# Data-Driven Outreach for Private Well Users

FINDINGS FROM A STATEWIDE SURVEY OF HOUSEHOLDS ON PRIVATE WELLS WITH ELEVATED LEVELS OF ARSENIC

DEPARTMENT OF HEALTH

# Data-Driven Outreach for Private Well Users

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*To obtain this information in a different format call 651-201-4600.*

# Contents

# Introduction

Twenty-one percent of Minnesotans (1.2 million people) get their drinking water from a private well. Private well users (PWUs) do not have the same drinking water quality safeguards as people who get their water from public water systems. Public water systems make sure water meets all federal and state health standards, but PWUs are responsible for making sure their water is safe to drink. The Minnesota Well Code ensures that private wells are properly located and constructed. However, once the well is put into service, PWUs are responsible for testing, inspecting, and protecting their well. They are also responsible for treating their drinking water when necessary.

Recognizing this gap in public health protection, Minnesota Department of Health (MDH) wanted to find out if PWUs are taking action to ensure safe drinking water. In 2016, MDH sent a survey to nearly 4,000 households with private wells. Each of these households had a well drilled since 2008 and had an initial arsenic test result above 10 micrograms per liter (µg/L)[1]. When the arsenic result for a new well is above 10 µg/L, MDH mails educational materials recommending the well owner take action to protect their household's health. Drinking water with arsenic in it can increase the risk of cancer and other serious health effects. This survey helped identify whether those educational materials and approach were effective.

The survey consisted of 31 (often multi-part) questions divided into four main topics:

- Actions taken after receiving their elevated arsenic result and educational materials;
- Characteristics of the treatment system they installed if they installed a treatment system;
- Opinions and practices regarding well water; and
- Socio-demographic and household information.

Nearly 800 households participated in the survey. MDH analyzed the survey responses to determine if and how the following variables influence testing and treatment behaviors:

- arsenic concentration
- gender
- age
- education
- income
- growing up with a well
- number of years living the home
- knowing people who have tested their well water
- children living in or frequently visiting the home

This report shares key survey findings and provides recommendations for data-driven outreach approaches to encourage PWUs to regularly test their well water and treat it when necessary.

[1] 10 µg/L is the limit allowed in public water supplies (Maximum Contaminant Level).

# Results

## Response rate

A total of 798 households participated. The survey response rate was 27 percent, excluding 815 households in which the first and/or second mailing was undeliverable and five ineligible households. Participants reported on well water at both primary residences and vacation/seasonal homes. ***The following results are limited to participants with wells at their primary residences (n=664)***, where drinking water exposures are continuous and highest.

## Participant characteristics

Table 1 summarizes survey respondents' general characteristics. More men than women participated in the survey. This difference could be related to the survey instructions asking that the person who manages the safety and quality of the well water fill out the survey. The study sample also had a higher percentage of older age groups and higher education/income groups than the general Minnesota population. These differences are due to an unknown combined function of who lives in homes with private wells and who chose to participate in the survey.

*Table 1: Individual-level participant characteristics overall and by housing type*

| Characteristic[2] | Primary residence participants (n=664) Count (percent) |
|---|---|
| Men | 396 (61) |
| Women | 257 (39) |
| <40[4] years old | 121 (19) |
| 40-49 years old | 80 (12) |
| 50-59 years old | 147 (23) |
| 60-69 years old | 155 (24) |
| 70+ years old | 146 (23) |
| Have a high school diploma or less | 153 (24) |
| Have some college, no diploma | 132 (20) |
| Have an associate degree | 117 (18) |
| Have a bachelor's degree | 148 (23) |
| Have a postgrad, professional, or doctoral degree | 100 (15) |
| Raised in home with a well during at least part of childhood | 439 (67) |
| <$40,000 (household income)[3] | 93 (16) |
| $40,000-$59,999 (household income) | 109 (19) |
| $60,000-$79,999 (household income) | 90 (16) |
| $80,000-$99,999 (household income) | 104 (18) |
| $100,000+ (household income) | 177 (31) |
| Lived in primary residence for 10+ years | 370 (47) |
| >2 residents live in primary residence | 230 (35) |
| Children <18 years old live in or frequently visit primary residence | 373 (56) |

[2] Missing data counts by characteristic: gender=20, age=15, education =22, income =117, number of people living in home=11, length of time in primary residence=17, months per year in vacation/seasonal home=17.
[3] Due to low counts, participants in the under $20,000 category (5 percent) and $20,000-$39,999 category (9 percent) were combined into one category.

# Action(s) taken in response to arsenic test result

Eighty-three percent of respondents (544 of 664) recalled they had received information about the arsenic concentration in their well water. They were either:

- residents at the time of well construction and recalled receiving/reading the MDH arsenic result materials or
- were not residents at the time of well construction but were notified by the previous resident or developer about the level of arsenic in the well water.

These respondents were classified into categories based on what type of action they took in response to the arsenic level in their well water (Table 2). **Thirty-four percent did not take any action.**

*Table 2: Actions taken after receiving arsenic result (n=541, 3 missing)*

| Action | Count (percent) |
|---|---|
| Installed an arsenic treatment system | 196 (36) |
| Drink bottled water (no treatment system) | 136 (25) |
| Other effective action[4] | 14 (3) |
| Ineffective or unknown action[5] | 10 (2) |
| No action | 185 (34) |

# Predictors of installing an arsenic treatment system

Multivariate logistic regression identified the following as significant[6] predictors of installing an arsenic treatment system:

- **Knowing people who have tested their well:** A household that knows someone who has tested their well was 2.8 times more likely to install an arsenic treatment system than those who did not know anyone who has tested their well water.
- **Income:** Those in the highest income category ($100,000 or more) were 2.4 times more likely to install treatment compared those with household incomes under $40,000.
- **Children in the home:** Those with children living in or frequently visiting the home were 1.6 times more likely to install treatment compared to those who do not have children in or visiting the home.
- **Urbanicity:** Based on the Rural-Urban Commuting Area (RUCA) Codes[7], households in small towns and metropolitan areas were twice as likely to install treatment compared to those in rural areas.

[4] Other actions include re-testing and the second arsenic result was below 10 µg/L, connecting to community water system, or they had an effective treatment system already in place.
[5] Based on write-in responses (e.g., 'Brita filter')
[6] All statistical tests were two-tailed and p values <0.05 were considered significant.
[7] The rural-urban commuting area (RUCA) codes classify U.S. census tracts using measures of population density, urbanization, and daily commuting. Learn more at Rural-Urban Commuting Area Codes (https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx).

## How respondents selected their treatment system

The survey asked all participants that reported installing a treatment system (regardless of whether they recalled reading the MDH materials) what factors led them to choose the type of system (n=226). **The most commonly selected factor was the recommendation of a well contractor or water treatment company.**

*Table 3: Factors in selection of treatment system (n=220; 6 missing, multiple responses allowed)*

| How selected treatment system | Count (percent) |
|---|---|
| Recommended by well contractor or water treatment company | 107 (49) |
| Cost | 53 (24) |
| Convenience | 46 (21) |
| Other (write-in)[8] | 33 (15) |
| Internet search | 30 (14) |
| Recommended by MDH or local govt. agency | 21 (10) |

## Why respondents took no action

Table 4 shows the reasons at least 10 percent of the respondents selected for not taking action to reduce their household's exposure to arsenic. **Lack of concern about the arsenic concentration was the most common reason.**

*Table 4: Reasons for not taking any arsenic-related action (multiple selections allowed, n=185)*

| Reason | Count (percent) |
|---|---|
| Not concerned about arsenic level | 92 (50) |
| Wasn't sure what to do or who to contact | 39 (21) |
| Treatment options are too expensive | 28 (15) |
| Treatment systems are too difficult to use and maintain | 28 (15) |
| Haven't gotten around to it yet, but plan to someday | 21 (11) |
| Other | 30 (16) |

The odds of selecting cost as a reason for not taking action was five times higher among those in the lowest income category (<$40,000) compared to the highest income category ($100,000 or more).

## How often respondents use water with high levels of arsenic

The survey asked all participants, regardless of whether they recalled receiving/reading the MDH arsenic result materials, how often they use their well water for drinking and cooking. Excluding those who were no longer at risk of overexposure (e.g., installed an arsenic treatment system or reported that a follow-up test showed a concentration below 10 µg/L [n=614]), sixty-four percent reported 'mostly or always' using their well water. An additional 18 percent reported 'sometimes' using their well water for drinking and cooking. Therefore, at least

[8] 'Other' responses where n>1: Recommended by: builder/house contractor (n=6), friend or family member (n=5), plumber (n=2); used same system in previous home (n=3); required to secure mortgage (n=2).

82 percent of households with an arsenic concentration above 10 µg/L in their drinking water continue to be exposed to arsenic.[9]

## Well testing practices

MDH recommends PWUs test their well water for nitrate every other year and coliform bacteria every year. Restricting the dataset to wells that were constructed more than two years prior to the survey mailing, only 19 percent of participants had tested for nitrate and 17 percent had tested for bacteria. Not knowing anyone who had tested their well was a significant predictor of not testing one's own well. Households in which children live or frequently visit were significantly more likely to have tested for bacteria and nitrate.

## Barriers to reducing arsenic exposure and well testing

The survey asked participants how much they agree or disagree with the following statements related to perceived risk and barriers:

- 'My untreated well water is safe to drink' (perceived health threat).
- 'Homes in my area often have arsenic-contaminated well water' (perceived susceptibility threat).
- 'Arsenic in well water affects a home's value' (perceived financial threat).
- 'I know what level of arsenic in drinking water is a health concern' (knowledge barrier).
- 'I know where to find information to manage the safety and quality of my well water' (health literacy barrier).
- 'It is hard to compare the pros and cons of treatments to reduce arsenic in water' (health literacy barrier).
- 'It costs a lot of money to treat arsenic in well water' (perceived financial barrier).

MDH evaluated associations between these risk and barrier perceptions and protective behaviors. Overall, a large percent of respondents selected neutral responses to the statements, which may reflect respondents' reluctance to state an opinion on topics on which they feel they lack personal knowledge. However, there were some statistically significant associations.

**Risk perception was significantly associated with whether respondents took action to reduce arsenic exposure.**

- *Perceived health threat: Those* who did not think their untreated well water was safe to drink were 11 times more likely to reduce their arsenic exposure compared to those who agreed that their untreated well water was safe to drink.
- *Perceived susceptibility:* Those who did not think that homes in the area often have arsenic-contaminated well water were 3.7 times less likely to reduce their arsenic exposure

[9] Drinking water with low levels of arsenic over a long time is associated with diabetes and increased risk of cancers of the bladder, lungs, liver, and other organs. Coming in contact with arsenic can also contribute to cardiovascular and respiratory disease, reduced intelligence in children, and skin problems, such as lesions, discoloration, and the development of corns. Health impacts of arsenic may not occur right away and can develop after many years, especially if someone is in contact with arsenic at a low level over a long time.

compared to those who agreed that homes in the area often have arsenic–contaminated well water.
- *Perceived financial threat: Those* who did not think that arsenic in well water affects a home's value were 2.1 times less likely to reduce their arsenic exposure compared to those who agreed that arsenic in well water affects a home's value.

**Some perceived barriers were significantly associated with whether respondents took action to reduce arsenic exposure.**
- *Knowledge barrier:* Those who did not know what level of arsenic in drinking water is a health concern were 3.2 times less likely reduce their arsenic exposure compared to those who felt they know what level of arsenic in drinking water is a health concern.
- *Perceived financial barrier: Those* who did not think it costs a lot of money to treat arsenic in well water were 2.1 times more likely to reduce their arsenic exposure compared those who agreed that it costs a lot of money to treat arsenic in well water.

**Some risk perception and perceived barriers statements were significantly associated with well testing practices.**
- *Perceived health threat:* Those who did not think their untreated well water is safe to drink were 1.7 times more likely to have tested their well for a contaminant compared to those who agreed that their untreated well water is safe to drink.
- *Knowledge barrier:* Those who did not know what level of arsenic in drinking water is a health concern were 1.6 times more likely to **not** have tested their well for a contaminant compared to those who thought they knew what level of arsenic in drinking water is a health concern.
- *Health literacy barrier:* Those who did not know where to find information to manage the safety and quality of their well water were nearly twice as likely to **not** have tested their well for a contaminant compared to those who thought they knew where to find information to manage the safety and quality of their well water.

# Who perceived which barriers

Multivariable logistic regression identified statistically significant associations between perceptions and household and socio-demographic variables. Table 5highlights how some risk perceptions and perceived barriers are more common among certain subgroups of PWUs.

*Table 5: Subpopulations more likely to agree/strongly agree with perceived risk and barrier statements*[10]

| Independent variable | Groups significantly more likely to agree with this perception |
|---|---|
| **My untreated well water is safe to drink** (perceived health threat) | ▪ Males<br>▪ Grew up with a well<br>▪ Does not know someone who has tested their well<br>▪ No children living in or frequently visiting the home |

[10] Includes all 664 primary residence households. The 5-point scale of agreement was reduced to a binary dependent variable (agree or strongly agree, y/n). All a priori-defined variables listed in Section 2.3 were tested in a full multivariable logistic regression model and then the model was reduced until all remaining variables remained statistically significant. Lastly, variables were added back into the final reduced models to confirm the decision to remove them.

| Independent variable | Groups significantly more likely to agree with this perception |
|---|---|
| **Homes in my area often have arsenic-contaminated well water** (perceived threat) | ▪ Income >$100,000<br>▪ Knows someone who has tested their well |
| **I know what level of arsenic in drinking water is a health concern** (knowledge barrier) | ▪ Knows someone who has tested their well |
| **I know where to find information to manage the safety and quality of my well water** (health literacy barrier) | ▪ Income >$80,000<br>▪ Knows someone who has tested their well |
| **It is hard to compare the pros and cons of treatments to reduce arsenic in water** (health literacy barrier) | ▪ Income <$80,000<br>▪ Grew up with a well |

## Prompts to test

The survey asked how important ten factors would be in prompting participants to test their well water. Nearly all respondents (97 percent) identified 'a change in taste, smell or appearance of well water' as somewhat or very important prompt testing (Table 6). The second and third top rankings for very important prompts were 'recommendation of a doctor' (59 percent) and 'unexplained health problems' (55 percent). Traditional outreach strategies, such as news articles or recommendations from a public official, had the lowest 'very important' ranking.

There were significant differences amongst socio-demographic groups in terms of what they selected as very important. In general, females, those with children living in or frequently visiting the home, and those who did not have a private well at their childhood home were more likely to select 'very important' for many of the prompts.

*Table 6: Prompts to test well ordered by 'very important' ranking*

| Prompt | Percent ranking factor as 'very important' | Groups significantly more likely to select 'very important'[11] |
|---|---|---|
| **A change in taste, smell, or appearance of my water** | 80 | ▪ Not evaluated |
| **Recommendation of a doctor** | 59 | ▪ Female |
| **Unexplained health problems** | 55 | ▪ Female<br>▪ Households with children |
| **An infant or young child living in/visiting my home** | 50 | ▪ Female<br>▪ Youngest age group<br>▪ Lower education |
| **A well testing event happening in my township/county** | 50 | ▪ Female<br>▪ Did not grow up with a well<br>▪ Younger age<br>▪ Households with children |
| **Hearing from a neighbor about a water quality problem in my area** | 49 | ▪ Female<br>▪ Did not grow up with a well<br>▪ Higher income<br>▪ Higher education<br>▪ Younger age |
| **A coupon for a discount on a well water test** | 47 | ▪ Households with children |

[11] Based on multivariate logistic regression

| Prompt | Percent ranking factor as 'very important' | Groups significantly more likely to select 'very important'[11] |
|---|---|---|
| | | ▪ Lowest income group |
| **Selling my home** | 35 | ▪ Did not grow up with a well |
| **Recommendation of a town official** | 31 | ▪ Female<br>▪ Households with children<br>▪ Did not grow up with a well |
| **Seeing a news article about well water testing** | 21 | ▪ None |

# Preferences for receiving and returning test kits

When asked how they would like to order and return a well test kit, picking up and returning a test kit to a local location was respondents' top choice (Table 7). However, preferences varied by age, education, and income. Younger age groups and higher income/education groups were more likely to prefer ordering a test kit on a website; older age groups and lower income/education groups preferred picking up a test kit and returning it to a local location (Figure 1).

*Table 7: Well testing preferences (missing=7)*

| Test kit preference | Count (percent) |
|---|---|
| Pick up test kit at **local location** and return the sample to **local location** | 284 (43) |
| Order a test kit on a **website** and return the sample by **mail** | 201 (31) |
| Order a test kit over the **phone** and return the sample by **mail** | 135 (21) |
| Other[12] | 37 (6) |

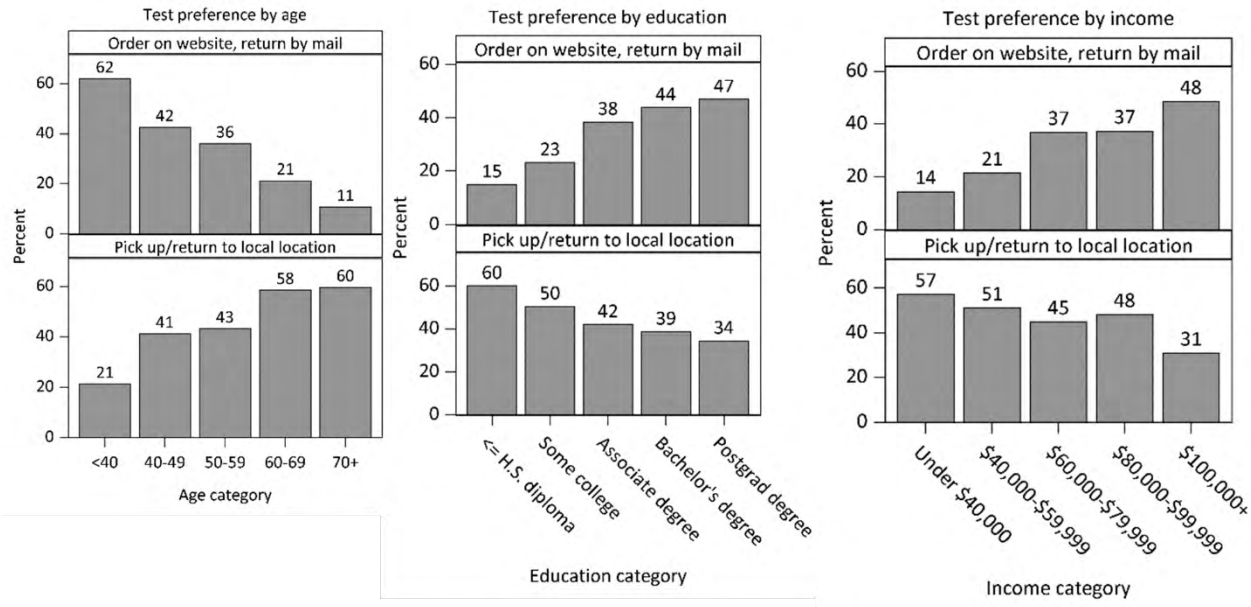


*Figure 1: Test kit preferences by age, education, and income*

[12] Most common 'other' response was to have a professional come to the home the collect the sample (e.g., well driller, water company, and plumber).

# Information sources to manage well safety and water quality

The survey asked participants where they would look for information to help manage the safety and quality of their well water. They were instructed to select their top three choices from a selection of 10 options or a write-in category. Almost half of the respondents selected the MDH website as a source for information; however, this result is biased since MDH sent out the survey. Excluding MDH, the three most common choices of where to look for information were water testing lab (43 percent), general internet search (39 percent), and local government (32 percent). Like other questions, responses to this question varied by income, education, and age of the respondent (see Table 8).

*Table 8: Preferred sources of information to manage well safety and quality by age, education, and income category (missing=2)*

| Information Source | Frequency (percent) | Groups ranking this option in their top three |
|---|---|---|
| **Water testing laboratory** | 284 (43) | All groups but those with only an associate's degree. |
| **General internet search** | 260 (39) | ▪ <70 years old<br>▪ At least some college education<br>▪ Household income >$40,000 |
| **Local/county govt. website or office** | 213 (32) | ▪ <60 years old<br>▪ All education groups except for respondents with only an associate's degree<br>▪ Household income >$60,000 |
| **Well drilling company** | 205 (31) | ▪ >60 years old<br>▪ Have an associate's degree or less<br>▪ Household income <$60,000 |
| **University or county extension service** | 178 (27) | ▪ >70 years old<br>▪ Household income <$40,000 |
| **Water treatment company** | 146 (22) | none |
| **Friend, relative, neighbor or co-worker** | 86 (13) | none |
| **Health clinic** | 51 (8) | none |
| **Federal govt. website** | 32 (5) | none |
| **Other**[13] | 15 (2) | none |

While selection of 'MDH website' is biased and unreliable, lower education and income participants were significantly less likely to select MDH as an information source to help manage the safety and quality of their well water.

[13] Most common 'other' response was plumber

# Data-Driven Outreach Recommendations

The results from this survey demonstrate the opportunity for state, local, private, and public entities to partner and improve well stewardship through tailoring outreach to PWUs. Based on the study findings, MDH recommends incorporating the following eight approaches to strengthen outreach to PWUs.

## Encourage people to talk about testing their well water

Encouraging PWUs to talk about testing well water with each other could be an effective way to get more people to test and treat their well water when necessary. The survey found PWUs who knew someone else who tested their well were 2.8 times more likely to have reduced their exposure to arsenic in their drinking water. Not knowing anyone else who has tested their well was also a significant predictor of not testing one's own well water. Forty-nine percent of respondents also identified that hearing from a neighbor about a water quality problem in their area would be a very important prompt for testing. Possible ideas for this outreach approach include:

- Leverage social media outlets, such as Facebook, Twitter, and Instagram, to get people talking about testing their well water.
- Host an 'each one reach one' campaign, where people who test their well water receive a coupon for a well water test they are requested to give to a neighbor who uses a private well.
- Train local well water advocates to talk with neighbors and friends about groundwater quality issues in the area and the importance of well water testing.

## Improve risk messaging

Of those who did not take action to reduce their exposure to arsenic in their drinking water, 50 percent said they did not take action because they were not concerned about the level of arsenic. Clear messaging about what arsenic and other contaminants are, how common they are in groundwater in the area a PWU lives, and the health risks associated with the contaminant can help people make informed decisions about what to do next.

## Clarify options to reduce risk

Of those who did not take action to reduce their exposure to arsenic in their drinking water, 21 percent said they did not take action because they were not sure what to do or whom to contact. Clear messaging about recommended next steps can help people take action. Messaging should include whom the person can contact with questions, which treatment types are effective options, the pros and cons of treatment options, and clear direction on what the person's next steps should be.

## Provide information through a variety of channels

Where people prefer to find information to manage well safety and water quality varied across age, income, and education groups. To ensure all well users have opportunities to find the information they are looking for, be sure to include information through a variety of channels. Key channels include water testing laboratories, the internet, local government, and well drilling companies.

## Partner with local agencies and businesses

Respondents look to physicians, well testing laboratories, water treatment companies, well drillers, local government, and building contractors for advice on whether they should test, whether and how they should treat their water, and general water quality information. Partnering with these agencies and businesses creates an opportunity to provide consistent messaging through a variety of channels that people are already looking to and trusting for information.

## Target messaging to families with young children

Fifty percent of respondents ranked having an infant or young child living in or visiting the home as very important to prompting them to test their well water. Incorporating well testing and water treatment messages into places where expectant parents and families with young children congregate may be a good way to target messaging to families with young children. Some ideas include childbirth classes, physicians/clinics, family home visiting programs, childcare centers, and schools.

## Address cost concerns

Forty-seven percent of respondents listed having a coupon for a discount on a well water test would be very important to prompting them to test. Twenty-eight percent of those who did not reduce their arsenic exposure said that at least part of the reason for not doing so was that treatment options were too expensive. Addressing cost concerns could include:

- Making sure well owners are aware of grants, tax-breaks, and low interest loans that could be used for installing water treatment units.
- Working with laboratories to see if they could offer discounts or coupons for well water testing.
- Working with legislators and local government to find ways to subsidize the cost of testing and/or treating well water.

## Make testing available locally

Half of the respondents said having a well testing event happen in their township/county would be very important in prompting them to test their well water. Forty-three percent also said they would prefer to pick up and drop off a well test kit at a local spot. Work with well testing laboratories and local agencies and businesses to develop a program for picking up and dropping off well water test kits.

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