sciencenews.org/article/snakes-probably-not-source-spread-new-coronavirus-outbreak-china. Accessed date: 10 February 2020.
Cohen, J., 2020. New coronavirus threat galvanizes scientists. Science 367 (6477), 492-493. https://doi.org/10.1126/science.367.6477.492. 31 Jan 2020.
Cui, J., Li, F., Shi, Z.L. 2019. Origin and evolution of pathogenic coronaviruses. Nat. Rev. Microbiol. 17, 181-192. https://doi.org/10.1038/s41579-018-0118-9.
Grant, R., Malik, M.R., Elkahlou, A., Van Kerkhove, M.D., 2019. A review of asymptomatic and sub-clinical Middle East respiratory syndrome coronavirus infections. Epidemiol. Rev. https://doi.org/10.1093/epirev/mxz009. Nov 29, 2019.
Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, Y., Yin, W., Li, H., Liu, M., Xiao, Y., Gao, H., Guo, L., Xie, J., Wang, G., Jiang, R., Gao, Z., Jin, Q., Weng, J., Cao, B., 2020. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395(4):564-573. 10 January 2020.
Jalava, K., Kauppinen, A., Al-Hello, H., Räsänen, S., 2018. An outbreak of norovirus infection caused by ice cubes and a leaking air ventilation valve. Epidemiol. Infect. 1-6. https://doi.org/10.1093/infdis/jiy087. 15 April 2019.
Koivunen, R., Markkula, A., Halkkalahti, A., Huttunen, R., Räsänen, S., Salminen, S., Heikkinen, A., Paasto, M., Närhimäen, M., Hakkinen, M., Korkeala, H., Jalava, K., 2019. Shopping detail information and home freezer sampling confirmed the role of commercial, modified-atmosphere packaged meatballs as a vehicle for listeriosis in Finland. Front. Publ. Health 7 (216). https://doi.org/10.3389/fpubh.2019.00216.
Cohen, O., 2019. How decision makers can use quantitative approaches to guide outbreak responses. Philos. Trans. R. Soc. Lond. B Biol. Sci. 374, 20180365. https://doi.org/10.1098/rstb.2018.0365.
Nature, news, 2020. Did pangolins spread the China coronavirus to people? https://www.nature.com/articles/d41586-020-00364-2. Accessed date: 10 February 2020.
National Health Commission of the People’s Republic of China, 2020. Epidemic prevention and control dynamics (Chinese). 2020. http://www.nhc.gov.cn/, Accessed date: 10 February 2020.

Self, J., Conrad, A., Strouka, S., Jackson, A., Whitlock, L., Jackson, K., Beal, J., Wellman, A., Fatica, M., Bidol, S., Pennell Huth, P., Homel, M., Franklin, K., Tschetter, L., Kopko, C., Kirsch, P., Wise, M., Basler, C., 2019. Multistate outbreak of listeriosis associated with packaged leafy green salads, United States and Canada, 2015–2016. Emerg. Infect. Dis. 25 (8). https://doi.org/10.3201/eid2508.180761.

Thompson, R.N., 2020. Novel Coronavirus Outbreak in Wuhan, China, 2020: Intense surveillance is vital for preventing sustained transmission in new location. J. Clin. Med. 9 (2), 498. https://doi.org/10.3390/jcm9020498.

Wang, D., Hu, B., Hu, C., Zhu, F., Liu, X., Zhang, J., Wang, B., Xiang, H., Cheng, Z., Xiong, Y., Zhao, Y., Li, Y., Wang, X., Peng, Z., 2020. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. https://doi.org/10.1001/jama.2020.1585. Feb 7, 2020.

World Health Organization, 2020. 2019-nCoV situation reports. 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports, Accessed date: 10 February 2020.