



DAVID SWITZER AND MANUEL P. TEODORO

The Color of Drinking Water: Class, Race, Ethnicity, and Safe Drinking Water Act Compliance

NATIONAL UTILITY DATA
SHOW SAFE DRINKING
WATER ACT VIOLATIONS ARE
GREATER IN LOW-INCOME
COMMUNITIES WITH HIGHER
BLACK AND HISPANIC
POPULATIONS.

The recent lead crisis in Flint, Mich., has brought the issue of environmental justice to the forefront of drinking water concerns in the United States. In 2014, under the direction of a state-appointed emergency manager, the city of Flint changed its primary source of drinking water from the Detroit water system to the Flint River. The switch in water source resulted in lead leaching from aging pipes into the drinking water of many city residents. Beyond the public health implications, the Flint lead crisis drew national attention that was due in part to the city's demographic composition: Flint is approximately 55% black, with more than 40% of the population living below the poverty line. The demographic realities in Flint have made it emblematic of environmental injustice, a term that represents the possibility that poor and minority communities may be disproportionately exposed to environmental harms. In February 2017, the state of Michigan's Civil Rights Commission (MCRC) declared that

the water crisis in Flint was in part a consequence of “systemic racism” (MCRC 2017).

In December 2016, another major water contamination event occurred in Corpus Christi, Tex. A chemical leak in an industrial site led to the potential contamination of the drinking water, with residents being unable to use the water for almost four days. This incident was simply the latest in a series of drinking water problems in Corpus Christi, which has experienced repeated violations of the Safe Drinking Water Act (SDWA) over the past decade. While Corpus Christi is not as poor a city as Flint, with 17.5% of residents below the poverty line (about 2% above the national poverty level), it is about 60% Hispanic. The situation in Corpus Christi shows that Flint may not be alone and that drinking water safety may not be uniformly distributed across demographic lines.

Is community drinking water quality in the United States systematically correlated with class, race, and/or ethnicity? If so, the crises in Flint and Corpus Christi may represent a broader pattern of environmental injustice in drinking water across the United States. Since its emergence as an area of inquiry in the 1980s, the topic of environmental justice has received increased attention from politicians, scholars, journalists, and activists. The US Environmental Protection Agency (USEPA) recently focused on environmental justice as a point of emphasis, developing a strategic action plan called “EJ 2020,” which looks to confront environmental challenges in poor and minority communities (USEPA 2017).

This article analyzes class, race, and ethnicity as predictors of drinking water quality beyond isolated cases with a review of SDWA compliance across thousands of US utilities over a four-year period. Importantly, the analysis considers the effects of race and ethnicity in socioeconomic context. The goal of

this analysis is to gauge the extent of demographic and economic disparity in drinking water quality in the United States, thus to open a broader conversation about class,

includes data on utility size, water source, and regulatory compliance for all public water utilities in the United States. The analysis here evaluates compliance for the years

The goal of this analysis is to gauge the extent of demographic and economic disparity in drinking water quality in the United States, thus to open a broader conversation about class, race, and ethnicity among drinking water professionals and the communities they serve.

race, and ethnicity among drinking water professionals and the communities they serve.

ANALYSIS OF SDWA COMPLIANCE

The present analysis investigates whether and how community demographics are related to utility violations of the SDWA. Violations of the SDWA provide a useful way of investigating environmental justice for a few reasons. First, utility goals are often ambiguous across settings, but regulatory compliance is regarded as a goal for all utilities. Regardless of personal opinions about regulations, all utility managers recognize the necessity of compliance with existing regulatory requirements. Also, all utilities are tasked with similar regulatory requirements under the SDWA, regardless of organizational characteristics. This common regulatory framework allows for a general comparability of utilities everywhere in the United States. Statistical regression allows analysis of the relationships between utilities’ SDWA compliance and their communities’ race, class, and socioeconomic characteristics, while accounting for other common factors that predict compliance.

Data. Data were drawn from a number of sources. Water utility and violations data were gathered from the Safe Drinking Water Information System (SDWIS). The SDWIS

2010–2013. The analysis includes 12,972 utilities over four years, representing all local government-owned utilities that serve populations of 10,000 or more. For ease of comparability, we exclude utilities owned by state or federal agencies, as well as private, investor-owned utilities. Demographic data were obtained from the US Census Bureau’s American Community Surveys from 2010 through 2013 (USCB 2014).

SDWA violations. Violations of the SDWA can be grouped into two distinct categories. “Health violations” relate to utilities’ ability to control the levels of contaminants in their water supply. Included in this category are maximum contaminant limit violations, which occur when the utility’s water contains contaminants above limits set by the state and USEPA, and treatment technique violations, which occur when a utility fails to follow mandated treatment methods. Second, the SDWA requires utilities to follow certain protocols for testing their water, filing reports, and communicating with the public; violations of these requirements are labeled “management violations.” These include what the USEPA calls “monitoring and reporting” violations and “other” violations; the precise requirements can differ depending on the size of the utility and the source of its water supply. Since this inquiry is

primarily concerned with public health, the analysis focuses on health violations, which the authors measure as a count of health violations committed by a given utility in a year. Health

SDWA violations, a number of demographic variables were included in the statistical model predicting health violations. For measures of race and ethnicity, the model

population also ranges from 0 to 100%, with a mean of 10.5 and a standard deviation of 16.9.

Also included in the analysis were a number of variables in the model meant to represent the socioeconomic status of the community served by the utility. Percent of the population that were high-school educated, percent of the population with a bachelor's degree, percent of the population below the poverty line, and median household income were all included in the model. Of key interest here is the percent of the population below the poverty line. This analysis is concerned not just with the possibility that utility performance is worse in minority communities, but also whether poverty exacerbates the effects of race and ethnicity (or vice versa). In other words, it is possible that a community's racial and ethnic composition predict its drinking water quality most where poverty is high. For this reason, the regression model linearly connects the interaction of the measure of percent of the population below the poverty line with the measures of race and ethnicity.

Controls. The analysis includes a number of control variables for utility characteristics that may also explain SDWA violations. First, the model includes a control for whether a utility's primary source of water supply is groundwater or surface water, coded "1" if the primary water source is groundwater and "0" if the utility primarily uses surface water. Groundwater tends to have fewer contaminants than surface water, so utilities that use surface water are expected to be more likely to commit health violations of the SDWA (Wallsten & Kosec 2008). Similarly, it is expected that utilities that purchase their wholesale water supplies will commit fewer violations since the wholesale provider is responsible for source quality and treatment processes (Teodoro 2014, Wallsten & Kosec 2008).

The age of a system could also be expected to influence SDWA

This analysis is concerned not just with the possibility that utility performance is worse in minority communities, but also whether poverty exacerbates the effects of race and ethnicity (or vice versa).

violations are relatively rare, with utilities committing an average of 0.19 violations per year. Table 1 summarizes the data used in the analysis.

Demographics. In order to investigate the relationship between race, ethnicity, socioeconomic status, and

included percent Hispanic population and percent black population of the primary city served by the water utility, as identified in the SDWIS. Hispanic population ranges from 0 to 100%, with a mean of 11.6 and a standard deviation of 17.3. Black

TABLE 1 Descriptive statistics used in analysis of national water utility data from 2010 to 2013

	Percentage	Mean	SD	Min	Max
Binary variables					
Groundwater supply	53.97				
Purchased water supply	28.08				
New system	11.61				
Continuous variables					
Health violations		0.19	1.11	0	75
Population with high school degree—%		83.44	9.62	19.1	100
Population with bachelor's degree—%		21.44	13.09	0	100
Population below poverty line—%		17.61	9.81	0	85.1
Median household income—1,000		45.79	19.05	2.5	250.00
Hispanic population—%		11.64	17.28	0	100
Black population—%		10.53	16.94	0	100
Population served—1,000		17.99	109.96	10.01	8,271

Observations = 51,889

Max—maximum, Min—minimum, SD—standard deviation

compliance since older systems may have antiquated technology and therefore may be more likely to commit health violations. Unfortunately, the SDWIS contains no information on the exact age of systems, and infrastructure can vary widely in age within any given system. As a next-best alternative, a new system variable was created that was coded “1” if the system existed in the SDWIS in 1981 (its first year) and “0” if it was entered into the SDWIS at a later date. Finally, system size may play an important role in SDWA compliance because smaller systems may lack the capacity to meet some of the more technically complex regulatory requirements (Switzer et al. 2016, Scheberle 2004). For this reason, the analysis also included a variable controlling for the size of the population served by the utility. It is likely that utility size does not have a linear effect on SDWA violations because the difference between utilities serving 5,000 and 10,000 customers should be more meaningful than the difference between utilities serving 100,000 and 105,000 customers. To control for this nonlinearity, the measure included in this analysis is the natural log of the population served.

Model. Because the dependent variable in the analysis is a count of the number of violations, a negative binomial estimator is appropriate for the analysis. The negative binomial model predicts the number of counts committed by a utility in a given year based on the independent variables included in the analysis. Additionally, since the SDWA is jointly administered by the USEPA and state governments, and regulatory requirements can vary across states, the model included a series of state dummy variables in order to control for state-level differences in regulatory regimes. Finally, a lagged dependent variable and year dummy variables were included in the model to control for potential biases that could result from the time series nature of the data.

Results. The results of the negative binomial regression are reported in

Table 2; Figures 1 and 2 present the estimates graphically. In general, they show that race and ethnicity have a major impact on the number of violations committed by a utility, but the relationship is conditional on

strongly predict the number of violations committed by a utility.

The finding that Hispanic population increases the number of violations committed by a utility is both statistically and substantively

The finding that Hispanic population increases the number of violations committed by a utility is both statistically and substantively significant, indicating a serious potential concern over ethnic bias in drinking water quality.

poverty. In relatively affluent communities, race and ethnicity have little effect on the number of violations. In relatively poor communities, however, race and ethnicity

significant, indicating a serious potential concern over ethnic bias in drinking water quality. Figure 1 depicts a contour plot that clearly shows the strong effect of Hispanic

TABLE 2 Negative binomial predicting Safe Drinking Water Act violations between 2010 and 2013

	Coefficient	Standard Error
Lagged violations	0.7969 ^a	(0.0161)
Population below poverty line—%	−0.0067 ^b	(0.0033)
Hispanic population—%	−0.0001	(0.0026)
Black population—%	−0.0058 ^b	(0.0029)
Hispanic and poverty interaction	0.0002 ^a	(0.0001)
Black and poverty interaction	0.0003 ^b	(0.0001)
Population with bachelor's degree—%	−0.0099 ^a	(0.0023)
Population with high school degree—%	0.0006	(0.0032)
Median household income		(0.0000)
Logged population served	−0.1069 ^a	(0.0168)
Groundwater supply	−0.6686 ^a	(0.0430)
Purchased water supply	−0.5783 ^a	(0.0460)
New system	−0.2222 ^a	(0.0586)
Constant	−0.8842	(0.3192)
Observations	51,889	
Log likelihood	−18,334.239	

^aSignificance level <0.01

^bSignificance level <0.05

Models also include state and year fixed effects.

population on the number of violations committed by a utility. The y-axis in Figure 1 is the population below the poverty line, moving from a community where 0% of the population is below the poverty line to a community where 50% of the population is below the poverty line. The x-axis represents the Hispanic

population of the community, moving from 0 to 100%. Red represents high numbers of predicted violations, while blue represents low numbers of health violations.

Figure 1 shows that the percent Hispanic population does not correlate with violations in the lower portion of the figure but strongly

predicts violations in the upper-right quadrant. In a community with 10% of the population below the poverty line, a change in the Hispanic population has very little effect on the number of violations committed. Moving from a 0% Hispanic population to an 80% Hispanic population results in a statistically insignificant increase in the number of predicted health violations from 0.10 to 0.11. The same increase in percent Hispanic population in a community with 40% poverty results in an increase in the predicted number of health violations from 0.09 to 0.17, or almost double the predicted violations. In other words, ethnic disparities in SDWA compliance are most pronounced in poorer communities.

The results are similar for the effect of black population on health violations. The contour plot in Figure 2 is similar to Figure 1, but the horizontal axis now represents the relative share of a community's black population. Percent black population does not correlate with the number of violations in the lower portion of the figure, where poverty is low. Where poverty is high, in the upper portion of the figure, moving from a low black population to a high black population greatly increases the number of violations. A move from 0% black population to 80% black population in a community with 40% of the population below the poverty line leads to a predicted increase in health violations from 0.09 to 0.13, equivalent to a 45% increase in the number of expected health violations.

Importantly, the effects of race and ethnicity in this statistical analysis cannot be dismissed as simply reflecting community socioeconomic conditions. The racial and ethnic disparities evident in the data persist after accounting for socioeconomic factors. Indeed, the interactive analysis indicates that the effects of race and ethnicity are amplified by poverty. Put

FIGURE 1 Effect of percent Hispanic population and poverty on Safe Drinking Water Act violations

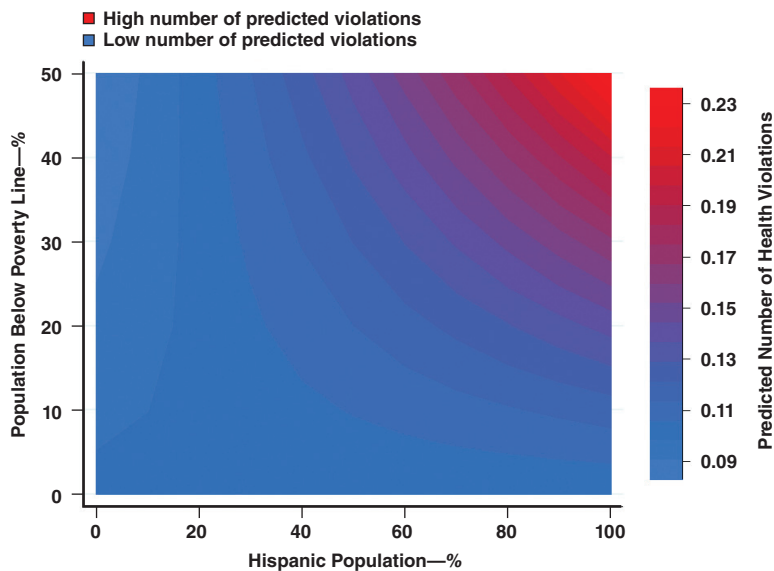
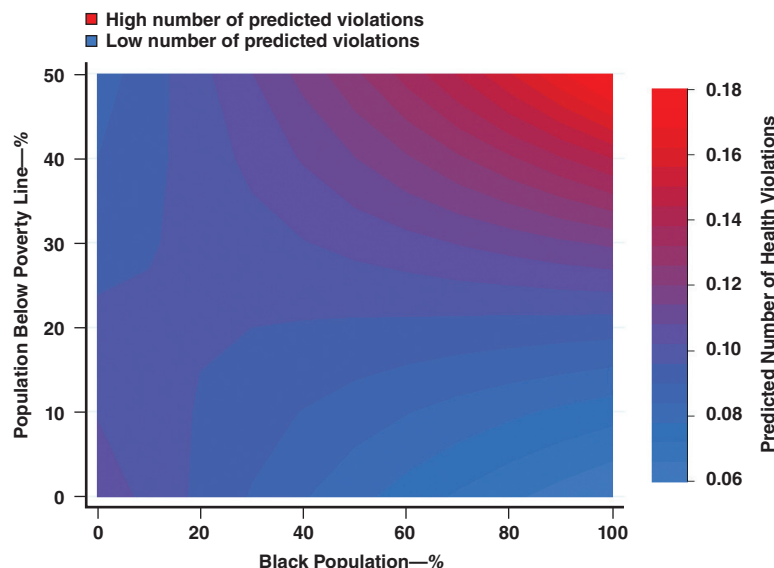


FIGURE 2 Effect of percent black population and poverty on Safe Drinking Water Act violations



another way, poor communities that are predominantly Hispanic or black are likely to experience worse SDWA health compliance than similarly poor communities that are predominantly non-Hispanic and white.

CONCLUSION AND IMPLICATIONS

Analysis of national water utility data shows that Flint and Corpus Christi are not isolated cases where communities of color received low-quality water; the results here provide strong evidence that there is a systemic issue in utilities serving low-income communities of color across the United States. In communities with higher populations of black and Hispanic individuals, SDWA health violations are more common. Importantly, this effect is not homogeneous across all utilities: it is in the poorest of communities that race and ethnicity seem to matter most in determining drinking water quality. Notably, while percent black population significantly correlates with drinking water violations, the correlation with Hispanic population is markedly stronger.

The racial, ethnic, and socioeconomic disparities in drinking water safety identified in this study are acute challenges to the utility industry in the United States. Not only do such disparities represent failures of the water utilities' core public health mission, they also threaten to undermine public trust and the legitimacy of utilities at a time when many utility leaders urgently need public support for capital replacement, improvement, and expansion. It is unlikely that the racial, ethnic, and socioeconomic disparities in American drinking water are due to conscious, overt bias; utility leaders and staff surely seek to provide the best service they can, regardless of their communities' color. Nonetheless, structural conditions, organizational incentives, and political contexts may contribute to the kind of "systemic discrimination

and racism" that the MCRC observed in Flint (2017).

As with any systemic problem, effective solutions to bias in drinking water quality will not be easy or immediate. In demonstrating racial, ethnic, and socioeconomic patterns of drinking water quality, this article seeks to open an industry-wide conversation on drinking water as a matter of environmental justice. Such conversations are never easy, and they are often uncomfortable. But AWWA's core principles of protecting public health and fostering diversity and inclusion demand that its utility leaders take up the challenge of ensuring equally high water quality to all of the people they serve.

ABOUT THE AUTHORS



David Switzer is an assistant professor in public administration at Florida Atlantic University, Boca Raton, Fla. His work investigates how context moderates the effect of organizational structures on utility performance. He is specifically interested in how factors external to organizations, such as citizen participation and human capital, affect the decision-making and performance of utilities. Manuel P. Teodoro (to whom correspondence may be addressed) is an associate professor at Texas A&M University, 2010 Allen Building, 4348 TAMU, College Station, TX 77843 USA; mteodoro@pols.tamu.edu.

<https://doi.org/10.5942/jawwa.2017.109.0128>

REFERENCES

- MCRC (Michigan Civil Rights Commission), 2017. *The Flint Water Crisis: Systemic Racism Through the Lens of Flint*. Michigan Department of Civil Rights, Lansing, Mich.
- Scheberle, D., 2004. *Federalism and Environmental Policy: Trust and the*

Politics of Implementation. Georgetown University Press, Washington.

- Switzer, D.; Teodoro, M.P.; & Karasik, S., 2016. The Human Capital Resource Challenge: Recognizing and Overcoming Small Utility Workforce Obstacles. *Journal AWWA*, 108:8:E416. <https://doi.org/10.5942/jawwa.2016.108.0093>.
- Teodoro, M.P., 2014. When Professionals Lead: Executive Management, Normative Isomorphism and Policy Implementation. *Journal of Public Administration Research and Theory*, 24:4:137. <https://doi.org/10.1093/jopart/muu039>.
- USCB (US Census Bureau), 2014. *2010–2013 American Community Survey*. www.census.gov/programs-surveys/acs/data.html (accessed May 12, 2015).
- USEPA (US Environmental Protection Agency), 2017. *EJ 2020 Action Agenda: EPA's Environmental Justice Strategy*. www.epa.gov/environmentaljustice/ej-2020-action-agenda-epas-environmental-justice-strategy (accessed Feb. 28, 2017).
- Wallsten, S. & Kosec, K., 2008. The Effects of Ownership and Benchmark Competition: An Empirical Analysis of US Water Systems. *International Journal of Industrial Organization*, 26:1:186. <https://doi.org/10.1016/j.ijindorg.2006.11.001>.

AWWA RESOURCES

- Roundtable—The Flint Crisis. McGuire, M.J.; Beecher, J.A.; Hanna-Attisha, M.; Masten, S.J.; & Rose, J.B., 2016. *Journal AWWA*, 108:7:26. Product No. JAW_0083783.
- The Path From Flint. LaFrance, D.B., 2017. *Journal AWWA*, 109:5:59. Product No. JAW_0084950.
- Why Flint Matters. Rothstein, E.P., 2016. *Journal AWWA*, 108:7:36. Product No. JAW_0083782.

These resources have been supplied by *Journal AWWA* staff. For information on these and other AWWA resources, visit www.awwa.org.

Journal AWWA welcomes comments and feedback at journal@awwa.org.