Preventing Norovirus Transmission: How Should We Handle Food Handlers?

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(See the article by Malek et al. on pages 31–7)

Noroviruses are nearly perfect pathogens. They are the most infectious agents ever described, with an estimated median infectious dose of 18 viruses [1]. Even minute amounts of fecal matter containing norovirus can pose a risk of transmission via hands, food, objects, aerosols, or water. Viral shedding can occur at extremely high levels. Chan et al. [2] reported that the median cDNA viral load for norovirus in stool samples ranged from $2.2 \times 10^4$ to $7.7 \times 10^9$ viruses/g. Furthermore, norovirus shedding can persist for weeks after the (usually short-term) symptoms have resolved. Approximately 25% of people infected with noroviruses shed virus for $\geq 3$ weeks [3]. Epidemiologic evidence and environmental studies indicate that these viruses have a prolonged duration of survival outside of the host in the aquatic environment [4] and on indoor surfaces [5]. Despite evidence of genetic resistance to 1 norovirus strain [6], most of the population appears to be highly susceptible to noroviruses. Outbreaks of norovirus infection have high attack rates and secondary transmission rates. This may be due to the low infectious dose, but we have also observed that $\sim 20\%$ of norovirus-infected people do not have symptoms and may continue to work and have contact with others while oblivious of their ability to infect them.

The reproductive number (i.e., the mean number of susceptible persons who become infected by an infectious individual) for norovirus is likely to vary greatly depending on the setting and who becomes infected. In this issue of Clinical Infectious Diseases, Malek et al. [7] describe an outbreak of norovirus infection in which the index case was an infected food handler at a meat processing plant who contaminated ready-to-eat food, resulting in illness among 137 people who participated in river rafting trips in the Grand Canyon. In other outbreaks involving food handlers, such as bakers who prepared wedding cakes, the number of cases associated with a single contamination incident has been estimated to be in the thousands [8]. In our review of reported outbreaks of norovirus infection in the scientific literature, we found that outbreaks associated with food or restaurant settings had significantly higher attack rates ($\geq 50\%$) than did outbreaks in other settings [9]. The Centers for Disease Control and Prevention (CDC) estimates that $\sim 50\%$ of all outbreaks of norovirus infection are linked to ill food service workers [10].

Malek et al. [7] identify 2 critical factors that contributed to this outbreak: (1) the food handler who sliced the implicated delicatessen meat returned to work 1 day after recovering from gastroenteritis symptoms that were clinically consistent with norovirus infection, and (2) bare-hand contact with the implicated meat occurred. Because this employee was working in a meat-processing plant, the relevant regulatory authority is the US Department of Agriculture (USDA) Food Safety and Inspection Service. The federal regulations that govern employee hygiene in this setting are vague about disease control and only state that "any person who has or appears to have an infectious disease…..must be excluded from any operations which could result in product adulteration until the condition is corrected" [11, p. 632]. It is obvious that ill food workers should be restricted in their activities or excluded from the workplace. Many outbreaks of norovirus infection have been associated with food service workers who are ill on the premises. Cooks and food handlers who have vomited in sinks, in wastebaskets, and on the floors of their workplace have infected their colleagues, contaminated the kitchen environment, and ultimately caused infection among the patrons of the food service establishment. Yet these incidents continue...
to occur, because there is no incentive for hourly wage workers to report illness and to lose their pay if they feel they can still work. Perhaps the more difficult issue to tackle is how soon after gastroenteritis symptoms have resolved is it safe for a food handler to return to work. The USDA regulations do not address this issue at all.

The US Food and Drug Administration (FDA) Food Code [12] applies to food handlers working in food service establishments. The 2005 Food Code specifically recognizes norovirus as highly infectious and restricts any food handling by symptomatic employees who have received a diagnosis of norovirus infection. Asymptomatic food employees who have received a diagnosis of norovirus infection are also restricted from working in food establishments that serve a "highly susceptible population." The timing of the exclusion ranges from 24 h to 48 h, depending on whether the food employee was symptomatic (in which case, the timing is 48 h after symptoms have resolved) or asymptomatic. Some state and local health departments have suggested more-stringent time restrictions, such as excluding all food employees for at least 72 h after gastrointestinal illness symptoms subside and prohibiting contact with kitchenware or ready-to-eat food for an additional 72 h [13]. However, 24–72 h is not likely to be a sufficient exclusion period for a food handler, because it is not unusual for someone with norovirus infection to shed virus for 2–3 weeks. The Food Code also notes that the food employee can be reinstated if he or she has "written medical documentation from a health practitioner stating that the food employee is free of a norovirus infection" [12, p. 36]. Real-time norovirus infection status can be determined only by detection of the virus in stool specimens—preferably by RT-PCR or, although it has greater speed but less sensitivity and specificity, by electron microscopy. Several commercial ELISA kits to detect norovirus antigen in stool specimens are still being evaluated and are not currently available in the United States. Therefore, it is unlikely that most health practitioners would be equipped to get a patient stool sample tested for norovirus and certify that the individual is no longer infected. A commercially available, rapid, sensitive, and specific diagnostic test for norovirus infection would aid in the identification of infected food handlers and allow better prevention of virus transmission.

The other critical factor in this outbreak—and in many other foodborne outbreaks of norovirus infection—is bare-hand contact with ready-to-eat foods. For >20 years, the FDA Food Code has required no bare-hand contact with ready-to-eat foods, and most states have adopted this regulation, although it is controversial [14]. Again, USDA regulations about cleanliness and food handling are vague and state that "all persons working in contact with product, food-contact surfaces, and product-packaging materials must adhere to hygienic practices while on duty to prevent adulteration of product and the creation of insanitary conditions" [11, p. 632].

If bare-hand contact is allowed, then food employees must practice extraordinary hand hygiene in order to ensure that their hands do not transmit norovirus, because of the low infectious dose and high titers in stool. The USDA [15] has adopted the specific guidance from the Food Code on how, when, and where to wash and sanitize hands. The issue is compliance with these recommendations. Observational studies of food workers have reported improper hand washing in 73% of restaurants [16] and that food workers washed their hands only approximately one-third of the time after performing activities for which hand washing is recommended [17, 18]. In addition, hand sanitizers must be selected carefully, because some can be very effective against noroviruses, whereas others appear to provide no measurable norovirus reduction [19]. Extraordinary hand hygiene can be promoted by education and training, positive incentives and reinforcement from managers, proper location and design of hand-washing stations, and effective handwash agents and sanitizers. Green et al. [20] observed that appropriate hand washing was associated with the presence of multiple hand sinks and a hand sink in the worker’s sight.

Glove use is not mentioned in the USDA regulations. The FDA Food Code requires single-use gloves or suitable utensils for contact with ready-to-eat food and specifies that the gloves be used for only 1 task [12]. Some food service companies argue that single-use gloves are extremely cumbersome in certain food service settings, such as those in which a single employee is preparing food and also working at the cash register. Like hand washing, food employee compliance with glove use varies. The FDA observed a failure to prevent bare-hand contact with ready-to-eat foods in 57% of restaurants [16]. Institutionalizing glove use and having glove supplies readily accessible in food preparation areas have been associated with a greater likelihood of glove use by food workers [20].

Given the characteristics of these viruses and the shortcomings of human behavior, what is the most effective means to prevent norovirus transmission by food handlers and to reduce epidemic and endemic norovirus infection? Even in countries that have attained the highest standards of hygiene, outbreaks of norovirus infection continue to occur frequently. The CDC now estimates that, in industrialized countries, noroviruses are associated with 64,000 episodes of gastroenteritis requiring hospitalization and 900,000 clinic visits among children each year, as well as up to 200,000 deaths annually among children aged <5 years in developing countries [21]. The substantial burden of disease associated with norovirus and the economic costs associated with outbreaks of norovirus infection are compelling reasons to seek more-effective prevention measures. Our understanding of norovirus immunology has significantly improved in the
past decade, and norovirus vaccines are currently under development. However, there are still many unanswered questions about the determinants of protective immunity against norovirus infection [22]. Epidemiologic evidence of temporal shifts in predominant norovirus strains associated with epidemics of gastroenteritis suggest that it will be necessary to set up global surveillance to track the emergence of new norovirus strains, to inform the design of effective norovirus vaccines [23, 24, 25]. Food service workers are a logical target population to immunize against norovirus infection because of the potential for significant public health benefit for the general population.

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References