Cold chain logistics: a possible mode of SARS-CoV-2 transmission?

Yuan-Yuan Li and colleagues argue that the limited evidence supports cold chain logistics as a transmission route for SARS-CoV-2

After the initial wave of the covid-19 epidemic in China was controlled, outbreaks associated with cold chain logistics were reported in several regions that had had no local cases for months. This gave rise to debates about whether SARS-CoV-2 could be transmitted through cold chain transport. Transmission of infection is mainly through droplets when in contact with infected people, but the World Health Organization recognised fomites as a source early in the pandemic. Although the evidence is not conclusive, we believe the virus could survive long periods in the cold chain.

Reported cases
The first reported cluster associated with cold chain logistics was an outbreak in Xinfadi market, Beijing’s largest wholesale food market, in June 2020, after 56 days without documented local cases. The index case was a 52 year old man with no known exposure to anyone with covid-19. Beijing Centre for Disease Prevention and Control (CDC) performed epidemiological investigations and viral genome analyses and found the SARS-CoV-2 strain in imported frozen salmon was very similar to the strain in the human cases from the market. The CDC speculated that this resurgence might be initiated by transmission from contaminated imported salmon. A subsequent study using field investigations and onsite simulations at Xinfadi market suggested the virus could spread from contaminated goods to humans, and environmental factors such as low temperature and high humidity, poor ventilation, and insufficient hygiene facilities and disinfection practices might contribute to viral transmission.

A further cluster of cases was reported in July 2020 in Dalian, China, the first of which was in an employee of a cold chain food company. No local infections had been reported in Dalian for 111 consecutive days before this case was confirmed. Phylogenetic analysis confirmed high homology between the sequences of the virus from the first case and those of samples from the frozen pollock packaging. However, attempts to isolate live SARS-CoV-2 failed.

Local outbreaks with cases connected to cold chain logistics were also reported in Kashgar, Tianjin, Shanghai, and Dalian in China. In all these outbreaks the index case had handled imported frozen products or containers and had had no contact with anyone with covid-19 before their infection was confirmed. Viral nucleic acid was detected on the surfaces of imported food packaging or cargo containers, and the phylogenetic analyses suggested that the virus strains were imported.

Notably, live SARS-CoV-2 virus was isolated from imported food packaging after an outbreak in Qingdao, China. In September 2020 two stevedores in Qingdao port were identified as having asymptomatic infection during routine nucleic acid screening. Live SARS-CoV-2 virus was isolated from the imported frozen cod packaging they had carried. The genome sequence of the virus isolated from the workers’ nasopharyngeal swab was highly homologous to the virus from the frozen cod packaging, suggesting that SARS-CoV-2 could have been transmitted through imported frozen food.

Potential mechanism of transmission
Is it possible that SARS-CoV-2 could stay alive and infectious during cold chain transportation? Cold chain logistics are used for goods such as temperature sensitive foods and biopharmaceutical products that need to be kept chilled (2°C to 8°C) or frozen (below −18°C) throughout processing, storage, transportation, and distribution. Researchers have studied the persistence of SARS-CoV-2 under different conditions (controlled relative humidity and temperature), and the initial virus concentrations of the laboratory samples are usually higher than those in droplets in real life situations.

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CoV-2 from surface swabs taken from an emergency unit and high dependency ward were unsuccessful.14 Another study failed to isolate live virus despite ongoing high viral loads of about 10^5 RNA copies/mL of sample.15

Despite these uncertainties, we consider it possible that SARS-CoV-2 can survive in the cold chain. Disinfecting surfaces of packages or cargoes in cold chain logistics may therefore be sensible. More research on the frequency of SARS-CoV-2 contamination on food packaging, the association between detection by PCR testing and infectious virus, and SARS-CoV-2 viability and infectivity in conditions that simulate those found in cold chain logistics is warranted.

Competing interests: We have read and understood BMJ policy on declaration of interests and have no relevant interests to declare.

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6 The source of the epidemic in Kashgar, Xinjiang has been found: it is a container. Voice of China 2020 Nov 27. http://china.cntv.cn/yasowen/20201127/t20201127_S25340696.shtml


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