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TITLE Utility Approaches to Evaluating the Effectiveness of Consumer Confidence Reports

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ABSTRACT The Safe Drinking Water Act Amendments of 1996 require community water systems in the United States to send consumers Consumer Confidence Reports (CCRs). CCRs contain information on detected contaminants and required educational information about drinking water. The authors of this study developed a survey to evaluate how utilities track consumer feedback, understanding, and the role of the CCR in shaping consumer perceptions about water quality. Responses from this survey indicate it is common for utilities to indirectly track the effectiveness of their CCRs, but few utilities indicated directly evaluating consumer understanding or the effect of CCRs on consumer perceptions.

KEYWORDS consumer confidence report, communication, water quality report

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1.1 BACKGROUND

A consumer confidence report (CCR) is required to be prepared annually by most community water systems (CWS) under the 1996 amendments to the Safe Drinking Water Act (PL 104-82). The purpose of the report, which is often referred to as a water quality report, is to provide information to consumers and enable them to make health-based decisions regarding drinking water consumption. The CCR serves as a public right-to-know provision of the SDWA (USEPA, 1998).

Under the CCR rule, CWSs with at least 15 service connections or serving more than 25 consumers year-round must provide an annual report for customers that includes information on the quality and safety of their drinking water. Unless the CWS has a waiver, CWSs must directly deliver the report to customers. The report must include:

1. water system information
2. information on the source of water
3. required definitions
4. a table summarizing detected contaminants
5. information on monitoring for *Cryptosporidium*, radon, and other contaminants
6. compliance with other drinking water regulations
7. variance and exemptions if applicable and
8. required educational information.

Required educational information includes statements about contaminants in all drinking water, information to vulnerable populations about *Cryptosporidium*, and statements on nitrate, arsenic, and lead if applicable (USEPA, 1998). CWSs are required to distribute the CCR to consumers and a copy to their primacy agency by July 1 of each year and within three months

after the report is due provide certification to their primacy agency that the report has been sent to consumers and contains correct information (USEPA, 1998).

1.2 CCR Effectiveness

Before the development and first distribution of the final CCR rule, researchers began to evaluate the effectiveness of components that would go into CCRs, including whether the pilot versions of the report affected consumers' confidence in the safety of their drinking water. Trax and Snyder (1998) conducted a questionnaire that evaluated consumers' overall understanding of a pilot CCR and found that 62-86% of customers remembered receiving the CCR. Those who recalled receiving the CCR, however, did not recall most important information, as determined by the CCR rule guidelines, such as contact information, source of the water, water quality contaminant levels, and the meanings of key terms, such as maximum contaminant level (MCL) and maximum contaminant level goal (MCLG). Importantly, the authors considered important information to be information that is required by the CCR rule, and the CCR rule does not require summary statements on whether water quality meets standards or other condensed information consumers may find more helpful. Trax and Snyder (1998) concluded it was possible there was an overload of information in the CCR.

In another evaluation of the report's effectiveness, one water utility in Connecticut voluntarily created and delivered a pilot CCR in 1997 and conducted pre- and post-report surveys on consumer response, finding that consumer confidence in water quality increased 2.4% (Odugbesan, Vaughn, Oswald, & Herlihy, 1998). Roper Starch (1999) conducted a nationwide survey to determine what information consumers already knew and what they wanted to know about drinking water. The study found that Americans wanted more information about the quality of their drinking water than they already had, and that 75% of the survey respondents

indicated that they "sometimes" or "always" read information regarding drinking water (Roper Starch, 1999). During the development of their first CCR, District of Columbia Water and Sewer Authority (now DC Water) conducted focus groups to evaluate and improve the report (Spiesman, Bhat, Lawson, & Rizzo, 2002). They found that the best practices for their CCR would be to include simple, large graphics and summary statements in larger font for those consumers who did not want detailed information (Spiesman et al., 2002).

Researchers continued to evaluate the effectiveness of the consumer confidence reports in the initial years after the rule. After the fourth year of utilities sending the CCR, Benson, Walker, and Montecinos (2002) conducted surveys with 89 CWSs in Nevada that evaluated consumer response, costs versus benefits of the CCR, and effectiveness of the CCR in informing consumers about water quality. The study found that there was a slight increase in consumer inquiries after distribution of the CCR. 39% of utility respondents indicated they believed the benefits to consumers of the CCR outweighed the costs at that time. When asked whether they believed benefits to consumers would continue to outweigh costs in the future, 51% of respondents indicated that they believed so. Lastly, 61% of utility respondents indicated that they felt the CCR was an effective tool to inform consumers about the source and quality of their drinking water (Benson et al., 2002). Johnson (2003) aimed to evaluate the effects of format and presentation of contaminant information on consumers' perceptions about their water quality. The study found that whether CCRs included qualitative descriptions of contaminant levels, numerical contaminant levels in a table, or a bold statement indicating a violation had occurred did not change overall consumer opinion on water quality and utility performance (Johnson, 2003). The author did find that qualitative reports performed the worst at communicating

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violation information and that consumers who viewed reports with bolded violation statements were more likely to indicate a violation had occurred (Johnson, 2003).

1.3.1 Challenges of the CCR: Readership and Recall

Researchers have studied the readership of the CCR. In 2002, the EPA conducted a survey of 1,000 households that included questions on the CCR. The survey found that only 29% of respondents indicated they had read their CCR and an additional 8% recalled receiving the CCR (USEPA, 2003). The survey found that 71% of respondents were either "confident" or "very confident" about the quality and safety of their tap water and over 90% indicated they would like more information about possible contaminants in their water (USEPA, 2003). Lazo et al. (2004) evaluated how CCRs influenced consumer perceptions and found that only 40% of consumer respondents remembered receiving a water quality report. Of those who remembered receiving a CCR, over 40% felt more confident in their water quality. The authors then estimated that 35% of all customer households read the CCR (Lazo et al., 2004).

In a more recent evaluation of CCR effectiveness, the Las Vegas Valley Water District evaluated the effects of primer mailing formats on customers' recall of the CCR. In this study, primer mailing pieces were letters or postcards sent to customers indicating the Consumer Confidence Report would be delivered in the near future. The authors found recall of the CCR was higher among individuals who remembered receiving any primer over individuals who did not remember receiving a primer at all. The study also found any recall of the CCR improved consumers' ratings on drinking water safety (Davis, 2007), indicating that recall of any primer piece shaped consumers' perception of drinking water. Similarly, Carpenter and Roberson (2013) conducted a series of utility and consumer surveys assessing recall and opinions on various portions of the CCR. In one of their surveys, the authors assessed consumer knowledge

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about CCRs, and 49.5% of respondents recalled receiving one either in the past year or sometime in the last three years. Of those who recalled receiving a CCR, between 65%-93% somewhat or strongly agreed that the report contained important information and increased their confidence in their water supply (Carpenter & Roberson, 2013).

1.3.2 Challenges of the CCR: Complex, Technical Language and Mandated Information

Community water systems are required to include definitions and other information with language that is suggested or mandated by the EPA or state's primacy agency (USEPA, 1998). The nature of this language required in the CCR began as and has continued to be a source of concern for many CWSs (Berberich, 1997). Johnson (2001) evaluated public reaction to language required by the CCR rule; the study found the majority of respondents understood the mandated language but expressed concern about water quality after reading it (Johnson, 2001). Rudd, Kaphingst, Colton, Gregoire, and Hyde (2010) aimed to rewrite a utility's CCR in plain language. The authors assessed, restructured, and rewrote a utility's CCR, focusing on simple vocabulary and sentence structure and length. The utility in charge of sending the CCR adopted some of the researchers' changes but were limited by the increase in report length, associated costs, and mandated language that could not be changed (Rudd et al., 2010).

Researchers have continued to evaluate the effects of the required language on consumers' confidence in water quality and how CWSs can improve their communication. Phetxumphou et al. (2016) evaluated the understandability of a sample of CCRs and found that many of the CCRs failed to effectively communicate drinking water information. The authors trained individuals to rate a sample of CCRs using the Centers for Disease Control and Prevention's Clear Communication Index (CCI) indices and found that none of the CCRs had passing CCI Index scores (CDC, 2015). Using the CCI Index score as a measurement of

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effective public health communication, the authors of the study concluded that CWSs were not effectively communicating water quality information to their customers (Phetxumphou et al., 2016).

In another study, the same group of researchers evaluated the readability of a nationally representative sample of CCRs using Flesch-Kincaid readability tests (Roy at al., 2015). Flesh-Kincaid readability tests use measures of word and sentence length to assess how difficult a passage is to understand; the tests develop a relative score and reading level associated with U.S. grade-level. Flesh-Kincaid tests are common in education, publishing, healthcare, and industry for written forms of communication (Kincaid et al., 1975). The authors found that the CCRs were written at the 11th to 14th grade level, while the National Institute of Health recommends public health communications be written at a sixth or seventh grade level (Roy et al., 2015). The authors suggested utilities consider adjusting the Flesch-Kincaid reading level of their CCR to increase its effectiveness (Phetxumphou et al., 2017).

1.4.1 Recent Analysis and Anticipated Changes to the CCR

The regulatory driver and structure underlying the CCR has been largely unchanged since the CCR rule was finalized in 1998. However, there have been a number of efforts focused on analyzing the use of the CCR from both a regulatory and communications perspective.

1.4.2 Retrospective Review of the CCR

In 2011, U.S. EPA announced that a retrospective review of the CCR rule would be conducted as part of the Obama Administration's Executive Order 13563 (76 FR 3821, 2011). One EPA official described the review as an opportunity to increase consumer awareness of water quality through consideration of new CCR methods (Eisenberg, 2011). In 2012, the EPA released a summary of the retrospective review, which included topics on CCR understandability

and consideration of electronic delivery of the CCR (USEPA, 2012). Public feedback on CCR understandability included views that information in the CCR could be confusing, misleading, and alarming, especially the detected contaminants tables and health effects language. The stakeholders involved in the understandability portion of the retrospective review suggested that the EPA update and strengthen guidance and templates (USEPA, 2012).

1.4.3 Electronic Delivery of the CCR

As part of the retrospective review, EPA considered the potential merits and drawbacks of electronic delivery of the CCR. Stakeholders believed that printing and mailing the CCR was unnecessarily expensive, technological and regulatory concerns could inhibit electronic delivery, and overcoming those concerns to allow for electronic delivery would provide multiple benefits to consumers (USEPA, 2012). After the retrospective review, U.S. EPA released a memorandum (USEPA, 2013b) detailing five electronic delivery options that would fulfill the CCR rule's requirement for reports to be "mailed or otherwise directly delivered" (USEPA, 1998). The electronic delivery methods include a CCR embedded in an email message, a CCR sent as an attachment to an email, URL linked directly to the CCR sent via email, a URL linked directly to the CCR mailed to customers (e.g. via a water bill's text, a separate mailing, etc.), or any additional electronic delivery method that met the definition of direct delivery (USEPA, 2013b). As part of an evaluation of possible benefits of electronic delivery, Carpenter and Roberson (2013) conducted two surveys with CWSs and one public survey and found that electronic delivery of the CCR could result in nearly $20 million in cost savings annually to utilities.

1.5 Anticipated Changes from America's Water Infrastructure Act of 2018 (AWIA)

America's Water Infrastructure Act of 2018 (S. 3021, Public Law 115-270) was signed into law on October 23, 2018. This law makes many changes across various portions of the Safe

Drinking Water Act. Section 2008 makes changes to the Consumer Confidence Report, which EPA will need to develop regulations for by October 2020. These changes include:

- Utilities with greater than 10,000 population served will need to provide CCRs at least twice per year
- The option for electronic delivery is now codified in the law, rather than an interpretation of previous law
- Increasing the "readability, clarity, and understandability" and "accuracy" of the information within the CCR
- Including information about corrosion control efforts as part of the required elements of the CCR.

Given these changes, additional information about the current use of CCRs and methods to utilize it as a communications tool will be increasingly important for policymakers and utilities to consider.

1.6 CCR as a Communications Tool Beyond Required Information

A roundtable of utility officials gathered by the American Water Works Association met in 1997 when the CCR rule was still in development to discuss challenges and benefits of the upcoming rule. In addition to concerns about the health effects language, participants noted that the CCR could be utilized as an annual report on water quality, including as an opportunity to make consumers more comfortable with their water source (Berberich, 1997). Many authors have since conducted studies with suggestions on how to increase the effectiveness or type of information included in CCRs (Meyer-Emerick, 2004; Phetxumphou et al., 2017; Spiesman et al., 2004). USEPA provides the CCR iWriter tool and reference sheets for utilities to consult when creating their CCR (USEPA, 2009, 2015). In these reference sheets, U.S. EPA often

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emphasizes the role of the CCR as a communications tool that can inform customers of other issues related to their drinking water, such as source water protection or water conservation methods (USEPA, 2009).

There is an opportunity to utilize the CCR as an instrument to engage with customers, provide meaningful information, and develop a process of continuous improvement based on feedback. Despite the CCR's potential, few researchers have comprehensively examined how utilities track the CCR's effectiveness and how utilities use the CCR for purposes beyond the regulatory requirements. This study, therefore, explores how utilities track the CCR's effectiveness and how it is utilized as a communications tool. The results of this survey may provide a baseline assessment of utilities' use of the CCR as well as research and policy options for future consideration.

2.1 Survey Methods

In light of concerns among U.S. consumers about the quality of drinking water (AP-GfK, 2016; Chapman University, 2017; DiJulio, Firth, Kirzinger, & Brodie, 2016; Firth, Kirzinger, & Brodie, 2016; McCarthy, 2016, 2017) and continuing issues with the effectiveness of CCRs (Phetxumphou et al., 2016; Roy et al., 2015), community water systems face challenges in increasing consumers' confidence in their drinking water. Although the CCR is one report most CWSs must use to communicate about the quality of their drinking water, concerns about effectiveness of the CCR remain. This survey was developed to understand how U.S. utilities track consumer feedback, understanding, and the role of their CCR in shaping consumer perceptions about water quality. The survey also aimed to identify consistent trends in consumer feedback or common areas of consumer misunderstanding and evaluate what methods utilities are using to increase the effectiveness of their CCR.

The survey was conducted from June 25, 2018 through July 23, 2018. It was distributed to American Water Works Association's approximately 4,000 member utilities. A reminder message was sent out approximately one week before the survey closed. The following categories of questions were included in the survey:

- Information about the utility, including utility name, state, and population served. Some of this information has been anonymized as the survey was conducted with the agreement that individual responses would not be identified. Utilities were not asked to identify whether they were publicly or privately operated.
- Information about how the utility tracks engagement and understanding of the CCR
- Information about how the utility tracks consumer confidence in water quality and the effect of the CCR on consumer confidence in water quality
- Information about how the utility assesses what information consumers would like in the CCR and ways the utility makes changes to increase engagement.
- Methods the utility uses to conduct outreach regarding the CCR, including information on the utility's website
- Whether the utility has used or is planning to use electronic delivery. For those utilities that have, whether they've changed or added information that could not be included before due to space, weight, or other limitations, and whether any testing on the impact of electronic delivery has been completed
- Information about feedback received from customers about the CCR
- Information about any specific challenges in CCR required language
- Any supplemental information included in the CCR to increase engagement

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- Whether the utility updates water quality information more than once per year through mail or electronic delivery
- Challenges the utility would face with a requirement to send more than one CCR per year

There are both strengths and limitations to the sampling method utilized. The use of AWWA's members allows for wide distribution of the survey and reaches many large water utilities. This wide reach can be seen in that the respondents collectively serve a population of over 48.2 million people. With approximately 86% of the U.S. population of 327 million served by public water systems (281 million), this sample contains the information of approximately 15% of the U.S. population served by community water systems. Since the main intent of this study is to understand the breadth and depth of techniques used to engage customers with the CCRs, this method accomplished reaching a large portion of the total possible study population. However, as the sample pool contains very few small and very small (<3,300 and <500 population served) utilities, it does not necessarily represent the practices undertaken by those utilities, which account for most of the nation's water utilities but a relatively small percentage of the people served by public water supplies. To better understand CCR practices at these smaller systems, future work could seek to specifically target systems of those types. The survey asked only for information about institutional practices and did not ask for the opinions of or information about individuals. The survey is therefore not considered human subjects research. To maximize response rates, utilities were not asked to provide examples or data in response to survey questions, such as questions about supplemental information included in the CCR or regarding how utilities track consumer engagement of the CCR.

3.1 Survey Results and Discussion

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The survey was sent to AWWA's approximately 4,000 utility members in U.S. states and territories. The survey consisted of a total of 20 questions. Three questions were open-ended, and 17 questions were multiple choice. 240 respondents completed the online survey. To maximize the number of responses, survey respondents were able to skip questions. As a result, each question in the survey did not receive an equal number of responses. Survey results were obtained from utilities in 43 U.S. states, excluding Alaska, Idaho, Mississippi, Montana, Nebraska, Rhode Island, and Vermont. There were no responses from the District of Columbia. There were responses from Guam and Puerto Rico. Because the CCR is a regulatory construct unique to the United States, responses were not solicited from other countries. To minimize the number of questions asked in the survey, utilities were not asked to identify whether they were privately or publicly owned. As a result, the results from this survey reveal no information about variation in CCR methods and community water system ownership.

Table 1 shows the distribution of responses to this survey by utility size. Utility sizes were based on those designated in the final CCR Rule (USEPA, 1998). Notably, the distribution of utility sizes represented in the survey differs from the distribution of utility sizes in the United States (Table 2). When viewed by number of utilities, community water systems in the United States are overwhelmingly very small (<500 population served) or small (501 - 3,300 population served). As such, because the distribution of CCRs is directly tied to population served, the vast majority of CCRs are provided by very large (>100,000 population served) and large (10,001 to 100,000 population served). For this reason, we recognize the applicability of these results to very-small and small systems is limited, but with the respondents reporting that they collectively serve a population of over 48,200,000 people, the respondents represent a considerable portion of the U.S. population served by community water systems. The results from this survey therefore

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remain valuable despite these limitations. The respondents of this survey represent a higher proportion of large (utilities serving between 10,000 and 100,000 people) and very large (utilities serving more than 100,000 people) utilities than are represented in the United States. The authors of this study recognize the results of this survey are therefore not representative of CCR methods used by all US utilities. This difference in utility size distribution of this survey and distribution of utility sizes does not interfere with the goals of the survey given that large and very large utilities provide water for 82% of the US population served by public water systems (USEPA, 2013a).

3.2 Tracking CCR Effectiveness: How Utilities Track and Increase Consumer Engagement, Understanding, and Perceptions of the CCR

For the purposes of this study, CCR effectiveness includes whether a CCR drives consumer engagement, is understandable to consumers, and/or affects consumers' confidence in their water. Survey respondents were asked to describe what methods their utility uses to track consumer engagement and understanding of the CCR. Table 3 shows utilities' responses. In total, 45% of utility respondents indicated they use at least one method of tracking consumer engagement or understanding of the CCR, and 22% of utility respondents indicated they use two or more methods. Of those utilities that indicated they use an "other" method, 10 indicated that they track consumer engagement with the CCR using website analytics. Under mail delivery of the CCR, utilities would need to perform surveys or other methods to estimate the readership of their CCR. With electronic delivery, utilities that are able to track the number of times the report has been accessed are able to more quickly estimate CCR readership.

Utilities were asked what methods they use to evaluate consumer perceptions about their water quality. Less than two percent of respondents (4/238) indicated they evaluate the effect of

the CCR on shaping consumer confidence in water quality. 13% (30/238) of respondents indicated they conduct consumer surveys evaluating consumer confidence in their water quality generally, and 11% (25/238) of respondents indicated they conduct consumer surveys evaluating specific consumer concerns about water quality. 15% (34/238) of respondents selected "other" as a method of evaluating consumer confidence in water quality. 68% of respondents indicated they do not track consumer perceptions about water quality. In turn, roughly one third of utilities in this survey conducted at least one method of tracking consumer perceptions about their water quality. These findings indicate that very few respondents are evaluating whether their CCR has a direct effect on consumers' confidence in water quality.

Meyer-Emerick (2004) noted CCRs may not address consumer concerns if the utilities are not aware of what information consumers want to know. The survey, therefore, asked what methods utilities use to evaluate information consumers would like in their CCRs. Less than 2% (4/238) indicated they conduct surveys or polls that directly ask consumers what information they would like in their report. 51% (121/238) of respondents indicated they address past questions or concerns from consumers in evaluating what information consumers would like in future CCRs. This finding means that more than half of the survey respondents have altered or considered altering their CCR based on feedback from consumers. 9% (20/238) selected "other" as a response, which included methods such as website analytics, social media, and tracking requests for paper copies. 46% (108/238) of respondents indicated they do not use any methods to understand what information consumers would like in their CCRs, pointing to an opportunity for future improvement in engaging with customers.

The format and language of the CCR have been sources of concern for both utilities (Berberich, 1997) and researchers concerned about public health communication (Phetxumphou

et al., 2016; Roy et al., 2015; Rudd et al., 2010). Section 1414(c)(4)(B) of the Safe Drinking Water Act lays out the specific requirements for the content of the CCR, including some format and language that cannot be altered (USEPA, 1998). As previously discussed, America's Water Infrastructure Act of 2018 (AWIA) changes some CCR requirements and provides US EPA and water utilities with an opportunity to reevaluate and possibly modify required language in a way that would improve readability, understandability, and usefulness of the CCR. Under the CCR rule, CWSs are able to add information that is deemed appropriate for public education, may change the format of most information, and can add information not required under the rule (USEPA, 1998). Utilities were asked what methods they use to change or test differences in CCR language or format to increase consumer engagement or understanding of the content, as shown in Table 4. Overall, 44% of respondents perform at least one method of changing or conducting testing on format or language, and 29% of respondents perform two or more methods, indicating that some utilities do use their capacity to make changes to the report where possible.

Utility representatives were asked to indicate methods their utility uses to conduct outreach of the CCR. 44% (105/238) of respondents indicated they provide an electronic or hardcopy newsletter to consumers. 34% (81/238) of respondents indicated that their utility gives announcements to local media outlets. 80% (190/238) of respondents indicated that information about the CCR is available on the utility website. 45% (107/238) of respondents indicated they advertise the CCR on social media. Only 16% (38/238) of respondents indicated that they do not conduct any outreach of the CCR. Overall, 83% of respondents perform at least one method of outreach, and 68% of respondents perform two or more methods of outreach. This finding shows a large majority of utilities perform at least one method of driving engagement and readership of their CCR. The question in this survey did not specify whether outreach efforts included

acceptable electronic delivery methods (USEPA, 2013b) or were required by utilities' primacy agency, so it is possible some utilities' responses about outreach efforts are also part of their primacy agency's requirements for meeting good faith efforts to reach non-bill paying consumers.

3.3 Utilities' Methods of Tracking and Increasing Consumer Engagement, Understanding, and Perceptions of the CCR Vary by Utility Size and Region

In total, 81% of utilities represented in this survey perform at least one method of tracking or evaluating consumer feedback, understanding, or perceptions about water quality based on the CCR. 19% (45 of 238 respondents) did not track CCR engagement or perceptions, did not evaluate what information consumers would like in their CCR, and did not test or make changes to the language or format of the CCR.

Figure 1 shows the utilities' methods of tracking and increasing consumer engagement, understanding, and perceptions by utility size. Using independent samples Kruskal-Wallis Tests with a significance level of 0.05, the distribution of all five methods varied across system size. $P<0.001$ was found for four of these categories, with $P=0.002$ for tracking of consumer perceptions. The distribution of these variables is visualized in Table 1. Because the survey yielded so few responses from CWSs serving a population of less than 500 people, results from systems of this size were not included in the analysis.

Overall, larger utilities were more likely to indicate they perform at least one method of tracking consumer engagement, understanding, or perceptions about water quality, changing CCR language or format, evaluating what consumers want in their CCR, or advertising their CCR. Utilities of medium size, those that serve between 3,301 to 10,000 customers, had the

fewest respondents that indicated they conducted at least one method of evaluating and increasing consumer engagement, understanding, and perceptions.

Figure 2 shows utilities' methods of tracking and increasing consumer engagement, understanding, and perceptions by US Census Bureau Region. Using independent samples Kruskal-Wallis Tesst with a significance level of 0.05, the distribution of three of five methods varied across regions, although with considerably less certainty than across system size. Significance values were P=0.004 for the distribution of conducting publicity, p=.013 for whether or not utilities tracked consumer perceptions, and p=0.039 for testing or changing aspects of the CCR language or format. Of the tests that were not significant, whether utilities tracked customer perceptions was p=.260 and whether utilities evaluated what information consumers wanted in CCRs has P=0.963.

3.4.1 Role of Electronic Delivery of the CCR's Effectiveness

In a 2012 survey, Carpenter and Roberson (2013) assessed potential cost savings, feasibility, and other potential benefits of electronic delivery of CCRs. Following the same outreach methods as this survey, Carpenter and Roberson (2013) distributed their survey to the approximately 4,000 American Water Works Association utility members in the United States and United States territories. Respondents to the Carpenter and Roberson (2013) survey represented 713 utilities, compared to 240 respondents of this survey. The utility respondents to the Carpenter and Roberson (2013) survey served a smaller average population size of 25.5 million people, compared to this survey's average of 48.2 million people served. Respondents were not asked to indicate whether their utility was publicly or privately owned.

Utilities were asked whether their utility had used electronic delivery for some or all of their consumer confidence reports (Table 5). Responses to this question regarding electronic

delivery were compared to Carpenter and Roberson's (2013) results. Notably, 70% of respondents indicated they have delivered their CCR electronically, compared to up to 93% of respondents that indicated they would use electronic delivery in the 2012 utility survey (Carpenter & Roberson, 2013). To evaluate other possible effects of electronic delivery of the CCR, respondents that indicated they currently or have sent the CCR electronically were asked if their utility had added information or changed aspects of the CCR that were not included in years where the CCR was delivered on paper. 57% (96/166) of respondents indicated they had not added more information and did not plan to. 13% (21/166) responded that they had not added information or changed aspects of the CCR but planned to. 32% (53/166) of respondents indicated they had added or changed aspects of the CCR since changing to electronic delivery. A summary of the information or altered aspects of the CCR is shown in Table 6. Importantly, the majority of changes included the addition of more information, indicating that electronic delivery allows for utilities to add clarifying information or information on water quality topics that may not be required to be addressed in the CCR.

Respondents were then asked if their utility had tracked or conducted testing on whether electronic delivery of the CCR had changed consumer feedback, understanding, or perceptions of water quality based on the CCR. 24% (40/166) responded that they have tracked the number of times the report has been accessed. 4% (7/166) indicated they had conducted consumer surveys, and 5% (9/166) of respondents selected "other." These findings continue a trend of indirectly evaluating changes in the effects of delivery method of the CCR. 69% (114/166) of utilities responded they have not tracked the effects of electronic delivery of the CCR on consumers' engagement, understanding, or confidence in water quality.

A literature review did not reveal published research evaluating the differences in readership or effectiveness of CCRs delivered by mail or electronically. For this reason, evaluating and comparing the effect of different mail and electronic delivery methods on CCR readership and recall is an important potential focus for future research. There may be variation in CCR readership based on acceptable methods of electronic delivery, such as a URL included in the electronic bill or URL included in the hard-copy bill. Electronic delivery introduces the potential for utilities to examine CCR readership through website analytics, such as click-through rates or page views. Utilities may not have low-cost methods of evaluating the readership of their CCR sent through mail-delivery; such evaluations could include phone or other customer surveys evaluating customer recall of receiving and reading the CCR. As such, a potential area of future research may include evaluating whether electronic or mail delivery methods affects CCR readership.

3.4.2 Cost Savings of Electronic Delivery of the CCR

In their 2012 utility survey, Carpenter and Roberson (2013) asked utilities whether they expected to use electronic delivery and the expected cost savings of implementing various forms of electronic delivery. The estimated nationwide CCR cost in Carpenter and Roberson (2013) was $28,174,000 in 2012 dollars. Based on the information in Table 5 and values from Carpenter and Roberson (2013), a new upper bound estimate of current cost savings by utilities can be produced through the following calculation: Total pre-electronic delivery CCR costs X average percentage of estimated cost savings for “Bill providing URL” methodology X the percentage of utilities currently using electronic delivery = the upper bound of current electronic delivery annual cost savings.

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Because Carpenter and Roberson (2013) were reporting in 2012 dollars, for comparability, all of the values shown in Tables 7 and 8 are shown in both 2012 dollars and 2018 dollars (adjusting using the Bureau of Labor Statistics Calculator from January 2012 to January 2018). Table 7 shows this upper bound cost savings based on the utilities *currently* using electronic delivery of the CCR.

The same equation can be repeated with "percentage of utilities currently using electronic delivery" replaced with "percentage of utilities currently using electronic delivery plus percentage of utilities that have not used electronic delivery but plan to." The result is the upper bound potential savings, which assumes all utilities who reported they may use electronic delivery implement it in the future. These values are shown in Table 8.

The upper-bound cost estimates use the pre-electronic delivery costs to utilities and percentages of cost savings resulting from the most-cost efficient electronic delivery method evaluated in Carpenter and Roberson (2013). The upper-bound cost estimates assume that all utilities conducting electronic delivery use the bill providing URL delivery method because it is likely the most cost effective delivery method. A bill providing URL delivery method likely adds the least or no additional cost to a utility since a URL adds little additional text to a bill delivered through mail or electronically delivered bill. Other delivery methods, such as a mailed postcard with the CCR URL, may introduce more costs to a utility given printing and mailing costs. This upper bound savings estimate therefore does not take into consideration variation in utilities' electronic CCR delivery methods.,

Carpenter and Roberson's (2013) upper-bound savings estimate for electronic delivery of the CCR was $19,549,000 (2012 dollars) or $21,377,000 (2018 dollars). Compared to Carpenter and Roberson (2013), the current savings estimate based on information gathered in this survey

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is about 24% lower when considering only utilities already using electronic delivery (Table 7) or 12.5% lower when including utilities that may implement in the future (Table 8). The lower upper bound savings estimate can be attributed to the lower percentage of utilities that have implemented or are expecting to implement electronic delivery than was estimated in Carpenter and Roberson (2013).

4.1 Trends in Consumer Feedback of the CCR

Utilities were asked what common consumer misunderstandings they encountered after sending the CCR. Overall, 38% (87/230) indicated that they do not hear misunderstandings from consumers, which means slightly less than half of utilities encountered no misunderstandings. 39% (90/230) indicated consumers experience difficulty interpreting whether levels of detected contaminants are a concern, which was a pattern Johnson (2003) found. 21% (48/230) of respondents indicated consumers had difficulty interpreting whether information in required statements is applicable to them, and 32% (73/230) indicated that they encounter consumers not understanding that tested contaminants not listed in the report are not detected, which was not a pattern noted in the development of the CCR.

Table 9 shows a summary of utilities' responses to CCR requirements that make it more difficult for them to communicate to consumers. Some of those requirements were the same as those noted in prior literature, such as required definitions (Trax & Snyder, 1998) and detected contaminants' health effects (Berberich, 1998). No single requirement was selected as causing difficultly communicating by slightly more than one-quarter of respondents. In total, 53% of respondents felt there was at least one aspect of the CCR requirements that made it more difficult for them to communicate, and 36% indicated they felt there were two or more aspects.

Utilities were asked to describe the feedback they received from consumers regarding the CCR. 38% of respondents indicated they receive positive feedback from consumers. The highest recorded response was a request for a copy of the CCR (58%, 131/227), indicating some consumers may have lost their report, never received one, or wanted a hard copy. The next highest recorded response was questions or concerns about water quality after reading the report (56% or 126/227), in line with consumer concerns after reading the report that Johnson (2001) had shown. 38% (87/227) of utilities indicated consumers have questions or concerns about a water quality issue not included in the report, indicating that the CCR may not be answering all of consumers' concerns or questions about water quality. 21% (48/227) indicated consumers found at least some of the report content too technical. 13% (29/227) of utilities indicated they hear "other" feedback. Only 13% (29/227) of utilities indicated they did not receive any feedback on the CCR. Utilities may not receive feedback on the CCR from consumers for a multitude of reasons, including that consumers may not be reading the CCR, contact information for the utility may not be easily accessible, or that consumers were satisfied with the information in the CCR. The results from this survey question cannot reveal why utilities did not receive feedback.

To understand what information utilities are sharing with consumers beyond information required by the CCR Rule, utilities were asked what additional (i.e. not required) information they include in the report. Table 10 lists their responses. A large majority of respondents (83%) indicated they include at least one additional source of information, and 75% reported including two or more additional sources of information, indicating the majority of respondents to this survey are modifying and including information for consumers beyond CCR requirements. Notably, 64% (147/230) of respondents indicated they include a summary statement about the

quality of drinking water, which is consistent with Phetxumphou et al.'s (2016) finding that 63% of CCRs evaluated in that study explicitly stated whether the water was safe to drink according to state and federal standards.

4.2 Utility Concerns with A Potential Requirement to Send More Than One CCR Annually

At the time this study was being designed, A U.S. House of Representatives bill (H.R. 3387), the Drinking Water System Improvement Act of 2017, had been introduced containing provisions for improving and affecting water infrastructure, including one provision that would require two consumer confidence reports to be released annually (H.R. 3387, 2017). To understand what challenges this would present to utilities, utilities were asked how frequently they update water quality and what concerns they would have if there were a requirement to send more than one CCR annually. H.R. 3387 itself did not move forward in Congress, but many of its provisions were ultimately incorporated into America's Water Infrastructure Act, as described in Section 1.5, after the data collection for this study was complete.

78% (179/230) of respondents indicated they send only the CCR once annually as required. 14% (33/230) of utilities indicated they update water quality information more than once a year through mail, electronic delivery, or a combination of delivery methods. 8% (18/230) indicated they are considering updating information more than once annually. In total, less than a quarter of the respondents indicated they send information more than once per year or are considering doing so. This question was asked prior to the introduction or passage of AWIA and its requirement for biannual delivery. This study did not assess whether utilities prepare and make available additional and more frequent water quality information independent of the CCR framework, which many utilities may be providing.

Regarding problems associated with a requirement to send more than one CCR a year, 66% of respondents (150/227) selected difficulty associated with staffing needs required to create the CCR. 65% (148) indicated they would be concerned with costs associated with printing, mailing, and other paper delivery services. It is unclear why 65% of respondents indicated concern with paper delivery costs given that 70% of respondents indicated they use electronic delivery for CCR delivery. 14% (31/227) indicated a concern about the difficulty managing inquiries after a CCR is sent, and 15% (35/237) indicated a concern about technical difficulties associated with billing systems and websites. 21% of respondents (47/227) selected "other" as a concern regarding a requirement to send more than one CCR annually, including that sending more than one would be wasted utility effort (18), a concern about negative effect on public perception due to cost or causing confusion (11), and no concerns (three).

5.1 SUMMARY AND CONCLUSIONS

This survey sought to evaluate how community water systems track and evaluate the effectiveness of their consumer confidence reports. Survey results indicate that the majority of utilities perform indirect evaluations of the effectiveness of their CCRs, but very few indicated performing surveys or other methods that directly evaluated the CCR's effectiveness. While 81% of utilities represented in this survey perform at least one method of tracking or evaluating consumer feedback, understanding, or the role of the CCR in shaping perceptions about water quality, very few utilities indicated they conduct surveys that directly evaluate consumers' understanding of the CCR (5% of respondents), the role of the CCR in shaping consumer confidence in water quality (2%), or test the effects of differences in CCR language or format (1%). Practices in evaluating and increasing CCR effectiveness varied by utility size and US

Census Bureau region. Exploring this variation by utility size and US Census Bureau region is a topic for future research.

This survey also aimed to evaluate what areas of consumer misunderstanding and feedback utilities receive regarding the CCR. Almost 40% of utilities indicated receiving positive feedback of the CCR, indicating that some consumers may be satisfied with required information in their CCR and that the CCR may be increasing consumers' confidence in water quality. Nearly 40% of utilities reported hearing no misunderstandings of the report from consumers. The most commonly reported feedback and misunderstandings about the report were similar to consumer concerns in initial literature about the report. Over half of utilities reported receiving questions or concerns from consumers after reading the report, noted in Johnson (2001), and 38% reported receiving questions about water quality concerns not mentioned, highlighted as a concern by Meyer-Emerick (2004).

Utilities may have little incentive to try to improve or evaluate the effectiveness of the CCR given their own limited resources and the requirement to send the CCR with much of the same required language regardless of feedback received from consumers. However, some survey respondents reported modifying their CCR to increase consumer engagement with the report by conducting outreach methods that are not required by the regulation. Other survey respondents indicated modifying the language or format of their CCR to increase how understandable the information in the report is to consumers. Notable examples include utilities altering the Flesh-Kincaid reading level of their report to a seventh-grade reading level, using feedback from citizens' groups, and changing online CCR formats to be more user-friendly booklets.

The persistence of consumer concerns about the report highlights the importance of future research in evaluating the effectiveness of the CCR. Future research can focus on

evaluating the role of electronic delivery and its capacity to add more information or make more visually appealing reports in shaping consumer confidence or knowledge of water quality. Alternatively, future research may focus on comparing the readership or recall of CCRs delivered by mail compared to those delivered electronically. Utilities may consider increasing the effectiveness of their CCR by evaluating their CCR's recall (Davis, 2007), increasing clarity by adding summary statements (Phetxumphou et al., 2016), and decreasing sentence length or word complexity where possible (Roy et al., 2015). Such considerations will help utilities more clearly communicate information about water quality to consumers. Future research may also focus on the impact of AWIA's requirement for large utilities to send a CCR at least biannually on the effectiveness of the CCR. Information gained from this study and related CCR research may aid the EPA in addressing requirement set force by AWIA to increase the readability, clarity, understandability, and accuracy of the information presented in the CCR.

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Tables

Table 1. Distribution of Survey Responses by Utility Population Served				
Utility Population Size Category	Number of System Respondents	% Respondents*	Population Served	% of U.S. Population Served
25-500	2	1%	621	>1%
501-3,300	34	14%	61,249	>1%
3,301-10,000	32	13%	206,422	>1%
10,001-100,000	102	43%	4,397,435	1.4%
>100,000	69	29%	43,606,602	14.1%
Total	239	100%	48,272,529	15.6%
*Remaining respondent (1) is a wholesaler that does not provide the CCR in full directly to customers.				

Table 2. Distribution of U.S. Utility Sizes by Population Served				
Utility Population Size Category	Number of Systems	% of Systems	U.S. Population Served	% of U.S. Population Served
25-500	28,346	55%	4,763,672	2%
501-3,300	13,737	27%	19,661,787	7%
3,301-10,000	4,936	10%	28,737,564	10%
10,001-100,000	3,802	7%	108,770,014	36%
>100,000	419	1%	137,283,104	46%
Source: US EPA. (2013a). *Fiscal Year 2011 Drinking Water and Ground Water Statistics (*EPA 816-R-13-003).				

Table 3. Utilities' Methods Used to Track Consumer Engagement or Understanding of the CCR		
Method	Responses *number*	Responses *%* *
Record the number of inquiries or comments	84	35%
Record the content of inquiries or comments	57	24%
Conduct consumer surveys or other methods	12	5%
Other	27	11%
Do not track	131	55%
Total number of respondents	238	
*Percentages do not add up to 100% because utilities may use more than one method to track consumer engagement or understanding.		

Table 4. Utilities' Methods for Changing or Testing Differences in CCR Language or Format		
Method	Responses *number*	Responses *%* *
Change language/wording where applicable	85	36%
Change format of information	66	28%
Change format of figures or pictures	61	26%
Change the amount or type of information	59	25%
Conduct testing on differences in at least one of these aspects	2	1%
Other	13	5%
Do not change or test	132	56%
Total number of respondents	237	

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*Percentages do not add up to 100% because utilities may use more than one method of changing language or format aspects of their CCR.

Table 5. Utilities' Delivery Methods of the CCR

Use of electronic delivery	Responses number	Responses %
Have used electronic delivery	168	70%
Had used electronic delivery and have since stopped	5	2%
Have not used electronic delivery but plan to	26	11%
Have not used electronic delivery and do not plan to	40	17%

Table 6. Additions and Changes Utilities Have Made to CCRs Since Changing to Electronic Delivery

Change Made	Responses *number*
Provided More Information	43
More pictures	14
Overall More Visually Appealing	10
Other	8
Total Number of Utilities That Indicated They Have Made Changes Due to Electronic Delivery	53

Table 7. Upper Bound Cost Savings from Current Electronic Delivery of CCRs

Current electronic-delivery upper bound cost savings	2012 Dollars	2018 Dollars
Pre-electronic delivery nationwide CCR cost estimate*	$28,174,000	$30,809,000
Percentage estimated cost savings for "Bill providing URL" methodology*	75%	75%
Percentage of utilities using electronic delivery	70%	70%
Upper bound of current electronic delivery annual cost savings	$14,791,000	$16,175,000
*Value derived from Carpenter & Roberson 2013		

Table 8. Upper bound cost savings from potential future electronic delivery of CCRs

Potential electronic-delivery upper bound cost savings	2012 Dollars	2018 Dollars
Pre-electronic delivery nationwide CCR cost estimate*	$28,174,000	$30,809,000
Percentage estimated cost savings for "Bill providing URL" methodology*	75%	75%
Percentage of utilities using or considering electronic delivery	81%	81%
Upper bound of potential electronic delivery annual cost savings	$17,116,000	$18,716,000
*Value derived from Carpenter & Roberson 2013		

Table 9. Required Portions of CCR That Make It More Difficult for Utilities to Communicate Clearly with Consumers

Required Portion of CCR	Responses *number*	Responses *%**
Contact information	2	1%
Information on public participation opportunities	2	1%
Information about source(s) of water	11	5%
Required definitions (i.e. MCL, MCLG, TT, AL, MRDL, MRDLG)	60	26%
Detected contaminants health effects language	60	26%

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Information on monitoring for *Cryptosporidium*, radon, and other contaminants (if detected)	46	20%
Compliance with other drinking water regulations	21	9%
Variance and exemptions (if applicable)	18	8%
Required educational information regarding contaminants in drinking water and bottled water	36	16%
Information to vulnerable populations about Cryptosporidium	33	15%
Statements on nitrate, arsenic, and lead (if applicable)	35	15%
Other requirements	23	10%
No requirements make it more difficult to communicate.	109	48%
Total number of respondents	227	
*Percentages do not add up to 100% because there are multiple requirements for the CCR		

Table 10. Additional (i.e. not required) Information Utilities Include in CCRs		
Information	Responses *number*	Responses *%* *
Explanation of Treatment Process	98	43%
Diagram of Treatment Process	37	16%
A summary statement about the quality of drinking water	147	64%
Information about water conservation	99	43%
Information about costs of water treatment	13	6%
Educational information about area water issues	76	33%
Photos or other diagrams	102	44%
Other	37	16%
Do not include additional information	39	17%
Total number of respondents	230	
*Percentages do not add up to 100% because there are multiple requirements for the CCR		

Figures

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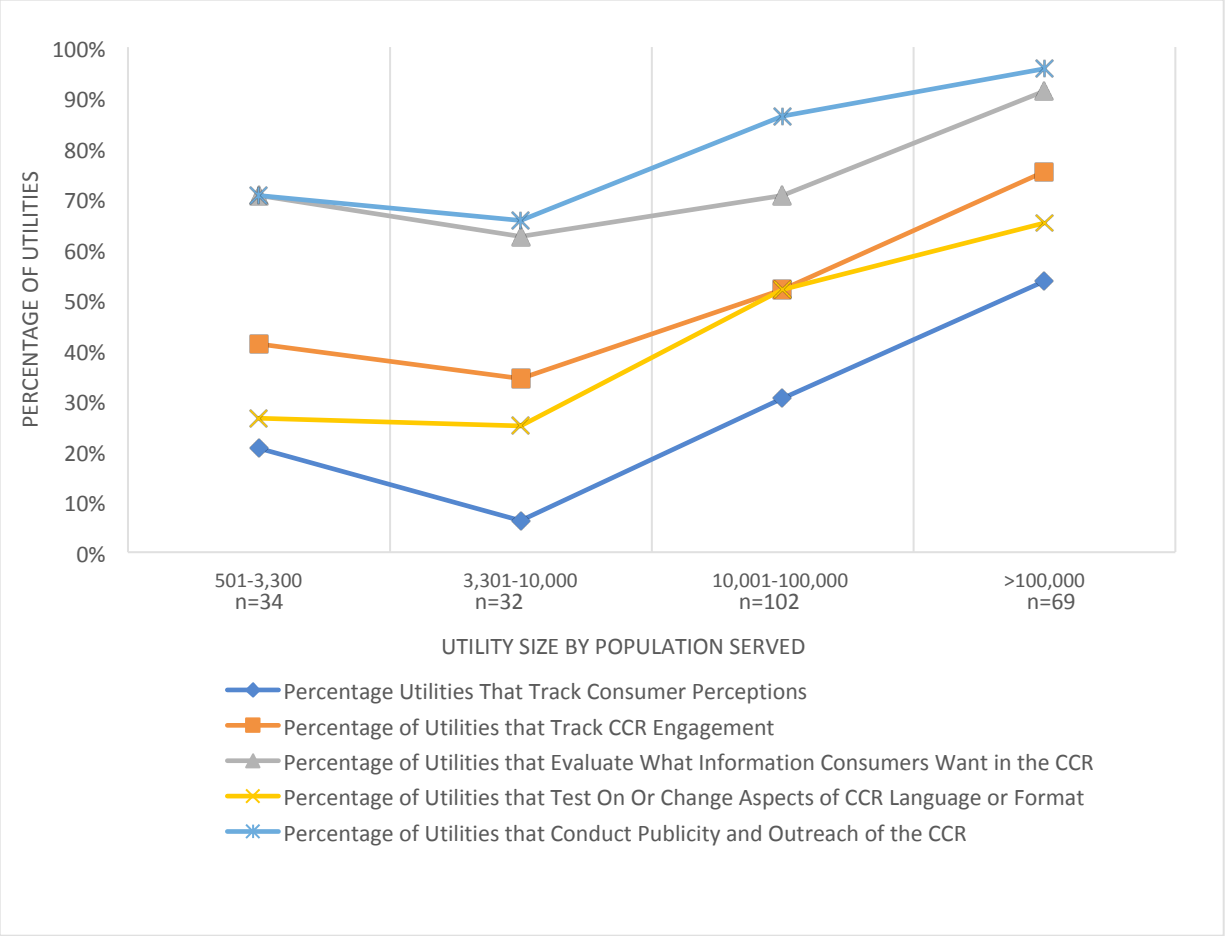

Figure 1. Utilities' Methods of Tracking and Increasing Consumer Engagement, Understanding, and Perceptions of the CCR By Utility Size

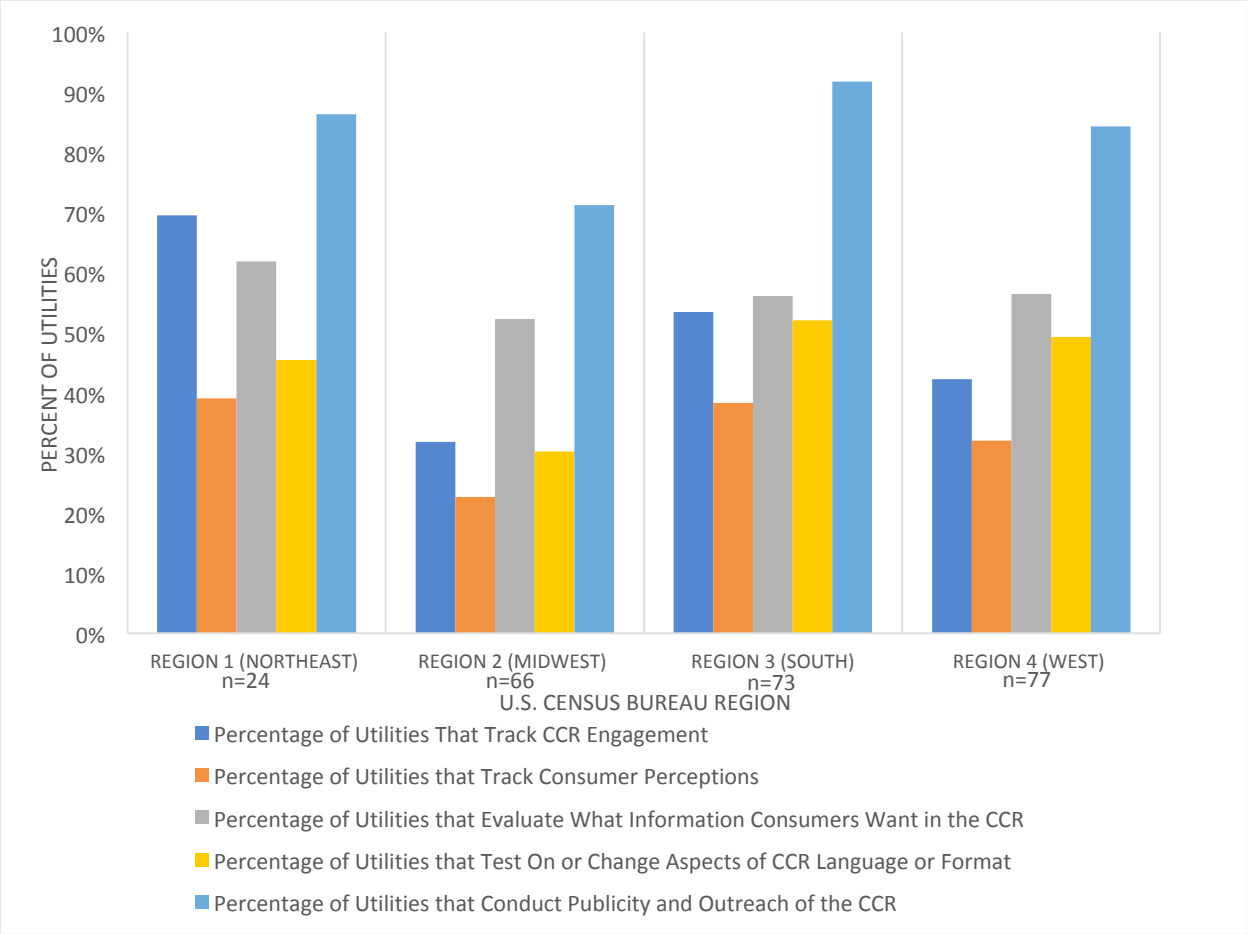

Figure 2. Utilities' Methods of Tracking and Increasing Consumer Engagement, Understanding, and Perceptions of the CCR By US Census Region