MOST GROUNDWATER NEEDS VIRUS TREATMENT:

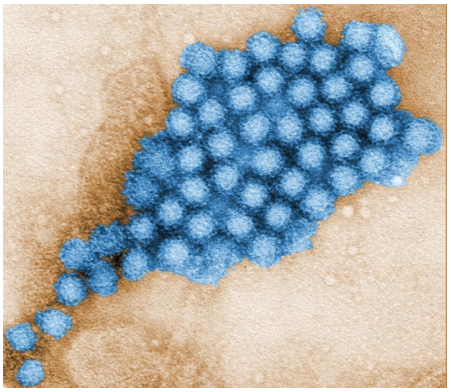
A Research Overview

UNIVERSITY OF WATERLOO

WATER Science, Technology & Policy Group

KEY MESSAGES

- Viruses can be present in drinking water sources not deemed to be groundwater under the direct influence of surface water (GUDI)
- Groundwater sources may need a minimum level of treatment for viruses, such as 4-log (99.99%) removal or inactivation
- Norovirus is increasingly relevant as a drinking water reference virus, but standardized analytical methods and consensus on dose-response are needed



CDC/Charles D. Humphrey, PhD.
Public Health Image Library (PHIL)

FOR WHOM IS THIS RELEVANT?

This research overview is designed for environmental health policy makers as well as water utilities using subsurface water supplies to provide safe drinking water to communities.

WHY WAS THIS DONE?

Across North America, **there are a variety of virus treatment requirements for subsurface drinking water supplies** not deemed "groundwater under the direct influence of surface water" (GUDI in Canada, or GWUDI in the United States). In Canada, most provinces implement Health Canada's recommendation of a minimum 4-log (99.99%) removal/inactivation of viruses in all public water supplies including groundwater. In contrast, many subsurface supplies in the U.S. not classified as GWUDI do not require any treatment under current U.S. standards. **The purpose of this study was to provide a health-based evaluation of the level of virus treatment needed given monitoring data from non-GWUDI sources in the United States.**

> "All raw water intended for drinking water should be subject to a characterization of each parameter that could constitute a public health risk. The results, regardless of the type of source, should be taken into account in designing and approving any treatment system."
>
> **Justice O'Connor**
> *Part Two Report of the Walkerton Inquiry*

WHAT WAS THE APPROACH?

Norovirus was used as a reference pathogen to represent enteric viruses in drinking water because it is a common pathogen with known health consequences that has been frequently implicated in outbreaks of disease attributed to contaminated drinking water. This study utilized a set of 392 norovirus data (quantitative polymerase chain reaction) from numerous non-GWUDI wells supplying drinking water to communities in Wisconsin. Although more than 90% of these samples were non-detects, norovirus was detected in samples from most of the wells, with concentrations up to 264 gene copies per litre. These data were analyzed using seven quantitative microbial risk assessment models with various dose-response relationships to determine the level of treatment required to reduce risk to a level commonly deemed acceptable in North America.

WHAT WAS SHOWN?

A minimum 4.0-log (99.99%) removal/inactivation was shown to be appropriate given the average concentration of 3.84 gene copies per litre from these wells. Notably, this would extend the same virus treatment requirement from GUDI/GWUDI sources to non-GWUDI sources. Application of several alternative published norovirus dose-response models to these data results in much higher calculated levels of treatment; however, the model assumptions that lead to those results may not be valid.

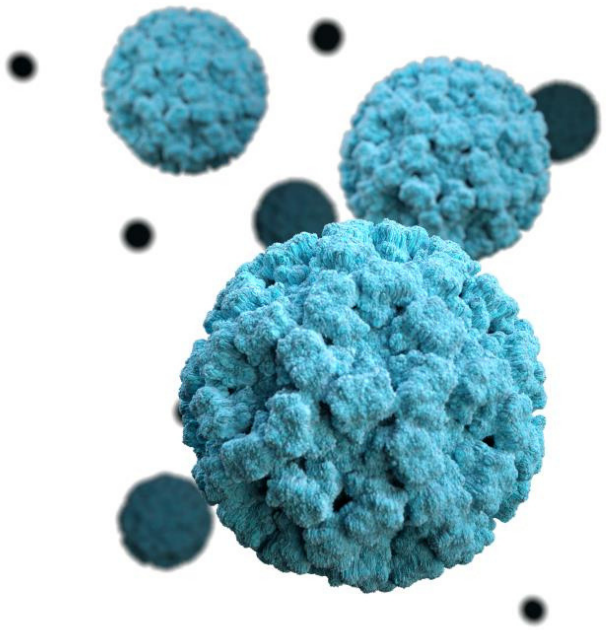


Illustration of norovirus virions based on electron microscopic (EM) imagery,
CDC/Jessica A. Allen
Public Health Image Library (PHIL)

WHAT ARE THE IMPLICATIONS?

This analysis shows that a minimum 4-log treatment guideline is generally warranted for subsurface water supplies used as sources for public drinking water systems. This is especially true in the absence of well-specific monitoring data that would be needed to facilitate more comprehensive risk assessment and decision-making. Continued research is needed to 1) develop and standardize norovirus monitoring methods, 2) understand typical norovirus concentrations in subsurface water supplies used as drinking water sources, and 3) achieve scientific consensus on the most appropriate norovirus dose-response models for accurately characterizing public health risks attributable to waterborne viruses.

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Confirming the Need for Virus Disinfection in Municipal Subsurface Drinking Water Supplies. Water Research, 157:356-364.