

2012 CFID SAFE DRINKING WATER PILOT PROJECT

Title: Association of enteric viruses in source water for drinking (surface and ground water) and sporadic viral gastroenteritis and outbreaks in Alberta

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1.0 Background

Water is a critical resource in Canada and has many competing uses including domestic, agricultural, industrial consumption, source for hydro-energy, medium for transportation, recreation, landscape and tourism (1). The water ecosystem is affected by atmospheric and terrestrial changes in nature as well as human activity and consumption. Clean water is essential to life and access to safe drinking water is a basic human right (2). Raw water including surface and ground water is the source water for drinking and a "multi-barrier approach to safe drinking water- from source to tap" developed by Federal-Provincial-Territorial Committee on Health provides a framework to block/control microbiological pathogens and chemical contaminants that may enter the water supply system which includes the source water, drinking water treatment plant and the distribution system. Traditionally, monitoring microorganisms in source water and finished drinking water provides an indication of the presence of pathogens. The Guidelines for Canadian Drinking Water Quality in December 2010 indicated a gap in the knowledge of the role of virus in environmental water as no maximum acceptable concentration could be provided for enteric viruses (3). Even though enteric viruses are known to cause severe illnesses and have been reported as causative agents in waterborne outbreaks (4, 5, 6), the guideline only recommends that treatment and measures known to reduce the risk of outbreaks be implemented if source water is subject to fecal contamination or if enteric viruses have been responsible for previous waterborne outbreaks, i.e., reactive responses only. It is important to collect data that would shed light on the relationship between enteric viruses in raw water and viral gastroenteritis disease burden to form the basis to build the framework for risk assessment of enteric virus in drinking water.

2.0. Preliminary Data from Related Research

2.1. Viruses in surface water. Through an initiative and support from Alberta Health and Wellness (AHW), we have developed a multiple viral detection panel using real time PCR (rtMP-PCR), cell culture and rtMP-PCR integrated with cell culture for broad detection and quantitation of enteric viruses including enteroviruses, adenovirus, norovirus, sapovirus, rotavirus, astrovirus as well as JC virus in source water from different watersheds (7). Between April 2010 and May 2011, 156 source water samples were collected monthly in duplicates from six locations in three cities of Alberta: 122 (80%) tested positive for one or more viruses using rtMP-PCR and 17 (11%) of samples tested positive using cell culture and the integrated method. Rotavirus was most frequently detected by rtMP-PCR (64%), followed by adenovirus (46%), astrovirus (40%), norovirus (21%), sapovirus (16%), JC virus (14%) and enteroviruses (8%).

2.2. Enteric viruses associated with gastroenteritis outbreaks: The Alberta Provincial Laboratory for Public Health (Provlab) performs norovirus testing using rtMP-PCR for all suspected norovirus outbreaks in the province. Stool samples from norovirus-negative outbreaks are batch tested for rotavirus, sapovirus, astrovirus and enteric adenovirus (Eadv) using rtMP-PCR since 2004 (8). From April 2010 to May 2011, 197 (67%) of 269

outbreaks were confirmed as caused by norovirus. Sapovirus, rotavirus, astrovirus and rotavirus mixed with astrovirus were found in 6 (8%), 6 (7%), 1 (1%) and 1 (1%) of the norovirus-negative outbreaks, respectively. Preliminary analysis of raw water and outbreak data showed an interesting time-association between norovirus in raw water and outbreaks during the study periods. However, the number of outbreaks caused by other enteric viruses was too small for similar analysis.

The current state-of-the art rtMP-PCR assays are not implemented for the identification of enteric viruses in sporadic gastroenteritis at Provlab due to limited resources (9). Electronic microscopy (EM) is still the routine diagnostic test for stool samples from sporadic gastroenteritis which missed >90% of norovirus and 50% of rotavirus, the two most commonly identified virus by rtMP-PCR and important pathogens for both sporadic gastroenteritis and outbreaks. These two viruses have different seasonality with spring predominance for rotavirus and winter predominance for norovirus. We propose to do 12-month of enhanced testing in stool samples submitted for suspected viral sporadic gastroenteritis to enhance data on viral gastroenteritis disease burden and complete a time series analysis of these two viruses in raw water at various locations in the province of Alberta and viral gastroenteritis in sporadic and outbreak settings for the same period.

3.0 Hypothesis

Association will be found between enteric viruses in raw water and sporadic viral gastroenteritis and outbreaks and provide preliminary information on the emergence and persistence of enteric virus in source water as related to gastroenteritis disease burden.

4.0 Study objectives

1. To enhance the detection of norovirus and rotavirus in archived stool samples from sporadic gastroenteritis between April 2010 and May 2011 using rtMP-PCR
2. To analyze the monthly prevalence of these enteric viruses in sporadic gastroenteritis and compare the time trend of these viruses with data collected in source water and outbreaks

5.0. Significance/Impact/Relevance

Our current knowledge pertaining to the relationship of enteric viruses in Canadian watersheds and human health is limited. There are several possible transmission cycles through water including consumption (i.e., drinking water), exposure (i.e., recreational water), or ingestion of food contaminated with enteric viruses originating from water (e.g., irrigation of food crops with contaminated water). The economic, political, social and public health impacts of human enteric viruses can be enormous; examples of prominent waterborne viruses include hepatitis A and norovirus. Data generated from our study will provide some baseline information on the association of confirmed viral gastroenteritis with enteric virus identified in raw water, which is source water for drinking. This information can shed light into possible spillage and persistence of enteric virus in raw water.

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