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## Description of calls from private well owners to a national well water hotline, 2013

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### Abstract

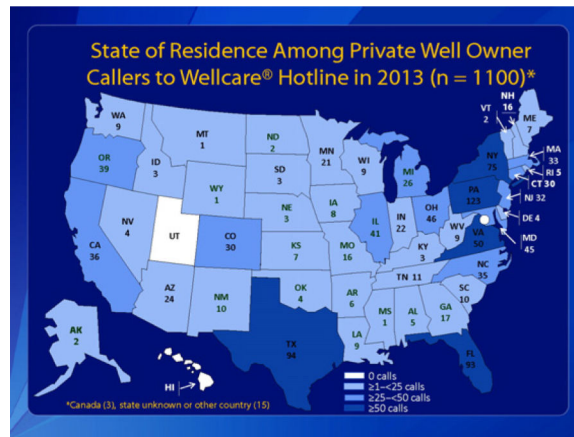
Water Systems Council (WSC) is a national, non-profit organization providing education and resources to private household well owners. Since 2003, WSC has provided wellcare®, a toll-free telephone hotline to answer questions from the public regarding well stewardship. In order to identify knowledge gaps regarding well stewardship among private well owners, we obtained data from WSC and reviewed calls made during 2013 to wellcare®. WSC records data from each wellcare® call—including caller information, primary reason for call, main use of well water, and if they were calling about a cistern, private well, shared well, or spring. We searched for calls with key words indicating specific contaminants of interest and reviewed primary reasons for calls. Calls classified as primarily testing-related were further categorized depending on whether the caller asked about how to test well water or how to interpret testing results. During 2013, wellcare® received 1100 calls from private well owners who were residents of 48 states. Among these calls, 87 (8%) mentioned radon, 83 (8%) coliforms, 51 (5%) chemicals related to fracking, 34 (3%) arsenic, and 32 (3%) nitrates key words. Only 38% of private well owners reported conducting any well maintenance activities, such as inspecting, cleaning, repairing the well, or testing well water, during the previous 12 months. The primary reason for calls were related to well water testing (n = 403), general information relating to wells (n = 249), contaminants (n = 229), and well water treatment (n = 97). Among calls related to testing, 319 had questions about how to test their well water, and 33 had questions about how to interpret testing results. Calls from private well owners to the wellcare® Hotline during 2013 identified key knowledge gaps regarding well stewardship; well owners are generally not testing or maintaining their wells, have questions about well water testing treatment, and concerns about well water contaminants.

### Graphical Abstract

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.



## Keywords

Private well; Well stewardship National hotline; Well water safety; United States

## 1. Introduction

Approximately 44.5 million people (about 14% of the U.S. population) rely on domestic wells as their primary source of drinking water (Maupin et al., 2014). The quality of private well water is determined by local factors, such as aquifer characteristics, including hydrogeochemistry (i.e., the chemical interactions between water and surrounding rocks and soils); local land use; precipitation; the quality of ground water recharge; and well characteristics. Since these domestic wells are not regulated by the Safe Drinking Water Act, routine testing to ensure water quality falls on individual well owners (Title XIV of the public service act, 2002). Without regular testing and maintenance, domestic wells may become compromised by various contaminants, including chemicals, radionuclides, and microbes, which may increase risk of adverse health outcomes. In a U.S. Geological Survey-National Water-Quality Assessment Program study of water quality conditions among 2100 domestic wells within 48 states, more than one in five (23%) of the sampled wells contained one or more contaminants at a concentration greater than a human-health benchmark (DeSimone et al., 2009). Although a few states require private well testing on real estate transactions, routine testing requirements do not exist in most states.

Currently, there are no national data on the number and location of private wells in the United States or the characteristics of private well water testing and few (11) states have chosen to include questions on private wells in national surveys (Centers for Disease Control and Prevention, 2013). However, regional assessments of the knowledge, attitudes, and practices of private well owners and their water testing practices (Kreutzweiser et al., 2011; Jones et al., 2005; Jones et al., 2006; Liukkonen et al., 2009; Murti et al., Under review; Flanagan et al., 2015; Imgrund et al., 2011; Schubert et al., 1999) have demonstrated a gap in knowledge among well owners about the importance of well maintenance and water testing.

There are many potential sources of information for well owners which include local and state health departments, agricultural extension agents, National Ground Water Association's hotline (National Groundwater Association Website) for household well owners, and the United States' Environmental Protection Agency's Safe Drinking Water Hotline (United States Environmental Protection Agency website). In addition to these, Water Systems Council (WSC), a national, non-profit organization that works to provide education and resources to individual well owners has provided since 2003 a toll-free telephone hotline called wellcare® for individual well owners and other interested parties including government employees, elected officials, and realtors with questions regarding health concerns, well water testing, or well maintenance. Information about the hotline is available on the WSC website, social media pages, and information sheets that are accessible to the public. Approximately 2000 calls are received annually. To describe the problems and determine common concerns among well owners across the United States regarding their wells, we analyzed previously collected data from calls made to wellcare® by private well owners. This information can be used in the future to help inform decisions about implementation of well owner education programs and interventions to promote routine well testing.

## 2. Methods

Using SAS 9.3 (SAS Institute, Cary, North Carolina) for data cleaning and generating frequencies, we characterized calls to wellcare®, focusing on calls from individuals who identified themselves as private well owners. Only calls from January 1, 2013 through December 31, 2013 were available for analysis as a new electronic data collection form was implemented on January 1, 2013 and included many data fields not collected in previous years. WSC operators, trained on groundwater, water quality, well operation, and maintenance issues, recorded data from each wellcare® call including caller demographic information, nature of the call, and information about the well water system on a standardized form. Specifically, WSC-collected variables available for analysis were: type of caller (i.e., well owner, business) and state of residence; well system type (i.e., private well, shared well, cistern, spring); if the caller performed well maintenance activities in the past 12 months; main use of water from the well; and primary reason for the call.

To ensure that priority contaminants, previously identified by public health departments as being important due to potential for exposure and existence of known health effects, were completely described, rather than relying solely on calls that were classified as contaminant-related, we also identified all calls that mentioned arsenic, coliforms, chemicals related to hydraulic fracturing (fracking), nitrates, or radon. We searched unstructured free-text fields (e.g., caller profile details, questions asked, reason for testing, contaminant of interest, and actions taken) for these key words using the following terms: “arsenic”, “coli”, “bac”, “frack”“hydraulic”, “nitr”, and “radon”.

For calls categorized as primary reason for call related to contaminants, contaminants were classified in analysis as metals (aluminum, barium, copper, iron, lead, manganese, and mercury), arsenic, coliforms, nitrates/nitrites, radon, or other. For calls categorized as primary reason for call related to testing of wells, we describe reasons for testing. By

reviewing free-text fields (e.g., questions asked and actions taken), we further classified testing-related calls as either “how to test well water”, “how to interpret testing results”, “other”, or “not able to classify” for analysis. The classification “how to test well water” included the following categories: questions related to where to submit samples to test well water; what to test well water for; and how to collect samples. For calls primarily related to treatment, we described the type of treatment of interest.

### 3. Results

During 2013, wellcare® received a total of 1690 calls, including 1100 calls from private well owners residing in all states except Hawaii and Utah (Table 1). Descriptive characteristics of the 1100 calls made by private well owners to wellcare® are presented in Table 2. Almost all private well owners (96%) primarily used their well water for drinking and household use. Only 38% of private well owners reported conducting any well maintenance activities, such as inspecting, cleaning, repairing the well, or testing well water, during the previous 12 months.

Free-text fields for all calls were searched for key terms: arsenic, coliforms, fracking, nitrates, and radon (Table 3). Nine calls containing “back” were incorrectly identified as related to coliforms and were excluded from analysis. Of the 1100 calls from private well owners, 273 calls (24.8%) mentioned at least one key term. Radon was cited most frequently (n = 87, 8%), followed by coliforms (n = 83, 8%), fracking (n = 51, 5%), arsenic (n = 34, 3%), and nitrates (n = 32, 3%). A list of top 3 states of residence of private well owner callers to wellcare® mentioning these key terms is presented in Table 4. Among the 273 calls mentioning at least one key term, the primary reason for call was classified as contaminant related for the majority (n = 137), however they were also classified as related to testing of well water (n = 87), miscellaneous calls about well systems (n = 249), and treatment of well water (n = 22).

The primary reasons for calls from private well owners are presented in Fig. 1. The majority of calls were classified as relating to well water testing (n = 403, 37%), well systems (n = 249, 23%), and contaminants (n = 229, 21%). For primary call reason classified as related to well water testing (n = 403), the majority, 319, were about how to test; 33 were about interpretation of well test results (Fig. 1). A specific reason for testing was given for only 191 of the calls classified as relating to testing of well water. The reasons included questions about annual testing (n = 74), the owners noticed a change in water quality (n = 34), someone in the household was ill (n = 32), concerns related to fracking (n = 25), someone recommended testing (n = 17), a previous well water abnormality (n = 7), and hearing media reports about well water testing (n = 2). For calls classified as contaminant related for the primary call reason (n = 229), the most common contaminants of concern were coliforms (n = 42), radon (n = 31), arsenic (n = 22), other metals (n = 24), and nitrates (n = 14) (Fig. 1). For calls classified as primary call reason related to treatment of well water (n = 97), the most frequent types of treatment mentioned were filtration (n = 35) and shock chlorination (n = 22) (Fig. 1).

## 4. Discussion

We analyzed calls to wellcare®, a national hotline that received calls from private well owners in almost every U.S. state during 2013, to identify well owners' key concerns. We learned that private well owners who called wellcare® were generally not testing or maintaining their wells, had questions about well water testing (i.e., where to test well water, what to test well water for, how to collect samples for testing, and how to interpret test results) and concerns about well water contaminants.

Only 38% of private well owners who called wellcare® conducted well maintenance activities during the past 12 months, demonstrating a gap in appropriate well stewardship practice in this population. The National Ground Water Association recommends well owners test their water at least annually for coliforms, nitrates and local contaminants of concern (National Groundwater Association website). Similar to our findings, other recent studies have also demonstrated a gap in knowledge among well owners about well maintenance and water testing (Jones et al., 2005; Jones et al., 2006; Liukkonen et al., 2009; Murti et al., n.d.). In a study of focus groups (15 participants across three focus groups) and surveys of 246 residents conducted in Ontario, Canada, the majority of participants reported confidence in knowing that their well water was safe although testing was infrequent (Jones et al., 2005; Jones et al., 2006). The Extension Great Lakes Regional Water Program found that 67% of private well owners in Minnesota, Wisconsin, and Michigan believed their untreated well water was either safe or very safe, one-half were unworried about possible health risks associated with private wells, and one-half reported not testing their well because they had been drinking it for years with no ill effects (Liukkonen et al., 2009). These findings were also corroborated by focus groups conducted by the Centers for Disease Control and Prevention among well owners in drought-impacted communities in Arkansas, Indiana, and Oklahoma in 2013 (Murti et al., 2015). Within those groups, only one-half of the participants had ever tested their water and few reported doing routine water testing (Murti et al., 2015). Additional work is needed to determine if, among well owners who called wellcare®, low well maintenance activities represent a lack of knowledge on the part of well owners, a lack of motivation to act on available recommendations, or a lack of belief that routine water testing is important.

Almost 80% of calls about well water testing, representing almost 30% of all calls to wellcare®, were concerns about how to test their water. A study by the University of Maine and the Maine Center for Disease Control and Prevention to assess the impact of media on private well owners testing behavior showed no overall link between media reports and testing data from 2005 to 2009; however, a positive relationship was observed between newspaper articles that prescribed or recommended well water testing and weekly testing counts (Bell et al., 2013). Due to limitations in wellcare® data, we were not able to determine which callers understood well water testing was important but had questions on how to do it, what to test for, or how to interpret results versus those who did not understand the importance of testing. Though we do not know if the information provided to private well owners from wellcare® increases knowledge or changes behavior, the hotline provides information and may prove to be a feasible way to educate well owners on proper well stewardship actions. About 21% of calls by well owners to wellcare® were primarily related

to contaminants with coliforms and radon being the most frequent. The U.S. Geologic Survey's website shows maps of samples with elevated compounds by State (DeSimone et al.). When reviewing free text from all well owner calls for specific contaminants of interest, states with the highest numbers of callers for each contaminant were also states which according to USGS had the contaminant of interest at a level above human health benchmarks. Most well owners called with questions related to well testing and contaminants; these findings may help programs target educational materials for well owners in the future, especially in areas with little information about knowledge, attitudes, and practices among well owners or in areas with high levels of specific contaminants.

Limitations to this study include factors related to the population, data collection, and inability to measure impact. This dataset captured a small proportion of private well owners who know of wellcare® and are motivated to call. This population may be more inclined to test or treat their well water compared with the general well owner population. We analyzed data for a single year (2013) because the data collected had recently been enhanced; these data were useful because national data on this topic are limited. Since the data were not collected for analysis but for tracking services provided by WSC, we were unable to evaluate all facets of stewardship among well owners. Finally, because no follow-up was available on the actions taken by well owners based on the information they received from wellcare®, we were unable to measure impact of the hotline on well water testing or treatment.

Further studies assessing knowledge, attitudes, and practices of private wells owners with regard to proper maintenance, testing, and treatment of their wells and well water could provide additional data to inform educational and other outreach strategies to improve private well stewardship. Collected data could include well owners' self-reported knowledge of recommended stewardship practices and local testing recommendations, where they go to seek this information, perceptions of the importance of testing, information on recent testing and testing frequency, and knowledge of actions to take if a test result indicates a problem. Finally, follow-up phone calls with well owner callers may be useful to assess the impact of the information provided by hotlines (i.e., how many tested or treated their well water based on information received from the call).

## 5. Conclusions

A small percentage of all U.S. private well owners (1100 of the 44 million people who use private wells for their drinking water) called wellcare® for information during 2013. Analysis of calls from private well owners who called the wellcare® Hotline identified key information gaps in well stewardship, including how to test well water and how to interpret test results. Despite widely available information describing good well stewardship, callers indicated they tend not to test their well water, a finding consistent with prior studies.

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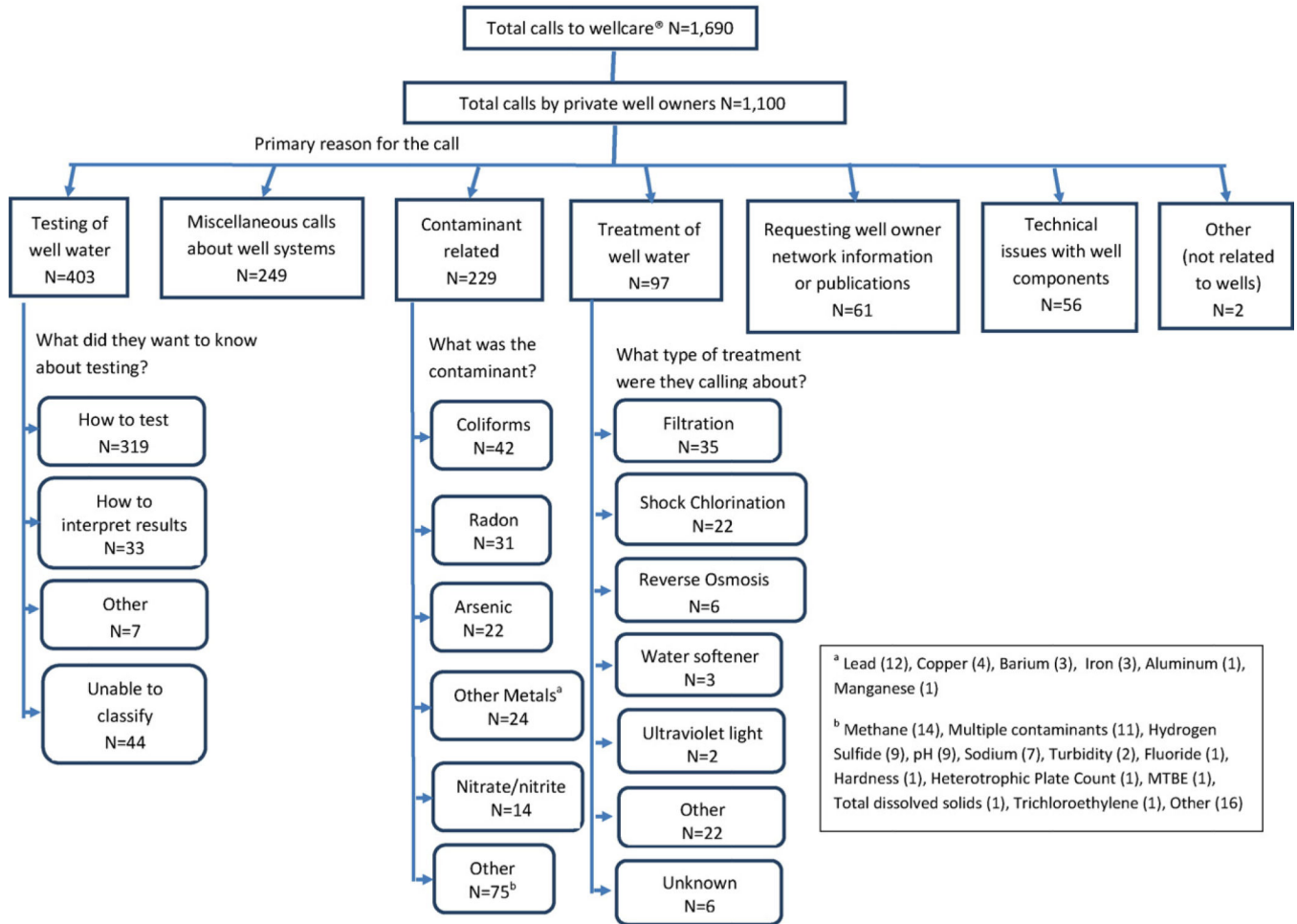
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**HIGHLIGHTS**

- The wellcare® Hotline is a national source of well-owner data in the U.S.
- Private well owners have information gaps in well stewardship practices.
- Information gaps include how to test well water and how to interpret results.





**Fig. 1.** Flow diagram of primary reason for calls to wellcare® hotline from private well owners during 2013.

**Table 1**

State of residence among private well owners who called wellcare® hotline during 2013 (n= 1100).

State of residence	Number of calls	Domestic self-supplied population (in thousands) (Maupin et al., 2014)	% of calls/domestic self-supplied pop (in thousands)
Arizona	24	218	11.01
Colorado	30	312	9.62
Oregon	39	607	6.43
Massachusetts	33	534	6.18
Florida	93	1910	4.87
Kansas	7	151	4.64
Rhode Island	5	113	4.42
Maryland	45	1070	4.21
Arkansas	6	144	4.17
North Dakota	2	49	4.05
South Dakota	3	76	3.97
Texas	94	2440	3.85
Pennsylvania	123	3350	3.67
New York	75	2050	3.66
New Hampshire	16	446	3.59
Illinois	41	1160	3.53
Connecticut	30	871	3.44
New Jersey	32	964	3.32
New Mexico	10	303	3.30
Virginia	50	1650	3.03
Ohio	46	1830	2.51
Nevada	4	158	2.53
West Virginia	9	393	2.29
Delaware	4	185	2.16
Tennessee	11	538	2.04
Minnesota	21	1130	1.86
Missouri	16	883	1.81
Louisiana	9	588	1.53
Iowa	8	591	1.35
California	36	2480	1.45
Indiana	22	1660	1.33
Oklahoma	4	316	1.27
Maine	7	561	1.25
Georgia	17	1530	1.11
Vermont	2	182	1.10
North Carolina	35	3300	1.06
Michigan	26	2680	0.97
Alabama	5	539	0.93

State of residence	Number of calls	Domestic self-supplied population (in thousands) (Maupin et al., 2014)	% of calls/domestic self-supplied pop (in thousands)
Washington	9	1000	0.90
Wyoming	1	114	0.88
South Carolina	10	1150	0.87
Nebraska	3	346	0.87
Alaska	2	260	0.77
Idaho	3	432	0.69
Wisconsin	9	1640	0.55
Kentucky	3	664	0.45
Montana	1	285	0.35
Mississippi	1	446	0.22
District of Columbia	0	0	0.00
Hawaii	0	56	0.00
Utah	0	51	0.00

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**Table 2**

Descriptive characteristics of calls made to wellcare® hotline by private well owners during 2013 (n= 1100).

Descriptive characteristics	Number of calls	% of total calls
Main use of water from well		
Drinking and household use	1055	96.1
Household use only (bathing, laundry, cleaning)	14	1.3
Irrigation only	12	1.1
Animal use only	2	0.2
Drinking water only	0	0.0
Other	15	1.4
Caller conducted any well maintenance activities during the past 12 months?		
Yes	414	37.7
No	216	19.7
Unknown <sup>a</sup>	468	42.6

<sup>a</sup>Includes when the caller did not know if well maintenance activities were conducted, as well as if this question was not answered.

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**Table 3**

Calls by private well owners to wellcare® (n= 1100) containing key words of interest.

Key word	Number of calls	% of total calls
Radon	87	7.9
Coliforms	83	7.6
Fracking	51	4.6
Arsenic	34	3.1
Nitrates	32	2.9
Total number of calls containing at least one key word <sup>a</sup>	273	24.8

<sup>a</sup>Each call may include mention of more than one key word.

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Top 3 states of residences of private well owner callers to wellcare@ hotline mentioning a key word; radon, coliform, fracking, arsenic, and nitrate (n= 273).

**Table 4**

<b>Radon (N = 87)</b>		<b>Coliforms (N = 83)</b>		<b>Fracking (N = 51)</b>		<b>Arsenic (N = 34)</b>		<b>Nitrate (N = 32)</b>	
Caller state of residence	# of calls	Caller state of residence	# of calls	Caller state of residence	# of calls	Caller state of residence	# of calls	Caller state of residence	# of calls
Pennsylvania	14	Texas	12	Pennsylvania	24	Arizona	11	Minnesota	7
Connecticut	8	Colorado	9	Ohio	12	Indiana	3	Illinois	3
Massachusetts	7	Oregon	7	Texas	8	Idaho	2	Oregon	3