

Fatal outbreak of COVID-19 in a nursing home

Karel Hruska^{1,2*}, Veronika Ozana³

¹Institute for Research and Education, Brno, Czech Republic (UPVaV)

²Veterinary Research Institute, Brno, Czech Republic

³Masaryk University, Faculty of Pharmacy, Brno, Czech Republic

*Corresponding author. Email: karel.hruska@upvav.cz

Abstract

A probable source of an outbreak of COVID-19 in a retirement home with 104 seniors was a female cook who tested positive for SARS-CoV-2, was asymptomatic, and worked on days 1, 2, and 5. Within 12 days, several clients developed mild gastroenteric symptoms. On days 13 and 15, three clients were hospitalized and tested positive in the hospital. Seventy (81%) positive clients were detected by antigen test on day 17. Another four were detected on day 29. Within 30 days, 15 clients were hospitalized, and later an additional 3. Fifteen clients died. The infection also affected 56% of tested personnel. This case report supports the hypothesis that the virus can be transmitted by contaminated food. Transmission should be eliminated by periodic testing of kitchen staff and by strict adherence to good operating practice.

Introduction

Several authors have noted that measures against transmission of SARS-CoV-2 are aimed only at viral spread through droplets and exhaled air, but food as a vector should not be neglected [1-5]. The risk of non-contact transmission of the virus is related to the number of people who shed the virus with insufficient prevention of contamination when working with food. If these people comprised one for every 200 examined (0.5%) at the beginning of the epidemic, and are currently 5%, the risk will increase 10-fold. This phenomenon is considered to be the second wave of the epidemic, but it may be a consequence of uncontrolled transmission of the virus through food.

Measures, such as wearing face masks or respirators, social contact restrictions, keeping distance, isolation and quarantine, hygiene rules, testing, and contact tracing are effective only if used correctly. It is now certain that one of the first measures announce, to keep a 2-m distance and a maximum of 15 minutes of contact, may not prevent infection [6]. Infection may also occur when staying in an empty unventilated room containing viral particles in the form of an aerosol. Even appropriate measures tend to fail due to the increasing number of tired, disappointed, and unscrupulous people. Some individuals may also avoid testing to not know whether they are carriers of the virus or become non-compliant with quarantine because of lower income or job loss. Non-compliance may also be an effort of the employees to maintain work operations endangered by sick leave. Government measures are trying to address these issues, though the evaluation of new information and its dissemination are a bit neglected. Overall, in the Czech Republic, the announced measures are still not very successful in controlling the epidemic if we compare the current situation to the situation at the beginning.

Vaccination of a large part of the population will certainly protect people, but the spread of the virus with any mutation must be limited immediately. Efficient control of viral spread, including kitchen staff testing, is urgently needed, at least until rapid and user-friendly diagnostics and reliable treatment are available.

An outbreak description

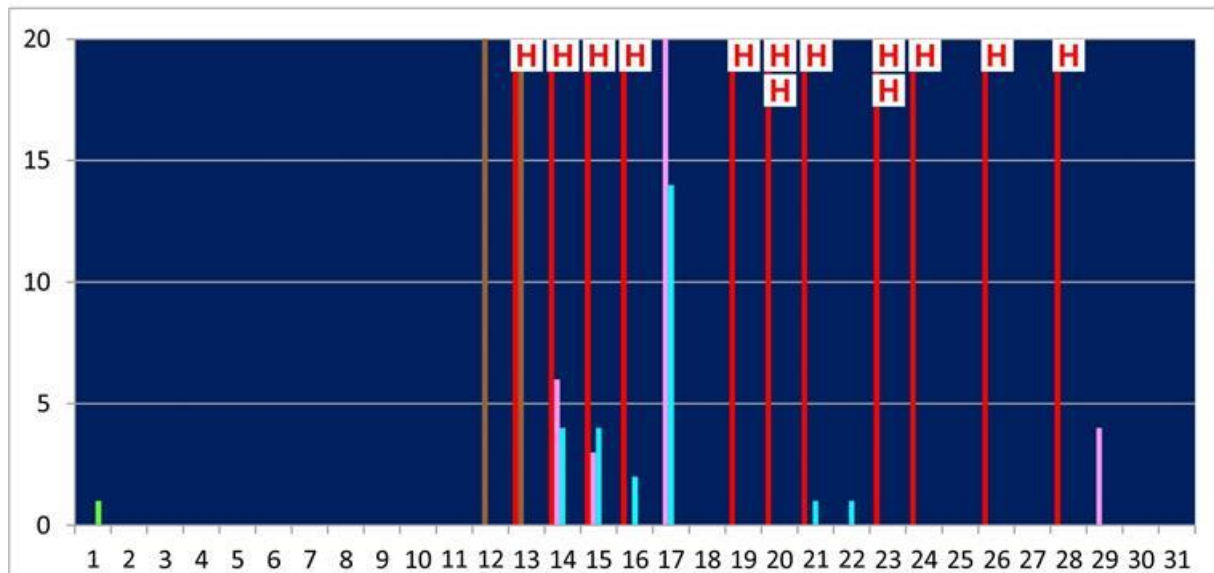
In December 2020, an outbreak of COVID-19 occurred in a retirement home with 104 clients in four separate pavilions (Fig. 1). The source of SARS-CoV-2 was most likely a female cook who entered quarantine on December 2 after a positive PCR test. No one else from the kitchen staff was positive in November or December. Antigen tests of employees were negative on November 16 and 30. Therefore, December 1, 2020, is considered to be day 1, though the virus may have spread from November 25 until November 30 as well. The infected cook was at work on days 1, 2, and 5 of the outbreak. On November 27, there was fresh cheese spread mixed with butter for dinner. On November 29, a ham mousse with pieces of ham whipped with butter was served. On December 1, a wiener schnitzel with potatoes was served for lunch (101 portions dispensed to clients and 41 portions to employees). On days 12 and 13, several clients had digestive problems that were considered insignificant. On days 13 and 15, three female clients were hospitalized for falling down the stairs (considered a stroke), worsening of diabetes, and dialysis. At the hospital, the clients were found to be SARS-CoV-2 positive and all three died. From days 14 to 16, antigen tests revealed 9 positive clients and 10 positive employees.

Antigen testing showed that, on day 17, 70 of 94 tested clients and 14 of 45 tested employees were positive. Therefore, in 17 days from the presumed spread of the infection, 81% of tested clients and 58% of tested employees were positive. On day 29, 22 previously negative clients were tested, 4 of whom were positive. On January 12, 2021, 18 clients were tested and were all negative.

In December, 15 clients were hospitalized. By January 22, 2021, 14 clients had died. By January 25, three more clients were in the hospital. In addition, two female employees are incapacitated long-term from work.

Visits were only allowed from December 5-13, 2020. All visitors (n=65) were subjected to antigen testing with negative results. Therefore, an outbreak of the infection after introduction of the virus by a visit is improbable.

Graphical summary
 Fatal outbreak of COVID-19 in a nursing home
 (Days x- axis; Number of events y-axis).



Clients COVID+ (70 clients on day 17, out of scale)

Indigestion in some clients (the number not known)

Hospitalisation

Staff working in direct contact with clients

Kitchen staff

Other staff

Until Jan 22, 2021 hospitalized 18 and died 15 clients

Discussion

In retirement homes and similar communities that did not previously have mass COVID-19 infection or had been tested and virus carriers not identified among clients and employees, the typical course of the infection can be monitored. In a single-source infection that spreads suddenly or over several days, the virus manifests after the incubation period as a worsening of the condition of patients who already have other diseases. These patients often end up hospitalized and diagnosed with COVID-19. As in the present report, a surprisingly high number of positive subjects may be discovered if both clients and employees are tested after 10 to 20 days.

The number of infected subjects depends on the viral transmission vector. For example, the number will be higher when all clients consume one contaminated food, such as cheese spread or ham mousse. In contrast, the number will be lower when consuming individual portions contaminated

during dispensation to a concrete client. Thus, if only some portions contain viral particles, fewer diners will get infected and there may not be obvious signs of a sudden outbreak. Similarly, coronavirus may spread from kitchens providing food delivery and dispensing windows, but inconspicuously, and detecting the consequences is difficult. Restaurants know little about the impact of food contamination and customers know little about the causes of the virus. For this reason, a careful medical history of COVID-19-positive patients should focus on their diet.

Reputable scientific journals have published information clearly indicating that SARS-CoV-2 attacks various tissues of the human body. The lungs are the main target organ after the coronavirus multiplies in the cells of the nasal and nasopharyngeal mucosa. It causes inflammation of the lung tissue and consequently reduces blood oxygenation. In severe disease, it is necessary to administer oxygen or ensure controlled breathing and extracorporeal oxygenation of the blood.

Attacks of the intestines manifest as diarrhea, nausea, vomiting, and abdominal pain [7, 8]. Similar to respiratory tract infections, the course of the intestinal form can be asymptomatic and the incubation period, until the virus is detectable in the **nasopharynx, may last up to several weeks. The virus enters the intestines by swallowing saliva or mucus containing the viral particles from either the nasopharynx or contaminated food. The virus is thought to be inactivated in the acidic environment of the stomach at $\text{pH} < 3$ [9]. However, penetration of the virus** into the intestine may be facilitated by a high infectious dose or insufficient comminution of food in the stomach. Furthermore, the virus cannot be completely inactivated in individuals with insufficient acidity of gastric juices, especially in the elderly and in people taking medicines to reduce stomach acidity [10]. This may be one of the causes of higher morbidity in the elderly and higher resistance of children. Fecal excretion of coronavirus may last several weeks longer than disappearance of the virus from the nasopharynx [11]. Therefore, the virus may spread by this route [12] if hygiene rules are not followed. Several reports have described intestinal damage in patients with COVID-19 [13-15].

The brain can also be affected by penetration of the coronavirus through neural pathways from the intestines [16]. This manifests as headaches, confusion, disorientation, and loss of consciousness [17]. Other organs, such as the kidneys, liver, heart, and blood vessels, can be damaged by the virus individually or together, which can be considered a worsening of comorbidity. If the infection is proven, these diseases should also be reported as COVID-19. The damage to vital organs can occur gradually or simultaneously. In the worst cases, pro inflammatory cytokines are released with the possibility of multi-organ failure (8). This process has also been described in children and adolescents [18].

If the intestinal form of COVID-19 precedes the symptoms of respiratory disease [19, 20], hospitalization of the patient may be delayed, often with the most severe course of the disease. Up to 50% of hospitalized patients come to the COVID-19 ward only after being diagnosed as positive by an examination in the hospital [21].

According to press reports, outbreaks of COVID-19 are suddenly occurring in retirement homes, nursing homes, care facilities, and hospitals. The sources of the infections are usually not identified or not published. It is generally assumed that the coronavirus is being introduced into the facilities by staff or visitors. However, outbreaks are also occurring in facilities that consistently divide staff into groups that do not meet in the workplace. Visits are either banned or visitors tested and have to be negative. In many COVID-19 outbreaks, affected groups of patients and nursing staff are connected by the consumption of food from the same source.

Food can easily be contaminated with droplets exhaled by infected employees during preparation, serving, and packaging. The contamination of food also occurs when hygiene rules are not strictly followed, particularly due to insufficient washing and disinfection of hands and the work environment, tasting with a used spoon, or the use of unwashed fruit and vegetables. The risk is increased by the long waiting time for serving prepared portions or covering food boxes. The virus survives for several hours at temperatures up to 65 °C and on the surface of frozen edibles for up to 2 years [2, 22]. Nevertheless, contamination of certain meals and their packaging may occur anywhere on the way from the supplier of ingredients to the consumer. A good vector may be, for example, a ham mousse when prepared from sliced ham leftovers from counter sales. The risk of contamination is also increased by the longer time needed for semi-finished products to be prepared for processing. Furthermore, storing food in the cold supports survival of the virus.

The method of meal preparation leading to its homogenization may endanger a larger number of people. A meal that is perfectly mixed during its preparation can be a transmission vector and may cause an outbreak in a large number of diners from the same kitchen. The same homogeneously contaminated meal is given to all diners, and the infection then manifests in many diners at once after an incubation period of 8 to 12 days. Accordingly, a suitable vector can be mashed potatoes, potato salad, soups, sauces, spreads, and icing on cakes. A good example of possible contamination is draught beer, as the glass is 20 to 30 cm from the barman's mouth. The concentration of the virus in the droplets present on the foam surface may be high. Customers ordering lunches and meals to their apartments from delivery restaurants, or buying food from dispensing windows, are at risk as well. Infectious meals may also endanger employees dining in company canteens, clients of elderly care services, and children in school canteens [23].

Measures against the transmission of SARS-CoV-2 by food are completely ignored for incomprehensible reasons. It is considered necessary for workers in kitchens, restaurants, confectionaries, delicatessens, bakeries, counter sales, and bulk grocery shops with goods intended for fast consumption to be tested repeatedly at intervals of 3 to 5 days and to not enter the workplace if diagnosed with COVID-19. Bread, pastries, and other bulk products should be covered with foil or paper when imported into stores. In stores, goods should be displayed in such a way that droplets exhaled by customers with incorrectly fitted masks would not contaminate them. It is suitable to sell small pastries and bread from closed boxes. Shops and all other workplaces should be intensively

ventilated and regularly treated with ionizers. Compliance with both previously introduced and new measures should be enforced and closely monitored. These measures should limit the transmission of any SARS-CoV-2 mutation. To determine the effectiveness, it is enough to monitor and evaluate changes in the percentage of positive cases during regular screening on a weekly basis. The number of hospitalized patients and the number of deaths are also important parameters to assess the effectivity of epidemic control.

The pandemic can be brought under control only with the active participation of the public, who must be informed of the reasons for the measures being taken. Curricula must be updated at all levels of education. Employees of nursing homes, social care providers, doctors, and other medical staff must be well acquainted with the properties of the virus, routes of transmission, diagnostics, and treatment options. Rapid vaccination of 80 to 90% of the population, adjustment of contingency plans, and establishment of active medical reserves should help ensure professional control of the pandemic.

In kitchens and food productions, the regulations should be adjusted [24], as well as hazard analysis and critical control points (HACCP). Information on the survival of the virus in different environments, its resistance to temperature, and possible methods of decontamination must be a call for research. Attention should be paid to the development of protective equipment and effective drugs. Studying the late consequences of infection should be at the forefront of interest as well. The introduction of biosensors into diagnostics should be an absolute priority, so the testing itself would be as simple as self-monitoring blood glucose. Suitable samples could be a swab from the oral cavity and rectum, or stool.

More frequent testing should reduce the number of positive people who could be a source of food contamination and the transmission of coronavirus in the population. This could provide a reliable indicator of the number of infected individuals in a sufficiently large group of examined subjects. This indicator, as well as the number of hospitalized patients and the number of patients placed in the intensive care unit, may allow easy monitoring of the effectiveness of the measures.

The public should be well informed and feel responsible for their health and for protecting the health of others. In addition, governments should rely on competent counsellors, listen to recommendations, and protect human lives and health as a priority. Unfortunately, this is not always the case. Therefore, this article is a report of what should be done and not an assessment of the success of the measures already in place.

Conclusions

Transmission of SARS-CoV-2 coronavirus by contaminated food is a major public health problem. In addition to a sudden outbreak in closed communities, the distribution of contaminated food to customers outside the restaurant can affect dozens of people and the source of the infection is difficult

to trace. Delicatessen and confectionery products can also be contaminated. This risk must be included in good manufacturing practice and in training programs for professionals. It will also require new technical solutions to protect against contamination in kitchens and grocery stores.

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