



State of New Jersey
DEPARTMENT OF HEALTH AND SENIOR SERVICES
CN 360
TRENTON, N.J. 08625-0360

CHRISTINE TODD WHITMAN
Governor

LEN FISHMAN
Commissioner

January 12, 1998

Barker Hamill
Bureau of Safe Drinking Water
Department of Environmental Protection

RE: Reportable infectious disease incidence and state coliform standards violations

Dear Barker:

In response to your request, we have completed an investigation into the possible association between the violations of total and fecal coliform/*E. coli* standards in community water systems and the reports of potentially waterborne infectious diseases. The available data suggest that only in one instance might coliform violations during 1991-1994 have been associated with increased occurrence of reportable diseases in the service areas of the water systems.

Methods

The diseases examined are those recognized by the U.S. Centers for Disease Control as potentially waterborne and reportable in New Jersey. They include:

- Hepatitis A
- Legionellosis
- Salmonellosis
- Shigellosis
- Campylobacteriosis
- Giardiasis

In addition, all cases of waterborne infectious disease, regardless of the pathogen, are required to be reported to the Department of Health and Senior Services (DHSS). However, it is rare that a reporting physician would recognize a waterborne disease outbreak. None of the viral cases of diarrhea (e.g., Norwalk virus, rotavirus, and many echoviruses) are reportable, per se, nor are they part of routine physician testing. The protozoan disease, cryptosporidiosis, was not reportable until 1997.

Violations of total and fecal coliform/*E. coli* standards in community water systems in the four-year period 1991-1994 were reported to the DHSS by the Bureau of Safe Drinking Water (Appendix). Coliform test results are interpreted differently in that each fecal coliform and *E. coli* detection is considered a violation, while total (or "monthly") coliform detections are reported as a violation only after 5% of the samples in a month (or one verified

detection when there are less than 40 samples per month) are positive. Water systems with violations were included in the analysis if the system served greater than 85% of the homes in a municipality. In cases where several municipalities were served by one system or where another system purchased all of its water from another system with a violation, each municipality served was part of the analysis. This analysis excluded military bases, institutions, parks, and small water systems serving fewer than 300 people.

Case counts of the above-noted reportable diseases in the involved municipalities were examined during a one month and a two month period after the date of each violation (Appendix). The incidence during this time period was compared with municipal and county incidence in the same calendar period during 1990-1994, excluding the year being examined. Use of similar seasonal periods of time is important because many infectious diseases have seasonal peaks. If there were multiple violations in a month, the comparison period would span from the date of the first violation to one and two months after the date of the last violation. If more than 30 days intervened between consecutive violations, the later violation or group of violations was considered a separate incident. For municipalities with violations in multiple years where the comparison time frame overlapped more than 15 days, comparisons were made only against years without violations. A comparison case count can be calculated by dividing the number of cases in the calendar period in the remaining years by the number of remaining years.

The statistical significance of comparisons was based on two-tailed 95% confidence intervals estimated by Poisson probabilities. Ratios of case counts served as a surrogate for rate ratios, assuming population stayed constant. Statistical comparisons were not made if there were less than 5 cases in the two-month period following a violation in an affected municipality, since the meaningfulness of temporal clusters of only a few cases is limited. Because small municipalities served by these systems have so few cases, small systems were also analyzed as a group.

Results

The Appendix lists the municipalities and dates of the fecal coliform/*E. coli* and the monthly total coliform violations, as well as the number of cases of each of the relevant reported diseases occurring one and two months after the initial positive tests and the total number of cases reported during the same one and two calendar periods during the entire 1990-1994 period. Surface water systems represented about 30-40% in both violation categories. Twenty-six community systems had fecal coliform/*E. coli* violations over 1991-1994, while 74 had total coliform violations. Eight systems had at least both one fecal and one total coliform violation during the same calendar month. In most instances violations were based on problems in a small part of the system.

Out of 29 fecal coliform and 103 total coliform violations in community water systems during 1991-1994, there was only one instance, in Elizabeth (see below), when a violation might have been associated with an elevated incidence of reported infectious disease(s) regarded as potentially waterborne, using the criterion of 5 or more cases occurring within the one or two month period following the violation(s).

In 1994, a total coliform violation in Elizabeth during August (8/3, 8/8, 8/10, 8/22, 8/25, and 8/29, at various locations) may have been associated with 5 cases of shigellosis and 6 of campylobacteriosis that were reported during the extended two-month period, August 3 through October 29. There were no cases of campylobacteriosis during this time frame during 1990-1993. The 1990-1993 annual average for shigellosis during the same time frame was 0.5 cases, yielding a statistically significant rate ratio for shigellosis of 10 (95%CI 3.2-23).

In addition, though 30% of the municipal population has private wells, excluding it from the study population definition, it is noted that a violation of the total coliform standard by the Hammonton Water Department in early September 1994 took place within two months of an identified shigellosis outbreak (#60-94), involving 79 cases, that occurred from primarily from November 1994 through March 1995. However, the two month time gap makes an association doubtful.

Following the criterion of 5 or more cases occurring in a municipality within the one-or two-month period following a coliform violation, only two fecal coliform/*E. coli* violations (in one municipality) and one total coliform

violation might have been candidates for statistical analysis. However, there were several additional instances where municipalities displayed an elevated incidence of reported infectious diseases occurring one and/or two months following total coliform violations when the case count was less than five. In 1991 Belleville had three reported cases of salmonellosis in the two months after the violation versus one additional case during the same calendar period during the rest of 1990-1994 (a rate ratio of 12). In 1992 Madison reported three cases of salmonellosis, which were the only cases in those one- and two-month calendar periods during the rest of 1990-1994. In 1993 Bloomfield had three cases of salmonellosis versus two additional cases during the same calendar period in the rest of 1990-1994 (a rate ratio of 6). In addition, Bloomfield had an elevated incidence of shigellosis (three cases during the two months following the total coliform detection versus one additional case during the same calendar period in the rest 1990-1994 (a rate ratio of 12). In 1991 Perth Amboy had four reported cases of giardiasis during the one month period following the total coliform violation versus one additional case in the same calendar period during 1990-1994 (a rate ratio of 16).

Grouping together water systems with coliform violations serving municipalities with populations less than 50,000, there was little evidence of an increased rate of reported infectious diseases

Discussion

All potential associations between water system violations and reported cases that may be waterborne disease must be substantiated by an investigation before they can be labelled as waterborne outbreaks. Unfortunately, it is difficult to establish the necessary facts several years later. As is well known, many of these diseases are spread by organisms whose prevalent sources are not drinking water. Salmonella and Campylobacter organisms have many food-borne sources. Shigella and Giardia are often spread through fecal-oral routes at day care centers and swimming pools. Giardiasis is also often contracted during foreign travel and drinking from untreated streams and springs.

However, conclusions drawn from the general absence of association between violation of microbial standards and reported infectious disease must also be limited for several reasons, related to both disease ascertainment and exposure classification.

Infectious disease reporting, as in almost all other states, is passive. Only a fraction of people with gastroenteritis, the most common symptom of waterborne infectious disease, see a physician, and only a fraction of those are tested for specific pathogens and ultimately reported to the Department of Health and Senior Services. Furthermore, there is no reporting requirement for specific types of viral gastroenteritis, such as rotavirus and Norwalk disease virus, nor do physicians typically test for those viruses.

On the water testing side of the equation, the detection of fecal coliform or *E. coli* is only an indication of fecal contamination, but it is not the same as detecting a specific pathogenic organism, especially an organism causing one of the reportable diseases. In addition, depending on the location of a positive water sample, not all of a system will be affected. Since the reported cases are only available on a municipality-wide basis, an elevated municipal rate would not be expected if only a small portion of the municipality is affected. Furthermore, since addresses are not currently entered into the database of reported diseases, one cannot electronically link disease data with sample sites and points of entry that triggered the violation. Another source of misclassification is from exposure elsewhere (e.g., job or vacation), though the case may have been diagnosed in the municipality of residence.

In conclusion, use of a simple method of retrospective analysis suggested a limited likelihood of waterborne illnesses stemming from violations of microbial standards. Only active surveillance can detect low level epidemics or endemic infectious disease incidence from potential waterborne sources with any reliability. This would involve querying physicians and/or pharmacies in and around affected towns when such violations occur. The recently released CDC Public Health Handbook on Cryptosporidium and Water has a number of recommendations in this regard. Another approach is to monitor pharmacy sales data in on-going projects, as currently done by New York City and Maryland. New York City also monitors diarrhea incidence in nursing homes. There has been increased

recognition of the usefulness of these monitoring methods ever since the cryptosporidiosis incident in Milwaukee, where pharmacies reported evidence of an outbreak before the water utility or the local health department even realized that there was a problem. In addition, future regulatory drinking water testing will probably include more microorganisms, such as the protozoan occurrence survey under the current USEPA Information Collection Rule.

If you have any questions, please call me at (609) 984-2193 or by email at pdh@doh.state.nj.us.

Sincerely,

A handwritten signature in black ink, appearing to read "Perry Cohn". The signature is written in a cursive style with a large initial "P" and a long horizontal stroke at the end.

Perry Cohn, Ph.D, M.P.H.
Drinking Water Project
Consumer and Environmental Health Services

c: James A. Brownlee, M.P.H.
Director, Consumer and Environmental Health Services

Janet DeGraff, M.P.H.
Director, Division of Communicable Diseases

APPENDIX

FECAL COLIFORM OR E. COLI MCL VIOLATIONS IN MUNICIPALITIES SERVED BY ONE COMMUNITY WATER SUPPLY (AND <15% PRIVATE WELLS), 1991-1994, COMPARED TO REPORTED INCIDENCE OF POTENTIALLY WATERBORNE INFECTIOUS DISEASES (SALMONELLOSIS, CAMPYLOBACTERIOSIS, SHIGELLOSIS, GIARDIASIS) ONE AND TWO MONTHS LATER AND THE SAME ONE- AND TWO-MONTH PERIOD DURING 1990-1994

Year	Municipality	Code	Date(s)	Salmonellosis				Campylobacteriosis				Shigellosis				Giardiasis			
				1mo*	1mo tot*	2mo*	2mo tot*	1mo	1mo tot	2mo	2mo tot	1mo	1mo tot	2mo	2mo tot	1mo	1mo tot	2mo	2mo tot
1991	Pemberton Boro	328	6/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Jersey City	906	7/8, 15, 19, 20, and 22	3	15	14	44	0	8	0	9	0	8	0	10	0	3	0	5
			10/7 and 8	4	16	5	27	0	0	4	5	1	2	1	5	0	1	0	4
	Hoboken#	905	(same as Jersey City, above)	4	12	7	18	0	0	0	0	0	2	0	2	0	1	0	1
				0	1	0	3	0	0	1	1	0	0	0	0	1	1	2	2
	Clinton	1005	8/8	0	0	0	0	0	0	0	7	0	1	0	1	0	1	0	1
	Milltown	1212	9/20	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0
	Boonton	1401	9/12	0	0	0	0	2	3	2	3	0	0	0	0	0	1	0	1
	Ocean Gate	1521	10/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Wanaque	1613	3/27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Passaic Valley Water Commission: Clifton sample site	1602	11/14	1	2	1	4	0	2	0	2	0	0	0	2	0	0	0	1
	Hackettstown	2108	4/22 and 24	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
1992	North Arlington	239	4/13 +	0	0	1	3	0	0	0	0	0	1	0	1	0	0	0	0
	Mt. Laurel	324	7/22	1	5	3	13	0	0	0	0	0	3	0	5	0	3	0	8
	Wildwood City	514	8/4, 5, 11, 12, and 19	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
	Vineland	614	12/15 and 17	2	13	2	13	0	0	0	0	0	0	0	0	0	0	0	0
	Bloomfield	702	8/12 +	0	1	1	5	1	1	1	1	0	1	0	2	0	3	0	4
			11/24	2	5	2	9	0	0	0	0	0	0	0	0	0	1	0	1
	Jersey City	906	8/18 and 19	1	27	2	45	0	1	0	2	0	2	0	4	0	2	0	2
	Old Bridge	1209	3/11 +	0	3	0	3	0	0	0	0	0	0	0	0	1	2	1	2
	Chatham Boro	1404	9/4 and 11 +	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
1993	Florence	315	4/16	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Jersey City	906	5/28	0	7	1	18	0	5	0	12	0	4	0	9	0	3	0	4
	North Brunswick	1215	7/8	0	3	0	4	0	0	0	1	0	5	1	7	1	2	1	3
	Keyport	1322	7/6 and 13	0	2	0	2	0	0	0	0	1	1	1	1	0	0	0	0
	Franklin	1906	11/15, 16, and	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Elizabeth	2004	7/29 and 8/2 +	0	19	0	24	0	8	0	9	0	4	0	7	0	0	0	1
1994	Garfield	221	8/30 +	0	2	1	3	0	0	0	0	0	0	0	0	0	2	0	2
	Perth Amboy	1216	10/4 +	0	5	0	7	0	3	0	5	0	0	0	0	0	6	0	12
	Pequannock	1431	12/20 +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total cases, 1991-1994 (including Jersey City, not Hoboken)				14	126	33	226	4	32	8	58	2	34	3	59	2	30	2	51

* 1mo or 2mo = number of cases in the 1 or 2 month(s) after the last date in the series of positive samples; 1mo tot or 2mo tot = the total number of cases during the relevant 1 or 2 month periods, 1990-1994, for the municipality.

Hoboken was included because it purchased 100% of its water from the Jersey City Water Department.

+ also a total coliform violation during the same month, same year

Year	Municipality	Code	Date(s)	Salmonellosis				Campylobacteriosis				Shigellosis				Giardiasis			
				1mo*	1mo tot*	2mo*	2mo tot*	1mo	1mo tot	2mo	2mo tot	1mo	1mo tot	2mo	2mo tot	1mo	1mo tot	2mo	2mo tot
	Sayreville	1219	8/	0	4	1	8	0	1	0	1	0	0	0	0	0	0	1	
	South Amboy	1220	5/	0	0	0	2	0	0	0	1	0	2	0	2	0	0	0	
	South River	1223	5/	0	2	0	3	0	0	0	0	0	2	0	2	0	0	0	
	Highlands	1317	10/	0	0	0	1	0	1	0	1	0	0	0	0	1	0	1	
	Boonton	1401	7/ ++	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
	Butler	1403	8/	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	
	Chatham Boro	1404	3/	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2	
			9/+	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	
	East Hanover	1410	1/	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	
	Madison	1417	2/	3	3	3	3	0	0	0	0	0	0	0	0	2	0	3	
	Penns Grove	1707	3/	0	0	2	2	0	0	0	0	1	1	1	1	0	0	0	
	Newton	1915	11/	2	4	2	4	0	0	0	0	0	0	1	1	0	2	2	
	Elizabeth	2004	8/ ++	1	6	1	10	0	3	0	3	0	1	0	5	0	0	1	
			10/ ++	0	10	0	14	0	3	0	3	0	2	0	5	0	1	1	
1993																			
	Florence	315	4/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Gloucester City	414	6/	0	1	0	1	0	0	0	0	0	0	1	1	0	0	1	
	Wildwood	514	9/	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	
	Belleville	701	6/	0	0	0	1	0	0	0	0	0	4	0	5	0	0	0	
			7/ ++	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	
			8/ ++	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	
			9/ ++	0	1	0	3	0	0	0	1	0	0	0	0	0	0	0	
	Bloomfield	702	7/	2	4	3	5	0	1	0	2	2	2	3	4	0	2	4	
	Livingston	710	7/	0	3	0	6	0	0	0	0	0	2	0	2	0	0	0	
	Stockton	1023	10/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	Hopewell Boro	1105	9/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Highland Park	1207	6/	0	0	0	2	1	1	1	2	1	2	1	3	0	0	0	
			7/	0	2	0	3	0	1	0	1	0	1	0	1	0	0	0	
	Old Bridge	1209	12/ ++	0	0	0	1	0	0	0	0	0	1	0	1	0	0	1	
	North Brunswick	1215	7/+	0	2	0	5	0	0	0	1	1	5	2	8	1	2	2	
	Keyport	1322	7/	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	
			8/	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	
			9/	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	
			11/	0	1	0	1	0	0	0	0	0	1	0	1	0	1	1	
	Boonton	1401	5/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			6/ ++	1	2	1	2	0	0	0	0	0	1	0	1	0	0	0	
			8/ ++	0	0	0	0	0	1	0	4	0	0	0	0	0	0	1	

Year	Municipality	Code	Date(s)	Salmonellosis			Campylobacteriosis			Shigellosis			Giardiasis						
				1mo*	1mo tot*	2mo*	2mo tot*	1mo	1mo tot	2mo	2mo tot	1mo	1mo tot	2mo	2mo tot	1mo	1mo tot	2mo	2mo tot
	Pennsville	1708	7/	0	4	0	1	0	0	0	0	0	1	0	2	0	0	0	0
			8/	0	7	0	8	0	0	0	1	0	1	0	2	0	0	0	0
	Franklin	1906	11/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Elizabeth	2004	6/	0	6	0	20	0	1	0	10	0	1	0	5	0	1	0	1
			7/+ ++	0	14	0	20	0	9	0	12	0	4	0	5	0	0	0	0
			9/ ++	0	4	0	14	0	0	0	3	0	4	0	6	0	1	0	2
1994																			
	Garfield	221	8/+	0	3	0	5	0	0	0	0	0	0	0	0	1	0	2	
	Burlington City	305	9/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	Cape May	502	4/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			5/	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	
	Stone Harbor	510	4/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			5/	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1	
			8/	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
	Wildwood	514	3/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			10/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belleville	701	3/	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	
			8/	0	3	0	4	0	0	0	0	0	0	0	0	0	0	0	
			10/	0	2	0	3	0	1	0	2	0	0	0	0	0	0	0	0
	Glassboro	806	9/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Pitman	815	5/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Stockton	1023	9/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Milltown	1212	1/	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Perth Amboy	1216	10/+	0	4	0	6	0	3	0	5	0	0	0	0	6	0	12	
	Sayreville	1219	4/	1	3	2	6	0	0	0	0	0	0	0	0	0	0	0	
	South Amboy	1220	2/	0	1	0	1	0	0	0	1	1	1	1	0	0	0	0	
	South Brunswick	1221	6/	1	3	1	4	0	2	1	5	0	0	2	0	1	0	4	
	Madison	1417	11/	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Pequannock	1431	12/+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Elizabeth	2004	4/	1	2	2	4	0	1	0	2	0	0	1	4	0	0	1	
			8/3, 8, 10, 22, 25, 29 ++	0	5	1	9	3	3	6	6	2	3	5	7	0	0	1	1
	Total cases, 1991-1994			26	172	40	297	5	53	6	95	11	64	21	112	11	47	15	99

* 1mo or 2mo = number of cases in the 1 or 2 month(s) after the last date in the series of positive samples; 1mo tot or 2mo tot = the total number of cases during the relevant 1 or 2 month periods, 1990-1994, for the municipality.

+ also a total coliform violation during the same month and year.

++ Two or more instances of monthly total coliform violation during significantly overlapping two-month calendar periods (see Methods) in different years.