Analysis of Private Well Water Quality and Well Owner Education in Maryland

Rhodel Bradshaw, Rianna Murray, Rachel E. Rosenberg Goldstein, Daphne Pee, Karen Aspinwall, Amy R. Sapkota
University of Maryland School of Public Health, Maryland Institute for Applied Environmental Health, UM STAR Program

Abstract

Introduction: About 33.3% of Maryland's population uses private wells for drinking water. However, private wells that serve fewer than 25 people are neither regulated by federal laws nor regularly tested for contaminants associated with adverse health outcomes. With no required monitoring, little is known about testing performed by private well owners; knowledge regarding well maintenance and testing; and private well water quality. Given the number of Maryland residents relying on private wells, addressing these knowledge gaps could have important health implications for Marylanders. A collaborative team of Extension professionals, University of Maryland (UMD) researchers, and other partners have launched a pilot project for a well water education program in four of Maryland's 24 jurisdictions, Cecil County, Kent County, Montgomery County and Queen Anne's County. Our overarching goal is to improve health and prevent disease related to compromised well water quality.

Methods: A prior knowledge needs assessment survey was used to capture the current knowledge base of participating private well owners. Trainings were conducted on properly collecting well water samples, interpreting water testing results, and finding solutions for high levels of contaminants. A total of 150 well water samples were collected from kitchen or bathroom faucets in private homes in Cecil, Montgomery, Queen Anne's and Kent Counties. Samples were analyzed for total coliform bacteria, fecal coliform bacteria, *E. coli*, *Enterococcus* spp. and *Salmonella* using standard U.S. EPA membrane filtration methods. Total dissolved solids and pH were measured using probes and commercially available kits from Hach Company. Total arsenic and nitrate were analyzed by the Maryland Department of Health and Mental Hygiene.

Results: Total coliforms and fecal coliforms were present in 25% and 15% of all samples, respectively. Only 5% of samples contained *E. coli* and 5% contained *Enterococcus.* 75% of wells were outside of the recommended range for pH. The average nitrate level was 2.3 mg/L. All wells had arsenic levels below the EPA recommended limit.

Conclusion: Most private well samples were below the EPA's maximum contaminant levels for tested contaminants. However, private well owners are advised to test well water quality at least once a year, and should maintain both well water systems and septic systems. A key aspect of this project is the collaboration between Extension educators and UMD researchers. This cooperation between experts on the many facets of well water safety, including water testing, needs assessment, program evaluation, and family-based health education, is essential to making a difference in the health of Maryland's communities.

Introduction

- About 33.3% of Maryland's population use private wells for drinking water.
- Many of these wells are able to be used without following federal standards.
- Safe Drinking Water Act(amended 1996)
    - Wells that serve fewer than 25 people are not required to be regulated by federal laws nor regularly tested for contaminants associated with adverse health outcomes.
- Little is known about testing performed by private well owners; knowledge regarding well maintenance and private well water quality.
- The purpose of this study was to assess water quality, educate well owners on health risks, and potentially to improve adverse health outcomes that may be associated with poor well water quality

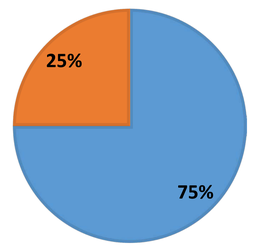
Table 1: EPA Maximum Contaminant Levels or Recommended Ranges for Drinking Water

Contaminants	Maximum Contaminant Level
Nitrate	10 mg/L
Lead	0.015 mg/L
Fluoride	4.0 mg/L
Arsenic	0.010 mg/L
Total coliforms (including fecal coliforms and *E. coli)*	0
pH	6.5-8.5
Total Dissolved Solids	<500 mg/L

Table 2: Demographics of the participants of the well owner education program

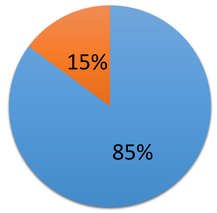
Age	Percentages
49 and under	17%
50 and over	83%
Ethnicity	
African American	4%
Hispanic	1%
Caucasian	87%
Other	4%
Didn't Specify	4%
Number of Years Spent in Location	
10 years or Less	28%
10-20 years	28%
20 years or more	28%
Didn't Specify	6%

FIGURE 1: TOTAL COLIFORMS



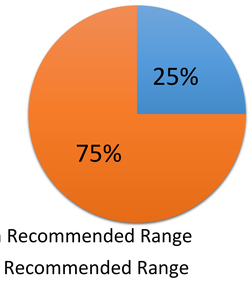
For recommended range see Table 1

Figure 2: Fecal Coliforms



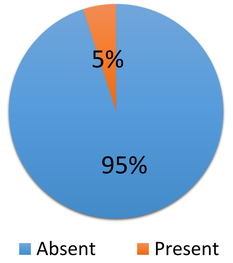
For recommended range see Table 1

Figure 3: pH



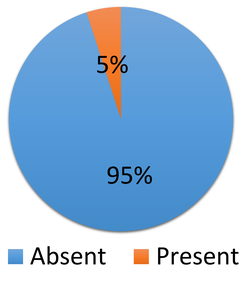
For recommended range see Table 1

Figure 4: E. Coli



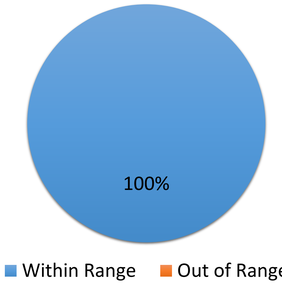
For recommended range see Table 1

Figure 5: Enterococcus



For recommended range see Table 1

Figure 6: Arsenic



For recommended range see Table 1

Methods

- A prior knowledge needs assessment survey was used to capture the current knowledge base of participating private well owners.
- Trainings were conducted on properly collecting well water samples, interpreting water testing results, and finding solutions for high levels of contaminants.
- A total of 150 well water samples were collected from kitchen or bathroom faucets in private homes in Cecil, Montgomery, Queen Anne's and Kent Counties.
- Samples were analyzed for total coliform bacteria, fecal coliform bacteria, *E. coli*, *Enterococcus* spp. and *Salmonella* using standard U.S. EPA membrane filtration methods.
- Total Dissolved Solids (TDS) was measured using a Hach Company TDS tester
- pH levels were measured using an Accument pH meter
- The Maryland Department of Health and Mental Hygiene's (MD DHMH) Trace Metals Lab analyzed the samples for arsenic using inductively coupled plasma mass spectrometry (ICP-MS).
- The MD DHMH Inorganics Lab analyzed the samples for nitrate using liquid chromatography-mass spectrometry

Limitations

- Survey design
- Loss to follow-up
- Input of results

Conclusions

- Most well water samples tested in this project were below EPA's maximum contaminants levels for the tested contaminants.
- Private owners should be aware of risks associated with poor well water quality.
- It is advised to have well water tested for a minimal number of contaminants on an annual basis to avoid any potential health complications.
- This project is contributing greatly to understanding private well water quality, and should be continued throughout Maryland

Potential Future Work

- Improve survey design
- Investigate soil bacterial content and soil composition
- Test the types of aquifers in Maryland: Crystalline and Carbonate
- Investigate potential relationships between individuals with symptoms of diarrhea and vomiting and bacterial content of wells
- Compare Cistern Water Quality with Well Water Quality

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Acknowledgements

- UMSTAR Program Directed by Dr.Hagberg
- Dr. Amy R. Sapkota
- Rachel E. Rosenberg Goldstein
- Rianna T. Murray
- Staff and graduate students that worked in Dr. Amy's Lab
- Kyle Netherton