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**Comments from the Medical Director,
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On the occurrence of norovirus in BC-harvested
oysters and on means to prevent illness resulting
from raw oyster consumption**

Environmental Health Services

August 2, 2018

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**From Dr. Tom Kosatsky, Medical Director,
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Land and marine sources of human sewage and norovirus outbreaks linked to oysters

Norovirus outbreaks in BC linked to the consumption of oysters arise when the marine environment becomes contaminated with human sources of sewage. These sources can be categorized as: originating from fixed land-based discharges, which include municipal treatment plants and individual septic systems, and mobile marine sources including commercial and/or recreational vessels.

Two patterns of oyster-norovirus outbreaks have been documented in BC since 2004: localized ocean-based (point-source) and geographically dispersed. In 2010 and 2018, overboard discharges of human wastes from mobile vessels were the most probable cause of marine water contamination. Because the marine discharges from the vessels occurred in close proximity to shellfish farms (within or less than 1 km), the discharges resulted in oysters becoming contaminated with norovirus and with subsequent illnesses in oyster consumers.

In 2004 and 2016-17, it appears likely that environmental conditions in combination with either or both of fixed land-based sources and marine-based sources of norovirus-containing human sewage dispersed norovirus into the marine environment resulting in contamination of oyster beds. Both of these outbreaks link back to marine contamination with human sewage, however, geographically dispersed outbreaks appear to be caused when propitious environmental conditions occur: antecedent rainfall, followed by cold temperatures, downwelling, and low sunlight. These and other potential environmental factors combine to promote norovirus dispersal and survival in the marine environment.

Human norovirus infection and illness occur when there is exposure to feces or vomit of another infected human. Marine mammals do not get infected by or spread human norovirus into the environment. The source of human norovirus in the marine environment is human sewage. In the marine environment norovirus in sewage is spread to filter-feeding oysters that then become contaminated with human virus. It must be stressed that human sewage sources containing norovirus are the underlying cause of outbreaks in consumers of raw and cooked oysters.

Other measures to consider from a public health perspective

Repeated outbreaks are damaging to the shellfish industry, both in actual costs, estimated at \$9.1 million dollars during 2016-17 and for the future of the industry. Everyone works to prevent food-borne illness and no one 'wants' oyster-sourced illness to occur. Control measures implemented in January 2018 allowed for the rapid identification and closure of oyster farms linked to illness (CSSP chapter 13)¹. In March 2018, a norovirus outbreak linked to oysters, most likely arising from overboard commercial vessel sewage discharge into the environment caused 176 documented cases of norovirus in BC, Alberta and Ontario oyster consumers.² More

¹ Canadian Shellfish Sanitation program - Manual of Operations Chapter 13 - Outbreaks of shellfish-related illness <http://www.inspection.gc.ca/food/fish-and-seafood/manuals/canadian-shellfish-sanitation-program/eng/1351609988326/1351610579883?chap=15>

² Public Health Agency of Canada. Public Health Notice — Outbreak of norovirus and gastrointestinal illnesses linked to raw oysters <https://www.canada.ca/en/public-health/services/public-health-notices/2018/outbreak-norovirus-infections-linked-raw-oysters.html>

illnesses occurred in the United States. While the new control measures likely prevented illness once the first cases were detected and a link to a producer was identified, CSSP chapter 13 was not designed to prevent illnesses before they occur. Further, the efficacy of these measures is unproven: do they work? Ultimately, are BC oysters safe to eat?

A stronger public health approach should be considered in light of recurrent outbreaks and illnesses linked to the consumption of raw oysters. Options that follow from the 2018 outbreak and the findings of the Working Group must be given careful consideration.

Until significant changes are made to address known sewage sources near to shellfish farms and in order to proactively prevent future illnesses, **further control options to manage the risk of norovirus illness from consumption of raw oysters need to be considered:**

1. **Require oysters to be cooked before consumption.** Although other bivalves (i.e. clams, mussels) also filter feed and are exposed to norovirus, oysters tightly bind norovirus to their tissues. Consumers prefer consuming oysters raw, while other bivalves are eaten cooked. While an extreme option, consideration could be given to banning the sale of raw oysters or to only allowing oysters to be sold as a cooked product.
2. **Precautionary closures when both environmental triggers and sewage source triggers occur.** While closing farms adjacent to high risk sewage sources would mitigate most risk, consideration must be given to broader closures. Since water-deposited sewage spreads and may travel further than previously thought, shellfish farms located away from immediate and known sewage sources still have the potential to become contaminated when environmental conditions are favorable and sewage is present. Precautionary closures may be considered under these circumstances: when a significant sewage event is noted, for example, during an unanticipated waste water treatment plant discharge or spill, and when environmental conditions favorable to norovirus survival and dispersion (antecedent heavy precipitation, cold temperatures, downwelling and low sunlight) occur. Trigger thresholds would need to be determined and monitored.