Full Title: "Is my tap water safe to drink?" : assessing a national sample of Consumer Confidence Reports for public health communication

Short Title: Evaluating the Content and Communication of Drinking Water Reports

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Abstract

The Environmental Protection Agency requires that public water systems create an annual report for their customers. This report is known as a "Consumer Confidence Report" (CCR) and was claimed to be the "centerpiece" of consumer right-to-know under the Safe Drinking Water Act. However, previous research indicates that CCRs are not understandable to members of the American public; as such, they are not serving their purpose of communicating important information about tap water to consumers. The purpose of this manuscript is to assess the communication and content quality of CCRs published in 2019-2020. No known work has examined the readability of CCRs published since 2013. In addition, no known work has evaluated CCRs for their adherence to EPA requirements. This manuscript describes the collection of a nationwide sample of CCRs, and the application of a content analysis to the sample. The objectives of the analysis were twofold: 1) to examine CCR communication quality;

and 2) to evaluate them for their inclusion of legally-mandated content, as well as non-mandatory information that may be useful to customers.

No CCR in this sample earned a passing communication score. When an item was required by law, the majority of CCRs included it. However, far fewer CCRs went "above and beyond" to provide readers with additional facts about their tap water, even though such information may be very helpful for consumer trust. This suggests that additional legal requirements for CCR content and language could have a marked impact in improving the reports to meet the needs of the American public.

Background

In the United States, nine out of ten citizens are served by a public water system.(1) Under the Safe Drinking Water Act (SDWA), the Environmental Protection Agency (EPA) has the authority to set water quality standards for over 90 contaminants in drinking water to protect public health.(2) To promote confidence in community water systems (CWSs) – or public water systems that serve the same population year-round – the 1996 SDWA amendments stipulated that every system create an annual educational document, known as a Consumer Confidence Report (CCR), for their customers. The final legislation governing the reports, known as the 1998 CCR Rule, claimed that CCRs would "provide valuable information to customers of community water systems," and that CCRs represented "the centerpiece of public right-to-know" in SDWA.(3)

However, in the approximately twenty years since the implementation of the CCR Rule, research and focus groups have called into question the usefulness of CCRs.(4) (5) (6) (7)

Despite SDWA's claim that a CCR delivers valuable information to people who receive water from CWSs, a 2012 EPA retrospective review concluded the reports were "confusing, misleading and alarming to some readers."(8) A 2004 American Water Works Association (AWWA) report stated that the CCR format failed to address underlying concerns customers may have with their water quality.(6) Two communication-based analyses evaluated a sample of 30 CCRs: one analysis concluded that the readability of the CCR sample was equivalent to the readability level of the Harvard Law Review Journal.(9) The other assessment graded CCRs based on the Center for Disease Control's Clear Communication Index (CCI), a tool for evaluating health communication materials, and found that none of the CCRs received a passing score.(4) In summary, critical reviews of CCRs challenge the notion that the reports are fulfilling their purpose to provide readable, understandable information about water quality to the American public.

Significance of This Work

There is a growing need for CCRs to fulfill their intended purpose of increasing consumer confidence. In the years since the Flint, Michigan water crisis, nationwide trust in drinking water has eroded. This lack of trust has deepened in minority communities. (10) Individuals who are nonwhite or make under $50,000 were more likely to report not hearing from their water utility company, and were less aware that their tap water was frequently tested by their utility. (7) When tap water avoidance increases, so do the consumption of bottled water and sugar-sweetened beverages (SSBs) – a tradeoff with deleterious impacts for the environment and public health.(11) (12) (13) This work is the first in a decade to evaluate a recent sample of CCRs, and evaluates them for their adherence to the stipulations outlined under SDWA.

Improving the quality of CCRs may have long-term ramifications for improving the trust of millions of Americans served by public water systems.

Methods

Methods Section 1: Sample Selection

A purposeful sampling methodology was developed to collect CCRs from across the United States (representing all 10 EPA regions), from communities of varying social vulnerability, and from a variety of different water system sizes. Two databases were used to connect water systems and demographic data: the Center for Disease Control's Social Vulnerability Index (SVI), and EPA's Safe Drinking Water Information System (SDWIS).

Utilizing CDC Vulnerability Database

To collect CCRs from communities of different social vulnerabilities, the CDC's SVI database was used. In the SVI, each US county is ranked, based on fifteen variables from the US Census.(14) These variables include information about age, minority status, income level, and housing types (including mobile homes). (15) Data were downloaded from CDC's 2018 county-level SVI Database in September 2021 and organized by EPA region. Within each region, county-level data were sorted by the overall vulnerability indicator.(16)

No perfect overlap exists between water system utility boundaries and demographic data.(17) County-level data were used in this analysis because counties represent the smallest geographic unit for which both water system data and US Census data were available. The methodology of using county-level data has been used in previous studies examining drinking water disparities.(17) (18) (19)

Selecting Water Systems

Once the most- and least-vulnerable counties were identified in each region, EPA's Safe Drinking Water Information System (SDWIS) database was used to identify CWSs in each county. Water systems of multiple sizes were selected, as classified by EPA: "Very Large" systems serve 100,000 or more people; large systems serve between 10,000 and 100,000 people; medium and small systems serve fewer than 10,000 people.(16) A Google search was subsequently conducted to find Consumer Confidence Reports for each identified water system. If a CCR could not be located, the water system was excluded, and a different utility was selected utilizing the methodology described above. This selection process continued until a water system of each size had been identified for both high- and low-vulnerability areas in each of the EPA regions.

This methodology yielded a total sample of 60 with the following attributes: 6 water systems per EPA region; 20 water systems in each size category (Very Large, Large, and Medium/Small); and 30 water systems in each of the two SVI strata (low and high vulnerability).

Methods Section 2: Evaluation Tools

Communication Evaluation: Clear Communication Index Score

The Centers for Disease Control (CDC) designed the Clear Communication Index (CCI) to aid researchers in creating materials for public education.(20) The Index evaluates seven key areas in scientific communication: the document's main message and call to action, language, information design, state of the science, behavioral recommendations, numbers, and risk.(20) Each CCI item is scored, with a zero indicating an item's absence and a 1 indicating its presence. The individual items are added, divided by the total number of questions, and then multiplied

by 100 to yield a final percentage score. Any score above 90 percent is considered "passing."(20)

Communication Evaluation: Readability Statistics

All CCRs were found online in PDF form and were converted into Microsoft Word to determine readability statistics. Within Word, two metrics were collected for each CCR: the Flesch Reading Ease, and the Flesch-Kincaid Grade Level. Both scores are functions of the number of words per sentence, and the number of syllables per word. The Reading Ease scale ranks documents on a scale from 0-100, with higher scores indicating greater reading ease.(21) The Grade Level scale assigns each document a numerical value that corresponds with the United States school grade level that would be required to interpret the text.(21)

Content Evaluation: Safe Drinking Water Act CCR Requirements and Other Information

CCR adherence to SDWA content was determined by evaluating each document against the stipulations outlined in the 1998 CCR Rule.(3) A 2010 EPA guidance document provided additional suggestions for items water systems could include for their customers. (22) Both documents were used to create a form to evaluate CCRs.

Each CCR was assessed for its inclusion of five main, required criteria: (1) information about the water system, (2) information about water sources, (3) water quality parameter definitions, (4) contaminant results (including stipulations regarding how they should be displayed), and (5) educational information. The latter category includes four blocks of pre-written text: information about the risks of lead in drinking water, and how customers can flush their pipes to reduce exposure; a statement on the ubiquity of contaminants in tap and bottled water; the

susceptibility of immune-compromised populations to drinking water contaminants; and an explanation about the origin of contaminants in drinking water.

In addition, non-mandatory information was collected, including suggestions made in the CCR Guidance document that CCRs include information on source water susceptibility, or information on the water treatment process. Within the results section tables, explanatory text clarifies when an item is required by law versus suggested in the CCR guidance document.

A data extraction form was created using the Qualtrics survey builder based on these categories.(23) An initial data extraction form was pilot tested with the assistance of a second reviewer, which led to the addition of response options and several new items. Each CCR was evaluated, and an additional spot check was performed to ensure accuracy.

Additionally, the EPA guidance document stipulated that systems should include a statement about the availability of a translation, if they served "a large proportion of non-English speaking residents."(22) Translation information was not applicable to every CCR but was collected for further evaluation.

Content Evaluation: Assessing Errors in CCRs

While conducting the initial content review, several recurrent errors were noted in the contaminant result tables. An additional form was built in Qualtrics to thoroughly assess the types of errors in contained in the CCR sample, including the use of one or more incorrect legal limits, formatting errors that rendered the table difficult to understand, and typographical errors.

Methods Section 3: Scoring and Analysis

Scoring the Consumer Confidence Index

Every CCR was scored on the CCI Index on a scale of 0 to 19. A material that earns at least a 90% or higher (at least 17 points out of 19) is considered to have received a passing grade.(20)

Coding and Analysis

Stata/BE 17.0 was used analyze SVI variables, adherence to SDWA content requirements, the assessment of table errors, readability scores, and CCI scores.(24)

Evaluating Contaminant Tables

Each CCR's contaminant table was explored for errors, which were grouped into three categories: the inclusion of non-detected contaminants, formatting errors (including misspelled contaminant names, or the exclusion of units), and listing incorrect water quality parameters. Tables displaying results for unregulated contaminants were not evaluated. If a contaminant exceeded its legal limit without being subsequently marked as a violation or explained further, it was noted. While it is impossible to determine whether this is an error, or a valid conclusion based on sampling criteria, it occurred frequently enough to warrant further exploration. Actual violations were noted in twenty-five percent of CCRs in the sample.

Results

Results Section 1: Sampling

Water System Data

Sixty (60) water systems were selected from 45 counties in 26 states, serving 15.3 million people. This represents approximately 5 percent of all Americans served by a CWS.(1) All water

systems were in the contiguous United States; the methodology did not yield results from Alaska, Hawaii, or any US territories. Figure 1 shows the geographic locations of water systems.

[Figure title] Water System Locations in each of EPA's 10 Regions

[File insert: Figure 1: Map of Water System Locations in each of EPA's 10 Regions]

[Caption:] Fig 1: The map shows locations of the water system locations from which the CCRs in this sample were collected. Some counties contained water systems of all three sizes in a vulnerability category. For example, in EPA Region 1, a high-vulnerability county in Massachusetts contained very large, large, and medium/small water systems. In the same region, the water systems from low-vulnerability areas were scattered across three separate counties, one each in Main, Massachusetts, and Vermont.

CCR Collection

Fifty-three (53) CCRs were found by searching Google. Seven could not be located, which resulted in the exclusion of those water systems, necessitating the selection of new water utilities for which CCRs were available online. Of the seven that were unavailable, four were from highly vulnerable areas, and three were from areas with low vulnerability. All seven were from water systems that served fewer than 12,000 people.

Results Section 2: Communication

Clear Communication Index

The CDC itemizes the CCI scores into four parts. Table 1 displays the overall CCI score, as well as the four subcomponent scores (Part A, Part B, Part C, and Part D). For a communication material to earn a "passing" grade on the CCI scale, it must earn a score of 90 percent or higher

(in this case, a score of 17 or greater).(20) None of the CCRs earned a passing grade; the highest score was 16/19.

Table 1: Clear Communication Index Scores

Clear Communication Index	Mean(SD)	Min	Max
CCI Total Score (19 possible points)	11.1(2.7)	7	16
CCI Part A: Core Items (10 possible points)	4.1(2.3)	0	8
CCI Part B: Behavioral Recommendations (4 possible points)	3(.13)	3	4
CCI Part C: Numbers (3 possible points)	1.8(0.40)	1	2
CCI Part D: Risk (2 possible points)	1(0)	1	1

Within the CCI, Part A evaluated whether the CCR contained a takeaway message regarding the quality of the drinking water provided by the utility. If such a statement existed, a CCR was further evaluated to determine whether it was displayed at the top of the document. If a CCR did not contain a main message, it automatically missed earning four possible points due to a skip pattern written into the CCI. Part B evaluated whether the document contained behavioral recommendations: all CCRs met the requirement by instructing customers on how to contact the utility, or by explaining how to flush water from pipes to prevent exposure to lead. Part C examined the display of numerical values. Scores for Part D did not vary because all CCRs contained some discussion about risk and contaminants in drinking water – nearly all included EPA's mandated language, and a few also included original content.

Key Communication Metrics

Fewer than half of CCRs included a main takeaway message for the reader, as shown in Table 2. Ten CCRs issued a takeaway statement on the first page of the document; among the remaining eleven CCRs, customers had to read an average of six (6) pages of material to reach the bottom line. Most CCRs included a column in their results table stipulating whether each water contaminant result was above or below the Maximum Contaminant Level (MCL) or Treatment

Technique. While nearly all CCRs included the mandatory definitions water quality standards, almost half of the CCRs did not include these definitions prior to the result table.

Table 2: Selected CCI Components

Communication Metric	**Count**	**Percent**
The CCR provides a main message (i.e. whether the water met all state and federal requirements)	26/60	43.3%
If there was a main message, it was located at the top of the CCR	15/26	57.7%
The CCR explained whether the water quality results were above or below each contaminant's respective legal limit	47/60	78.3%
The CCR provided definitions for water quality terms before using them in the result table	34/58*	58.6%

*Two CCRs did not contain a result table; the denominator for this metric is 58 rather than 60

Readability statistics for the sample of CCRs are presented in Table 3. Standard communication documents should have a readability goal level of 60-70 (the closer a document scores to 100, the more readable it is).(21) No CCR passed the minimum score for reading ease. EPA recommends that public health communication materials be written at a 7^{th}-8^{th} grade reading level; a single CCR fell within this range.(25) The remaining 59 were above the 9^{th} grade reading level, with 26 CCRs earning a score at the 12^{th} grade level or higher. None of EPA's pre-written educational statements (regarding lead, the ubiquity of contaminants, the health impacts of contaminants on susceptible populations, and the origin of contaminants in source water) achieved the goal range for reading ease or grade level.

Table 3: Readability Statistics

	Reading Ease (Goal: 60-70)	**Grade Level (Goal: 7-8)**
Overall CCR Sample	38.3	11.5
EPA Lead Language	39.1	13.4
EPA Contaminant Language	16.5	15.3
EPA Health Language	10	17.4
EPA Source Water Language	19.8	16.7

Results Section 3: CCR Sample Adherence to SDWA Requirements

The tables below display the results of the content analysis. When an item is marked as "Rule," it is mandated by the 1998 CCR Rule. Items marked as "Guidance" were found the 2010 CCR Guidance Document. Items that are "Not Required" were not mentioned in either document, but were considered to be important for consumer education.

Nearly all CCRs included at contact information for their water system operator, as displayed in Table 4. Almost half (32) of CCRs included both the name and phone number of a main point of contact at the water system. Twenty-four (24) CCRs provided a phone number, but no name. Among the CCRs that listed opportunities for public participation, twenty-six (26) included a time and place for recurring meetings. Others included web URLs users could access for meeting information. Approximately half of CCRs contained a statement regarding a translation of the report (32 of 60, 53%). Thirty-one (31) of these translation statements were made in Spanish, with a few CCRs using multiple additional languages. Most of these translation statements said that the report contained important information about drinking water, and that the reader should share the report with someone who could translate it for them.

Table 4: Required Information about Water System and Translation Availability

CCR Content	Count	Percent
The CCR includes contact information (e.g. phone number) for the water system (Rule)	56/60	93.3%
The CCR shared information on opportunities for public participation in decisions affecting the water system (Rule)	44/60	73.3%
The CCR states that a translation of the report is available*	32/60	53.3%
If YES, the translation statement is made in a language other than English	31/32	96.9%
If YES, the CCR directs non-English speakers to call a phone number or access a URL to obtain information in their language	12/32	37.5%

*Only applicable to water systems serving a high number of non-English speaking customers (3)

Table 5 presents information about source water. Every CCR provided at least some information about their water source, and nearly every report shared where their source originated. However, fewer CCRs shared information about a water system's susceptibility to contamination; the reports that did so tended to include action items customers could take to protect their source water, such as not applying pesticides or fertilizers prior to a rainstorm.

Table 5: Source(s) of Water

CCR Content	Count	Percent
The CCR contained information about the water source. (Rule)	60/60	100%
The CCR described whether the system obtains water from ground water, surface water, or a mixture. (Rule)	54/60	90%
The CCR contained a brief summary of the water source's susceptibility to contamination (Guidance)	22/60	36.7%
The CCR contained suggestions for actions customers could take to help protect their source water. (Guidance)	18/60	30%
The CCR shared pictures, maps, or diagrams of the water source (Guidance)	42/60	70%

Table 6 illustrates that most CCRs included mandatory, pre-written definitions for water quality standards. These include the Maximum Contaminant Level (MCL), Maximum Contaminant Level Goal (MCLG), Maximum Residual Disinfection Level (MRDL), Maximum Disinfection Level Goal (MRDLG), the Action Level (AL), and Treatment Technique (TT).

Table 6: Definitions

Definition	Count	Percent
Maximum Contaminant Level (MCL) (Rule)	52/60	86.7%
Maximum Contaminant Level (MCLG) (Rule)	53/60	88.3%
Maximum Residual Disinfection Level (MRDL) (Guidance)	46/60	76.7%
Maximum Residual Disinfection Level Goal (MRDLG) (Guidance)	54/60	90%
Action Level (AL) (Guidance)*	55/55	100%
Treatment Technique (TT) (Guidance)*	55/55	100%

*The denominators for the last two items are 55, due to five CCRs not reporting lead or copper results, and thus not including the definitions for AL or TT.

Table 7 shows that the majority of CCRs adhered to EPA's stipulations for displaying units. These requirements included displaying MCLs/MRDLs in a value greater than 1.0, and ensuring uniformity of units between MCLs and MCLGs. Most CCRs created a column for units within the result table, which ensured that the same unit was applied along the entire row of values.

Table 7: EPA Requirements for Water Quality Table Units

Results Table Adherence to EPA Rules for Units	**Count**	**Percent**
MCLs/MRDLs always displayed in units greater than 1.0 (Rule)	51/60	85%
The units for each MCL always match their respective MCLG (Rule)	55/60	91.7%
Contaminant results are always expressed in the same units as their respective "goal" units (e.g. MCLG) (Guidance)	56/60	93.3%
Contaminants regulated by TTs/ALs are specified (Rule)*	53/55	96.3%
Action Levels are always displayed in units greater than 1.0 (Rule)*	54/55	98.1%
MCLGs for copper and lead match AL units (Guidance)*	47/55	85.5%

*The denominators for the last three items are 55 due to five CCRs not reporting lead and copper results

The majority of CCRs met EPA's criteria for mandatory educational language inclusion, as shown in Table 8. If a CCR excluded one educational statement, it did not appear to be more likely to exclude additional statements: most CCRs only skipped only one of the four mandatory blocks of text. Just over half of CCRs included a sentence or more about the water treatment process. Some CCRs included a step-by-step process, illustrated with a diagram, to explain how their water was treated. Other CCRs mentioned basic water treatment steps. While CCRs are not required to specify how many contaminants the utility tests for in the water, nearly half included at least a sentence of information, often letting readers know the total number of contaminants tested for by the utility, or explaining that more contaminants are monitored than what were included in the results table. Very few utilities included information about the science behind drinking water standards, or additional information about risk and/or health impacts from contaminants.

Table 8: Required Educational Language and Additional Information

CCR Educational Material	Count	Percent
The CCR contains EPA's mandatory language about ubiquity of contaminants in drinking water (Rule)	53/60	88.3%
The CCR contains EPA's mandatory language about origins of contaminants in drinking water (Rule)	50/60	83.3%
The CCR contains EPA's mandatory language about possible health effects from contaminants in drinking water (Rule)	57/60	95%
The CCR contains EPA's language about lead in drinking water (Rule)	52/60	86.7%
The CCR contains information about the water treatment process (Guidance)	35/60	58.3%
The CCR specified when water samples were taken (Not Required)	44/60	73.3%
The CCR explains that many more contaminants are tested for than are displayed in the water quality results table (Not Required)	28/60	48.3%
The CCR provided additional information about potential health impacts of drinking water contaminants (Not Required)	5/60	8.3%
The CCR explains the origination of water standards (Not Required)	6/60	10%

Table 9 summarizes common errors in this sample of CCRs. Fourteen CCRs incorrectly listed at least one water quality parameter. Several CCRs listed a contaminant's MCL using parts per million instead of parts per billion (and vice versa), without the corresponding change in magnitude for the numerical value. In two CCRs, the arsenic MCL was listed at 50PPB (instead of 10PPB); in one of these, the maximum arsenic result was 12PPB, but it was not marked as a violation. "MCL" was used in place of "Treatment Technique" for E. coli and Total coliform bacteria in two CCRs. Some CCRs were missing contaminant MCLGs, or listed the MCLGs at greater values than the usual federal level (e.g. one CCR listed the MCLG for lead at 0.2 PPB instead of 0; another listed lead's MCLG as 15PPB). One CCR doubled all the numerical values for EPA's secondary MCL levels.

Table 9: Unclear Items in Result Tables

Incorrect Legal Limits, Formatting Errors, or Typos	**Count**	**Percent**
Contains at least one incorrectly listed "standard" (e.g. MCL or TT)	16/60	26.7%
The CCR contained a "formatting" error: misspelled chemical names, the exclusion of MCLGs, repeating contaminants multiple times, or missing units	15/60	25%
The CCR contained an MCL exceedance without explaining to the reader why it was not considered a violation	9/60	15%
CCR included non-detects in water result table	25/60	41.7%

CCRs frequently contained table formatting errors that rendered the entire table, or specific contaminant results within it, difficult to interpret. This included repeating contaminants in various places, misspelling contaminant names, excluding units, and marking a violation for a contaminant that exceeded a secondary, but not a primary, MCL. One CCR did not include column headings, and two CCRs excluded the water quality result table entirely. Twenty CCRs contained one or more formatting-related errors.

Nearly one out of every six CCRs listed an exceedance of a legal limit (i.e. the "maximum" level of a contaminant was higher than the MCL) but did not mark a contaminant as having been in violation. One CCR listed the arsenic MCL as 5PPB (a state regulation), but reported an arsenic detection of 5.8PPB and did not note it as a violation. Disinfection byproducts and disinfectants (trihalomethanes, haloacetic acids, and chlorine) frequently had a maximum result that exceeded the MCL. No explanations were given to clarify why these contaminants, detected above their legal limits, were not considered violations. Finally, 24 CCRs contained at least one "non-detected" contaminant in their table. The most frequently included "non-detect" result was lead (10 CCRs), followed by E. coli and Total coliform (9 CCRs each), and copper (2 CCRs). Three CCRs included 60 or more regulated contaminants in their table, many of which were

below detection levels. The EPA guidance document specifies that CCR water quality tables should only include contaminants for which there were results above the limit of detection.(22)

Discussion

Sample Generalizability

The generalizability of the purposeful sample of 60 CCRs was evaluated by comparing the population served by each size category (Very Large, Large, and Medium/Small) against the respective national data for each system size. Within the Large and Very Large categories, the spread of the population served was comparable to the spread in population served on the national level. However, because eighty percent of all community water systems in SDWIS are very small (serving a population of 500 people or fewer), the range in population served in the smallest subset of water systems is heavily skewed.(26) Thus, this sample may not accurately reflect the quality of CCRs for very small water systems (only one water utility in the sample served fewer than 500 people).

The proportion of violations contained in this sample of CCRs is representative of national drinking water violation data. According to EPA's Enforcement and Compliance History Online website, approximately 26 percent of water systems reported a violation of any kind in 2020.(26) Twenty-five (25) percent of the CCRs sampled reported a violation (twelve CCRs reported one violation, and three reported two violations). The sample slightly over-represented CCRs with health-based violations, with 10 percent of the sample reporting such a violation (compared to 5.2 percent nationally). The representation of CCRs with monitoring and reporting violations was roughly equivalent to the national percentage of CCRs with the same violation (22 percent versus 19 percent, respectively).(26)

Clear Communication Index Results

The previous study on CCR communication was conducted using a sample of CCRs from 2011-2013.(4) The findings of this paper demonstrate that no clear improvements have been made to CCR communication quality during the intervening years. The breakdown of scores across the various indices was similar to those found by Phetxumphou et al., with behavioral recommendations earning the highest overall score. The behavioral findings of the CCI evaluation illustrate the benefit of EPA creating content for utilities: due to the mandatory statements on lead (which included information on how to flush pipes to reduce lead exposure) and immunocompromised populations (which instructed the reader to call the Safe Drinking Water Hotline), all CCRs earned points on the Index for behavioral recommendations.

Only one out of every four CCRs provided a main message at the top of the document. The CCI scoring system heavily weighs the inclusion of a main-message statement (if there is no main message, the CCI includes a skip pattern that precludes material from earning four possible additional points). Considering previous surveys have demonstrated how relatively few people remember receiving and reading their CCR, having a bottom-line statement at the top of the document may help people recall what was in their report.(27) (28)

Readability Scores

No CCR achieved the ideal “readability” score range, which is between 60-70. This supports past conclusions that CCRs are difficult to interpret. The CCR average grade level score may be interpreted as requiring the reader to have a mastery of eleventh-grade reading skills to understand their report. Additionally, each of EPA’s pre-written educational language texts were written above a high school reading level. Given that one out of every ten Americans over

the age of 25 does not have a high school diploma, this finding indicates that there is a large portion of the US population that may have difficulty understanding their CCR.(29)

SDWA Requirements: the Impact of Requiring Information

The result tables demonstrate the impact of EPA's requirements on CCR quality. When items are required, they are included by the vast majority of CCRs: for example, over eighty (80) percent of CCRs included information about source water, MCL/MCLG definitions, contact information for the utility, and four blocks of pre-written language. However, when items are not required by the CCR Rule, the likelihood of their inclusion drops. Nearly four out of ten CCRs excluded information about the water treatment process, and half of CCRs did not include information on the total number of contaminants tested for by the utility. Three in ten CCRs provided actionable steps customers could undertake to protect source water, and only one out of ten CCRs gave background information about drinking water quality standards.

The differences illustrate an important finding: when EPA creates language and mandates its inclusion, it is highly likely to be used by the utility and passed along to the consumer. Utilities rarely create their own educational material—an understandable finding, given the budgetary constraints experienced by many water utilities, which likely affect the bandwidth of the staff.(30)

However, more work should be conducted to determine whether EPA's current language statements are useful to customers. Several of them (MCL, MCLG, AL, and MRDLG) are self-referential, using their own acronym or another water standard's abbreviation in their definitions. In addition, every block of EPA's mandatory language failed to meet the ideal goal range for readability and grade level scores. EPA should consider convening focus groups,

consisting of members of the public, to test the understandability of pre-written language, and adjusting each segment of text according to their feedback.

Accessibility

Approximately half of CCRs sampled stated that a translation of the report was available. EPA does not require translation information be included in all CCRs; the CCR Rule states that utilities serving a "large proportion of non-English speaking residents" must include translation information in the language spoken by the portion of their population that does not speak English.(3) To this end, EPA provides the following statement for CCR writers: "This report contains important information about your drinking water. Have someone translate it for you, or speak with someone who understands it."(22) Given that CCRs contain technical information, it may prove difficult for a non-English speaking CCR recipient to find a translator proficient enough in both languages to interpret the document. Only twelve CCRs included information about the translation at the top of the report; it is unrealistic to expect a reader who cannot understand the document to peruse a multi-page document to find translation information at the end.

Unclear Items in Result Tables

Incorrect Water Standard Listed

Approximately one-quarter of CCRs reported an incorrect water quality standard. This may have been due to a typing error – substituting parts per million for parts per billion – but in some instances, it appeared questionable. In one extreme case, arsenic was detected at 12PPB, but the MCL was incorrectly listed at 50PPB. A customer reading this CCR would be unlikely to identify the MCL as being outdated by twenty years, and it would likely not occur to them to

think that the level of arsenic in their water may be too high (the correct MCL is 10PPB). To check CCRs for the proper reporting of water quality standards for this paper, each MCL in every report was cross-referenced against EPA's list of all primary drinking water standards (nearly 90 contaminants). Such fact-checking cannot be expected of consumers. EPA's adoption of a standard template, in which all water quality standards are pre-filled (perhaps with state-specific templates for the states that have their own standards), could help standardize this required section of CCRs.

Water Standard Exceedances

EPA states that the public finds the use of the word "safe" to be misleading when there is an MCL exceedance.(22) Among the nine CCRs with MCL or Action Level exceedances, seven stated a bottom line that the water met or exceeded all federal and state requirements or was safe to drink. It is entirely possible that these exceedances occurred congruently with MCL compliance, because EPA organizes compliance in three ways: a determination made on an annual (or less than annual) basis; a determination based on a running annual average at a sampling point; and a determination based on the running annual average of all samples collected from all sampling points within the water system.(31) However, only one CCR explained how each contaminant's MCL compliance was determined. It is reasonable to expect that a consumer who received such a report would question how their water could be safe to drink, when one or more contaminants exceeded their legal limit.

Other Typos, Formatting Errors, and the Inclusion of Undetected Contaminants

One CCR misspelled names of organic contaminants, two excluded their water quality table entirely, and one very large utility failed to label column headings – rendering the table

impossible to interpret. In addition, two out of every five CCRs included a non-detect in their drinking water table; the EPA guidance document stipulates that this should not be done, but it is possible that utility managers do so out of a desire to show customers that their water is free of certain high-profile contaminants. This could explain why lead and E. coli are the most common "non-detected" contaminants included in result tables.

Other Observations

COVID-19 Disruptions

Among the monitoring and reporting violations in the CCR sample, several operators noted that they were uninformed about their responsibilities about testing schedules or reporting contaminant results. Given that many CCRs in the sample were from 2020, it is possible that disturbances caused by the COVID-19 pandemic affected water utility budgets, staffing, and laboratory operations – which in turn may have impacted testing schedules and sampling turnaround times.(32)

Report Format

The CCR Rule provides guidance on what CCRs are supposed to include, but it does not stipulate the exact order of items. Reports generally followed the order for required information as outlined under the CCR Rule and EPA's Guidance Document, by putting the source water first, followed by definitions and a result table near the end of the document. However, only the contents—and not the order in which they are presented—are mandated by EPA's rules.

Limitations/Assumptions

To implement the purposeful sample selection for high and low vulnerability communities, the decision was made to utilize county-level data with the assumption that it is representative of

the demographic served by the utility. This assumption is likely stronger for smaller water systems, but not all demographic data will correlate perfectly with the population served by the water utility. Some water system boundaries are not publicly available, which would impede efforts to determine the exact area for which census data would need to be obtained (S. Bradbury, personal communication, May 18, 2022).

Additionally, the sampling methodology may have led to some over-sampling of the larger-sized systems in each category. When the SDWIS database listed more than one water system, the database was sorted in descending order of "Population Served." This allowed for the determination of the category of water system size(s) included within each county and ensured there was a uniform way of selecting water systems for inclusion. However, because the items were sorted in descending order by population, the larger-sized systems within each size category were listed first, and were the first to be selected for further examination. Identifying water systems for inclusion relied on EPA's SDWIS database, which may have missing data (S. Bradbury, personal communication, May 18, 2022).

Finally, not all CCRs were available online: seven CCRs that could not be found via Google, and all were from systems that serviced fewer than 12,000. Thus, system size appeared to be an important determining factor in CCR availability online. Availability did not seem to be related to whether a system was in an area with high or low social vulnerability (four were from highly vulnerable areas; three were from low vulnerability areas). It is possible that the CCRs that were unavailable online were of different quality than the CCRs that could be found online.

Conclusions

CCRs should convey a few key messages: that tap water is frequently monitored, treated extensively, and overseen by EPA, which has set regulations to ensure its safety. However, some reports are over twenty pages long; others fail to define key terms that would be necessary to interpret the information on whether water is, or is not, in exceedance of a particular standard. One in four CCRs included an incorrect water quality standard in their table, and forty percent included non-detected contaminants in the water table whose purpose is to communicate information about detected contaminants. The majority failed to share a main message about water quality at the beginning of the material.

Thus, CCRs generally fail to answer a most basic question: “is the water safe to drink?” Even if a report technically meets all SDWA’s content requirements, it still may not prove useful to the average consumer, as evidenced by the fact that no CCR received a “passing” score on the Clear Communication Index. Given these impediments, EPA’s revisions of the CCR Rule will be a step in the right direction toward improving consumers’ “right to know.”

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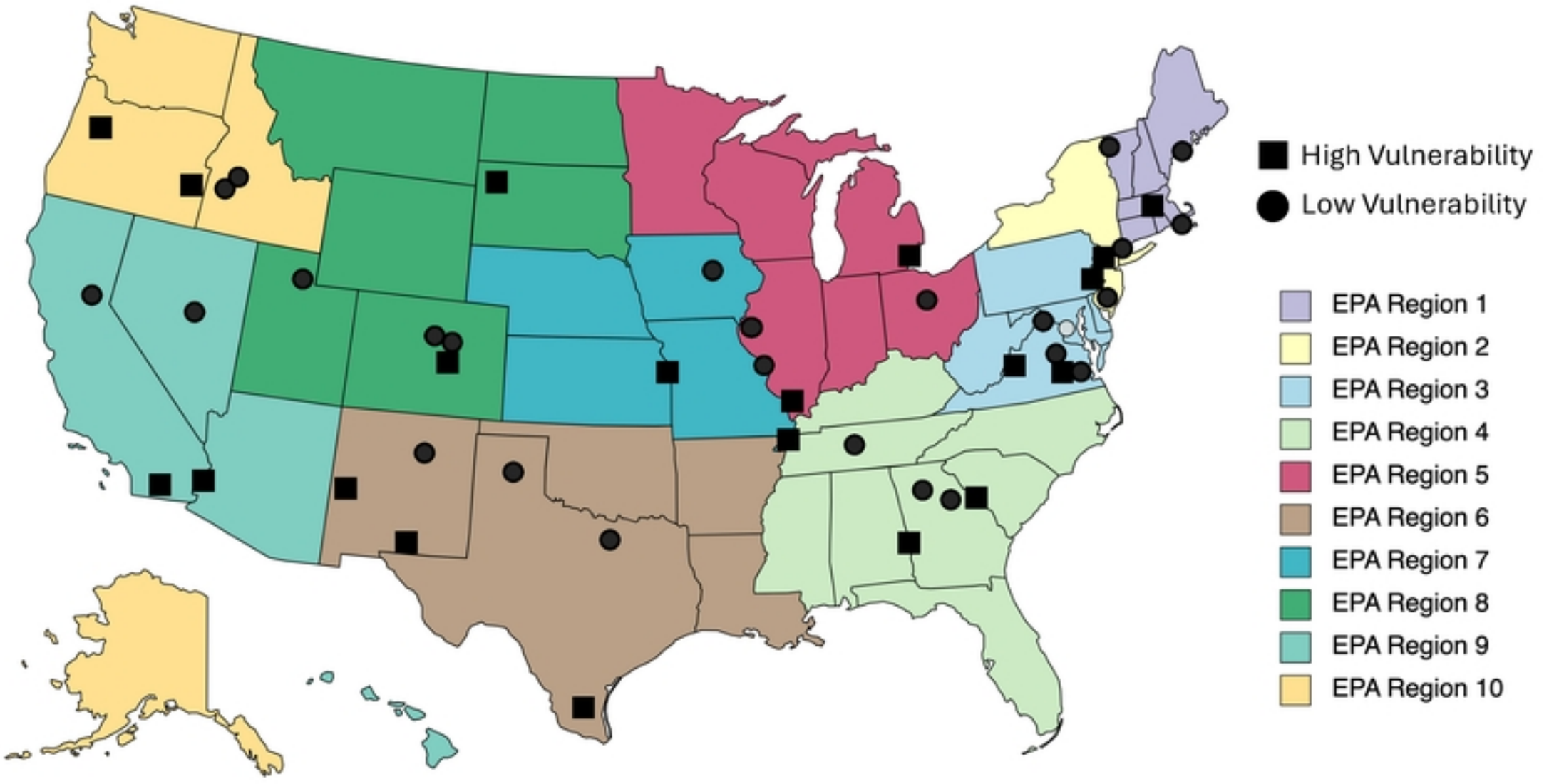
High Vulnerability
Low Vulnerability
EPA Region 1
EPA Region 2
EPA Region 3
EPA Region 4
EPA Region 5
EPA Region 6
EPA Region 7
EPA Region 8
EPA Region 9
EPA Region 10

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