Rural Drinking Water & Human Health

Guest Speaker: Dr. Anna Majury (Microbiologist with Public Health Ontario)

Disclaimer: The research shared in this presentation is evidence-based, much of which was undertaken by Dr. Anna Majury in collaboration with university colleagues, graduate students, and Public Health Ontario (PHO) staff. All of the opinions shared throughout the presentation are Dr. Anna Majury's and not those of PHO.

PRESENTATION SUMMARY

Water Testing

The laboratory analysis of bacterial water samples must begin within 48 hours of collection. At this time the water is filtered, the filters placed onto agar plates and incubated. Following the incubation period sample plates are examined for E. coli and Total Coliforms. After analysis the results are provided to the client and a summary report is provided to the Public Health Unit via an online portal.

PHO's laboratory tests for E. coli and Total Coliforms which are indicators of bacterial contamination. E. coli is from sewage/feces and Total Coliforms are from sewage, soil, and vegetation. If water samples are contaminated with E. coli it is unsafe to consume. If Total Coliforms are present in a water sample, the water may be unsafe to drink. There are other bacterial pathogens, viruses, and parasites that can lead to illness which include Campylobacter, Shigella, giardia, polio, and enterovirus, among others.

Walkerton

In May of 2000, an E. coli outbreak from a municipal well caused over two thousand people to become ill and seven residents passed away. This tragedy is considered the worst E. coli outbreak in Canadian history. This tragedy led to a six-month boil water advisory and millions of dollars worth of clean-up, human suffering, and government spending. An inquiry into these events (The Walkerton Inquiry) led to various forms of legislation including but not limited to the *Safe Drinking Water Act*, Clean Water Act, and *Ontario Regulation 903: Wells*. It is important to note that O. Reg 903 is the only regulation that provides some level of protection to private wells, and even then the regulation is specific to only the construction and decommissioning of wells. Within the Walkerton Inquiry, it is stated that:

"The province should encourage regular testing by private well owners and should continue to make free microbiological tests available through local health units."

Immediately following the tragedy in Walkerton, there was a significant increase in drinking water samples received at the Ontario Public Health Laboratories (over 120,000 more samples in July 2000 compared to July of 1999). As time passed, people forgot about the Walkerton Tragedy and sample numbers decreased. It is important that we do not forget about this tragedy and continue to test private drinking water systems.

Well Density and Care

Dr. Anna Majury shared various images of wells and reiterated the importance of properly maintaining and caring for your well. Southern Ontario's high well density has classified Ontario as being the largest private well-reliant province in all of Canada.

Background on Private Well Water in Ontario

There are roughly two million individuals in Ontario who rely on private wells. These well owners are responsible for their own water stewardship as existing legislation does not require private systems to meet the regulatory standards of the Ontario *Safe Drinking Water Act* or *Clean Water Act*.

Private wells have an increased health risk in comparison to municipal systems for a variety of reasons, including but not limited to, lack of standard maintenance practices, treatment and testing. Research by Murphy et al, suggests that approximately 80,000 illnesses per year can be attributed to private well water in Canada. These illnesses range in severity and some of these illnesses are likely underreported – especially for mild cases.

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Background Studies and Analysis

The WELLness project aimed to provide evidence-based information regarding risks, drivers, testing, and maintenance of private well water in Ontario. This study looked at both the physical characteristics (hydrogeological, microbiological, etc.) and social aspects (awareness, perceptions, practices, etc.).

The long-term aim is to assess the human health burden associated with private drinking water in Ontario by examining the social and physical factors influencing water security. This in turn will inform best practices for private well owners and public health practitioners.

Spatial Analysis of E. coli

The following study aimed to identify the distribution of E. coli contamination in Southern Ontario.

Study: "A spatial analysis of private well water Escherichia coli contamination in southern Ontario"

This study identified several "hot spots" for E. coli contamination, relative to surrounding areas, whereby the areas had higher rates of contamination. This work contributes to some of the evidence that not all wells are the same, and that prescribing a specific testing frequency (e.g. three times per year) is is inappropriate and each well must be tested with a frequency determined based on a number of different factors.

Microbial Sources of Contamination

Molecular (DNA) tracking methods were used to determine the source of E. coli contamination. DNA was extracted from E. coli positive samples, in order to identify the origin of the contamination (bovine, human, etc.). The results of the study identified the most common E. coli contamination origins (human and bovine).

The evidence for human fecal contamination in wells, hihglights the importance of properly maintaining household septic systems as well as proper well maintenance. It also prompts landowners to investigate source water protection measures that they can implement on their property to prevent future bacteriological contamination.

WELLness Project

Private well sample data from 2010-2020 were reviewed, analyzed and geocoded.Geocoding allowed the reconciliation of well locations with local geology.
The project investigated the impact or importance of potential drivers of contamination such as aquifer type, subsoil and well depth, seasonality, and bedrock type.

Aquifer Type

Wells in consolidated aquifers exhibited higher detection rates than those in unconsolidated aquifers. Consolidated aquifers; for example, limestone (Karst), and various other types of bedrock, are often fractured, allowing surface water access to groundwater aquifers below the surface. Unconsolidated aquifers are made up of porous substrate which consists of aggregates of individual particles such as sand or gravel. The groundwater occurs in and moves through the openings between the individual grains, rather than through open fractures.

Subsoil & Well Depth

Shallow and moderate depth of overburden and shallow well depths had significantly higher detection rates compared to deeper wells with more overburden. For example, areas, where karst formations are found (shallow overburden and fractured bedrock), are more susceptible to contamination, and thus exhibit higher detection rates.

Seasonality

Based on our data, summer and fall bacterial detection rates were significantly higher than winter and spring.

Summary: Sample Frequently

- Waterborne illness from private well water consumption is a significant concern in Ontario.
- Risks vary depending on a wide range of factors such as the location of the well, hydrogeology, well characteristics, contamination sources, and preventative measures implemented on the property (Best Practices). Therefore, a prescribed testing frequency for all wells is inappropriate, given each well and the well water within is subject to different drivers of contamination. Accordingly, it is advised to test.
- Private well water quality is the responsibility of the well owner. It is important to test, treat, and properly maintain your well.

Publications Referenced and Items of Potential Interest:

Best Practices for Source Water Protection
Source Protection Plans and Resources