



DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service
Centers for Disease Control
and Prevention (CDC)

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Subject: Epi-Aid Trip Report: An assessment of health concerns in a community exposed to chloramine treated tap water in Vermont, 2006–2007 (Epi-2007-054).

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INTRODUCTION

The U.S. Environmental Protection Agency (EPA) requires all public water supplies (PWSs) using surface water to disinfect the water provided to their customers. In addition, all PWSs are required to maintain a residual disinfectant throughout the water distribution system to control bacterial re-growth. PWSs have several options for methods to disinfect drinking water, including filtration or chemical disinfection with chlorine or chloramine. Because chloramine produces fewer of the drinking water disinfection by-products that are currently regulated by the EPA, using chloramine as a secondary disinfectant is becoming more common. Chloramine is produced by combining chlorine and ammonia in water and, under the usual conditions of water and wastewater chlorination, monochloramine is the principal end product and disinfectant. Chloramine has been approved for use by the EPA; however, data gaps remain about the potential health effects of using chloramine for large scale water disinfection.

Chloramine has been used since before World War II for drinking water treatment. Its most frequent current use is as a residual disinfectant; its use allows systems to maintain the required detectable residual throughout the distribution system while simultaneously controlling regulated disinfection byproducts (total trihalomethanes (TTHM) and five haloacetic acids (HAA5)). There is also evidence that chloramine may control biofilm in the distribution system more effectively than other residual disinfectants (see EPA's website for information about chloramine disinfection of drinking water: <http://www.epa.gov/safewater/disinfection/chloramine/index.html>).

BACKGROUND

On April 10, 2006, Vermont's Champlain Water District (CWD) changed its drinking water treatment process to use chloramine rather than chlorine as the secondary disinfectant. CWD's use of chloramine is consistent with use in systems across the

country. This change affected Chittenden County (12 municipal systems that serve approximately 68,000 people). Between April 2006 and May 2007, the Vermont Department of Health Agency of Human Services and the Champlain Water District received approximately 74 calls from community members reporting a wide range of health symptoms, including upper respiratory symptoms, complaints of watery eyes and nose, scratchy throat, gastrointestinal ailments, skin rashes, and “itchy skin.” The Division of Environmental Hazards and Health Effects (EHHE) of the National Center for Environmental Health (NCEH) was asked to investigate community concerns regarding exposure to chloramine treated tap water.

METHODS

On September 25, 2007 a seven person team from CDC and the EPA arrived in Burlington, Vermont. The team from CDC consisted of two Epidemic Intelligence Service Officers, a Senior Epidemiologist, and a Medical Student. The team from the EPA consisted of the Associate Director of Drinking Water from EPA’s Region 1 in Boston, MA; and a Water Engineer, and an Environmental Science and Policy Specialist from the Office of Water/Ground Water and Drinking Water Standards and Risk Management Division in Washington, DC. The objective of the trip was to gather information to better understand community concerns about symptoms believed to be associated with exposure to tap water disinfected with chloramine.

Tuesday afternoon, 9/25, the CDC team met with the Vermont Department of Health and reviewed a questionnaire prepared by CDC to characterize symptoms which people reported to be associated with chloramine exposure.

On Wednesday 9/26, there was a full day of meetings that allowed an organized venue for various groups to express their concerns about chloramine exposure. Our meetings started with the Commissioner of Health, Commissioner of Environmental Conservation, and Health Department staff. We then met with the Champlain Water District senior staff and engineers, and then the State’s Senator and local Representatives. In the afternoon on Wednesday, we met with advocacy groups: People Concerned about Chloramine (PCAC) and Vermonters for a Clean Environment. On Thursday morning 9/27, we toured the water treatment plant to view their drinking water treatment process. Home visits and telephone interviews were conducted from Wednesday afternoon through Friday afternoon. We returned to Atlanta on Friday evening, 9/28.

The media requested permission to attend all of the meetings scheduled for Wednesday. They were provided the opportunity to interview representatives from each group involved in the meetings and to record the meeting with the advocacy groups.

Group	Stated Objective for Participation in Meeting
People Concerned about Chloramine	To have chloramine removed from drinking water
Vermonters for a Clean Environment	To have chloramine removed from drinking water
State Legislators	Wanted to understand all issues
Champlain Water District	Explain their water treatment process, changes in the process, and their concerns

HOME VISITS AND TELEPHONE INTERVIEWS

Participant inclusion criteria

Eligible participants included all individuals residing in Chittenden County, Vermont, who had contacted the Champlain Water District or were identified in local media since April 10, 2006 and reported health effects they believed were associated with exposure to tap water.

Questionnaire

A questionnaire was prepared which focused on respondents' health, health of their families, and tap water usage (Appendix A). We interviewed 50 individuals either by telephone or during a home visit. A water engineer was part of each team visiting homes, and they examined point-of-entry and/or point-of-use water filtration systems in the residences.

Statistical Analysis

We entered and analyzed data in EPI Info 3.3.2. Descriptive statistics are presented.

Quality Control of data collection

Self-reported symptoms

This investigation was subject to biases as discussed below and any data analyses should be interpreted with caution. The respondents to this questionnaire were a convenience sample and were not examined by a medical care provider to verify the symptoms they reported.

Local influence

It was reported to field investigators, that the local chapter of People Concerned about Chloramine (PCAC) had implemented a mass media campaign prior to our arrival. This campaign distributed approximately 10,000 flyers by going door to door and approaching individuals "on the street" and in grocery stores. One report stated an individual with visible skin problems was approached by a member of PCAC in the grocery store and was told the source of their skin problem was the chloramine in the tap water. PCAC has also utilized the local press and public radio spots to mobilize an anti-chloramine campaign. This campaign started prior to April 2006 and continues today. PCAC's flyers and internet website have identified symptoms they claim are associated with the change in water disinfection, including furry tongues, gastrointestinal upset, dermatitis, and respiratory ailments.

Field investigators observed PCAC members coaching survey respondents (many of whom are PCAC members) prior to the meeting on Wednesday. In one case, a PCAC

member was present during the home visit and prompted the respondent to provide specific answers to our questions.

Based on these influences and biases these results can not be interpreted as representing the rates of symptoms, health conditions, or complaints of the overall community.

RESULTS

All interviews were conducted between September 26 and October 10, 2007. At first 74 individuals were contacted by the health department and asked if they would participate in the questionnaire and or home visit. Of those 74 individuals 49 were interviewed. At the request of PCAC the deadline for interviews was extended. This extension allowed PCAC time to contact their membership, requesting their participation in the questionnaire and provided the Vermont Department of Health the opportunity to continue interviewing individuals who wanted to participate in the questionnaire. One person contacted the health department following the extension of the deadline. Of the 50 individuals interviewed, 46 met the inclusion criteria described above. Of the four excluded: three stated their symptoms were not caused by the water and one individual had no symptoms but called because they were concerned. The 46 individuals interviewed represented 36 households. The median age of participants was 55 years (range: 2-88 years) and 29 (63%) were female. Our questionnaire inquired about 11 symptoms and participants were asked to identify if they had experienced any of these symptoms (Table 1). In addition we asked participants what activities, if any, triggered their symptoms (Table 2).

Twenty-five (54%) of the participants stated they had preexisting chronic health conditions. Of these, 6 reported more than one preexisting chronic health condition. The chronic health conditions and the number of participants reporting each condition were as follows: allergies (9), dermatologic problems (6), arthritis (5), asthma (4), diabetes (3), auto immune disorders (3), cardiac history (3), respiratory (2), cancer (2) and other (6). Thirty two (70%) of the participants sought medical attention for their symptoms and 8 (17%) of these individuals received a diagnosis. The diagnoses reported and the numbers of participants with each diagnosis were as follows: psoriasis/eczema (5), fluid in the lungs (1), "writer's rash" (1), and surface eye irritation (1).

We also asked study participants if they had changed their source of drinking water or changed how they used their water. Of the 46 participants: 34 (74%) reported they have changed their tap water habits. These changes included showering outside the home (outside water district's domain); using bottled water for drinking, bathing and or both; lowering temperature of water, or shortening duration of exposure. Twenty three (50%) reported they filter or purify their household water. There were 4 (17%) who reported they use a point of entry filtration system and 16 (70%) who use a point of use filter in their home (such as a carbon filter) and 3 (13%) did not answer the question.

Of the 34 participants who reported they have changed their tap water use habits, 23 (67.6%) reported their symptoms improved or had gone away after they changed their water use. Four (11.8%) reported no change, 3 (8.8%) reported they did not know, and 4 (11.8%) did not answer the question.

Table 1. Symptoms reported by 46 residents of Chittenden County, VT which they believed were associated with exposure to chloramine treated tap water, September and October 2007.

Symptoms	Number of people reporting symptom		%
Dry, flaky, or itchy skin	36		78.3
Rash	28		60.9
Eye irritation	23		50
Cough	20		43.5
Joint aches	14		30.4
Breathing troubles	14		30.4
Skin pain, numbness or tingling	10		21.7
Diarrhea	10		21.7
Headache	9		19.6
Anything else	8		17.8
Fever	2		4.3

Table 2. Activities reported to be associated with symptoms for the 46 residents of Chittenden County, VT who reported symptoms, September and October 2007.

Symptoms	Shower		Bath		Drank		Washed Dishes	
	N	%	N	%	N	%	N	%
Dry flaky itchy skin (N=36)	25	69.4	5	13.9	3	8.3	4	11.1
Rash (N=28)	20	71.4	4	14.3	4	14.3	2	7.1
Eye irritation (N=23)	17	73.9	3	13	1	4.3	0	0
Cough (N=20)	8	40	1	5	5	25	0	0

ENVIRONMENTAL PROTECTION AGENCY OBSERVATIONS

CWD treatment and operational practices

Based on information provided by CWD staff, CWD operations are consistent with good operational practices for drinking water treatment. Chloramine dosage, chlorine:ammonia ratio, and pH are near the median for national use. CWD's chloramine concentration of 1.8-2.3 mg/L at its distribution system entry point is well below the maximum residual disinfectant level (MRDL) of 4.0 mg/L (with compliance determined as an annual average); actual exposure for consumers from water delivered by the distribution system will be less. It is important to note that the MRDL for chloramine was set at the MRDL goal (MRDLG); MRDLG was set at a level at which no known or anticipated human health effects occur, with an adequate margin of safety, as is required under the Safe Drinking Water Act amendments.

CWD has conducted additional monitoring beyond that required for compliance determination in order to better understand and control their treatment and distribution processes. CWD has measured no increase in lead levels; this is probably due to their careful switch from chlorine to chloramine as the residual disinfectant. This is part of the system's proactive compliance strategy (preventing violations) rather than a reactive compliance strategy (responding only after violations).

Observations made during visits to individual households

An EPA staff member was included in each CDC team that visited individual households, to evaluate any treatment that homeowners may have installed. Teams found a mixture of no

treatment, treatment to reduce chloramine level, and treatment that addressed issues other than chloramines. There was a mixture of point-of-entry (whole house) and point-of-use (faucet or showerhead) treatment units. Based on these visits, there do not appear to be any supportable engineering conclusions that can be made concerning a link between treatment and exposure/symptoms.

RECOMMENDATIONS

1. Not having baseline data, the post hoc analysis is difficult especially since there are strong biases with this data. Information provided by this questionnaire should be utilized to explore the design of future prospective studies eliminating biases and allowing for a baseline understanding of the symptoms that pre-exist in the community.
2. CDC and EPA should work with State and local agencies to develop the next steps in addressing the issue of community concerns about chloramine-treated tap water.

OMB CLEARANCE

This was not a research study.

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Appendix A: Questionnaire

Self-reported Symptoms and Exposure to Chloramine-Treated Tap Water, Vermont Questionnaire

INTRODUCTION SCRIPT

VT State Health Department Staff

Hello, may I speak with _____? My name is _____, and I am calling from the VT State Health Department. We are working with the Centers for Disease Control and Prevention looking into reported symptoms related to exposure to chloramine treated tap water. We received your name from the Champlain Water District because you have reported symptoms. We would like to ask you some questions about your health, the health of your family, and your tap water usage. Your answers will help us understand what symptoms have been reported since the Champlain Water District switched over to disinfecting their water with chloramine. The questions will take about 20 minutes. May we go ahead now with the questionnaire?

If no, is there a convenient time when I can call you back?

Day: _____ Time: _____ AM / PM

Telephone: _____

CDC Staff

Hello, may I speak with _____? My name is _____, and I am calling from the Centers for Disease Control and Prevention. We are working with the VT Department of Health looking into reported symptoms related to exposure to chloramine treated tap water. We received your name from the Champlain Water District because you have reported symptoms. We would like to ask you some questions about your health, the health of your family, and your tap water usage. Your answers will help us understand what symptoms have been reported since the Champlain Water District switched over to disinfecting their water with chloramine. The questions will take about 20 minutes. May we go ahead now with the questionnaire?

If no, is there a convenient time when I can call you back?

Day: _____ Time: _____ AM / PM

Telephone: _____

CASE No: _____

Self-reported Symptoms and Exposure to Chloramine-Treated Tap Water, Vermont
Questionnaire

Date: _____

Time interview began: __: __ AM / PM

Interviewers Initials: _____

1.0 First, I would like to confirm that you contacted someone to report that you or someone you know had symptoms. Did you contact any person or organization to report these symptoms?

- No
- Yes
- Don't know
- Refused

IF NO. OK, we are interested in talking with the people who contacted someone to report symptoms. I am sorry to bother you. Thank you for your time.

IF YES:

1.0a Can you please tell me who you contacted? (check all that apply)

- Champlain Water District
- Vermont Department of Health
- People Concerned about chloramine
- Health care professional
- Emergency room
- Newspaper
- Radio or TV
- Political representative
- Don't know
- Refused
- Other, explain _____

Now I would like you to think back to when you contacted <CONTACT> to report these symptoms. Then, I would like to ask you a couple of questions about that call. Are you ready?

1.0b What prompted you to contact <CONTACT>?

1.0c Were you calling for yourself or for someone else?

- Self
- Someone else

1.0d If you were calling for someone else, what is their name and relationship to you?

1.0d1 Name: _____

1.0d2 Relationship: _____

1.0e Could I please interview that person / May we continue with the interview?

(If child, ask parent if you can continue on with interview)

- Yes, interviewed other person
- No, refused
- No, other person not available
- Yes, interviewed other person
- Yes, interviewed parent or individual on phone who made contact for other person

2.0 If you were experiencing symptoms or health problems when you made your contact, can you tell me what they were? Also, I would like to know when each symptom started, when it stopped,

whether or not you have the symptom now and what activities trigger these symptoms. Is that clear?

OK, can you tell me your symptoms?

2.0a Symptom	2.0b Start Date	2.0c End Date	2.0d Have it now?	2.0e Do any of the following activities trigger these symptoms?
			<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Don't know <input type="checkbox"/> Refused	<input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____ <input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____
			<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Don't know <input type="checkbox"/> Refused	<input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____ <input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____
			<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Don't know <input type="checkbox"/> Refused	<input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____ <input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____
			<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Don't know <input type="checkbox"/> Refused	<input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____ <input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____
			<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Don't know <input type="checkbox"/> Refused	<input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____ <input type="checkbox"/> Washing dishes <input type="checkbox"/> Doing laundry <input type="checkbox"/> Using dishwasher <input type="checkbox"/> Showering <input type="checkbox"/> Taking a bath <input type="checkbox"/> Using hot tub <input type="checkbox"/> Other Explain _____

3.0 In addition to the symptoms you told me about, I am now going to read you a list of symptoms.

Did you have the following symptom?

Did it get worse when you: _____?

Before April 2006 when you _____ (activity) did you have this symptom?

3.0a Cough

- No
- Yes
- Don't know
- Refused

- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____

- No
- Yes
- Don't know
- Refused

3.0b Fever?

- No
- Yes
- Don't know
- Refused

- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____

- No
- Yes
- Don't know
- Refused

3.0b1 How High ___

3.0c Headache?

- No
- Yes
- Don't know
- Refused

- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____

- No
- Yes
- Don't know
- Refused

3.0d Joint aches?

- No
- Yes
- Don't know
- Refused

- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____

- No
- Yes
- Don't know
- Refused

3.0e Breathing troubles?

- No
- Yes
- Don't know
- Refused

- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____

- No
- Yes
- Don't know
- Refused

3.0f Rash?

- No
- Yes
- Don't know
- Refused

- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____

- No
- Yes
- Don't know
- Refused

Did you have the following symptom?

3.0g Dry, flakey, or itchy skin?

- No
- Yes
- Don't know
- Refused

3.0h Skin pain, numbness or tingling?

- No
- Yes
- Don't know
- Refused

3.0i Diarrhea?

- No
- Yes
- Don't know
- Refused

3.0j Eye irritation?

- No
- Yes
- Don't know
- Refused

3.0k Anything else?

- No
- Yes
- Don't know
- Refused

Did it get worse when you:

- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____
- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____
- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____
- Washed dishes
- Did laundry
- Used dishwasher
- Showered
- Took a bath
- Used hot tub
- Drank
- Cooked
- Other Explain _____

Before April 2006 when you _____ (activity) did you have this symptom?

- No
- Yes
- Don't know
- Refused

- No
- Yes
- Don't know
- Refused

- No
- Yes
- Don't know
- Refused

- No
- Yes
- Don't know
- Refused

- No
- Yes
- Don't know
- Refused

4.0 Did you seek medical attention for any of the symptoms we just talked about?

- No
- Yes
- Refused
- Don't know

Comments: _____

IF NO go to 5.0

IF YES:

4.0a Where did you go? (check all that apply)

- Primary Care Provider
- Emergency Department
- Urgent care
- Alternative health care provider
- Other

Explain _____

4.0b Were you hospitalized for this condition?

- Yes
- No
- Refused
- Don't know

4.0b1 If yes, when? _____

4.0c Did you receive a diagnosis?

- No
- Yes
- Refused
- Don't know

4.0c1 If yes, what was the diagnosis? _____

5.0 We have heard that people have stopped using their tap water for certain activities, like showering. Have you changed your tap water use habits?

- No
- Yes
- Refused
- Don't know

5.0a If yes, can you please explain? _____

6.0 Do you filter or purify your household water?

- No
- Yes
- Refused
- Don't know

6.0a If yes, do you have a point-of-entry filter, that is one that serves your whole house or a point-of-use filter, that is, a filter just for your drinking water?

- Point-of-entry filter
- Point-of-use filter

6.0a1 IF POINT-OF-ENTRY (serves your whole house)

Can you tell me what kind of point-of-entry system you use?

- Carbon filter
- Water softener
- Ultraviolet treatment
- Reverse osmosis
- Other

Describe _____

- Refused
- Don't know

6.0a2 IF POINT-OF-USE (just for your drinking water)

Can you tell me what kind of point-of-use treatment system you use?

- Carafe filter
- Faucet-mounted filter
- Counter-top filter
- Under-sink filter
- Refrigerator filter
- Other
- Describe _____
- Refused
- Don't know

6.0a2a What type of treatment is the point-of-use system?

- Carbon filter
- Ultraviolet treatment
- Reverse osmosis
- Distiller
- Other
- Describe _____
- Refused
- Don't know

6.0a3 What is the name of your filter and name of the company that manufactured your filter?

- Access business Group LLV – makers of eSpring products
- Culligan International Co.
- Cuno Inc - makers of Aqua-Pure
- Everpure LLC
- Japin International Inc.
- Multi-Pure
- Paragon Water Systems, Inc.
- Rainsoft Division of Aquin – makers of Hydrefiner
- Selecto Scientific, Inc
- Shurflo Pump Manufacturing Co.
- Sta-Rite Industries
- Other
- Describe _____

7.0 Are you on municipal tap water, that is, do you get your water from the Champlain Water District?

- No
- Yes
- Refused
- Don't know

IF NO:

Can you tell me the source of your tap water? _____

7.0a Have your symptoms improved or gone away since you changed your water use?

- No
- Yes
- Refused
- Don't know

Now I am going to ask you a few questions about your general health.

8.0 Do you have any chronic health conditions, such as diabetes, skin conditions, asthma, allergies or anything else?

- No
- Yes
- Refused
- Don't know

8.0a If yes, what are they? _____

8.0b When were you diagnosed with this / these conditions? Date: _____

Now I have a few questions about you.

9.0 How old are you? _____

10.0 What is your sex?

- Male
- Female

11.0 Is there anything else related to your chloramine concern that you think I should know about?

That was the last question. Thank you for taking the time to answer our questions.

If you are interested in the results of this questionnaire and additional information on water disinfection, please refer to the Vermont Department of Health website at <http://healthvermont.gov/enviro/water/chloramine.aspx>