

## Overview of Illnesses Associated with Raw Milk Consumption

### Summary of selected bacterial pathogens that can be found in raw milk

| Organism        | Incubation Period | Symptoms  | High-risk Groups   |
|-----------------|-------------------|---|--|
| Campylobacter   | 1-10 days         | Diarrhea (often bloody), abdominal pain, malaise, fever, nausea, vomiting   | Children under age 5, young adults, immunosuppressed   |
| Salmonella      | 6-72 hours        | Fever, headache, abdominal pain, diarrhea, nausea, vomiting   | Infants, the elderly, immunosuppressed   |
| E. coli O157:H7 | 2-10 days         | Diarrhea (can be bloody), hemolytic uremic syndrome   | Children under age 5, the elderly  |
| Listeria        | 3-70 days         | Encephalitis, septicemia, coma, fever, headache, nausea, vomiting. Usually results in spontaneous abortion in pregnant women. Fatality approximately 35% in adults and 50% in newborns. | Pregnant women, fetuses, newborns, immunosuppressed, the elderly, alcoholic or diabetic adults |

In 1938, before milk pasteurization was widespread, an estimated 25% of all foodborne outbreaks were associated with milk. By 2001, this percentage was estimated at <1%.<sup>1</sup>

During 1973-1992, raw milk was associated with 46 outbreaks. Most of these occurred in states in which the sale of raw milk was legal.<sup>2</sup>

Among dairy product-associated outbreaks reported to CDC between 1998 and 2011 in which the investigators reported whether the product was pasteurized or raw, 79% were due to raw milk or cheese. From 1998 through 2011, 148 outbreaks due to consumption of raw milk or raw milk products were reported to CDC. These resulted in 2,384 illnesses, 284 hospitalizations, and 2 deaths. Most of these illnesses were caused by *Escherichia coli*, *Campylobacter*, *Salmonella*, or *Listeria*. It is important to note that a substantial proportion of the raw milk-associated disease burden falls on children; among the 104 outbreaks from 1998-2011 with information on the patients' ages available, 82% involved at least one person younger than 20 years old<sup>3</sup>.

Because not all cases of foodborne illness are recognized and reported, the actual number of illnesses associated with raw milk is likely greater.

### Examples of United States Outbreaks Associated with Raw Milk

| Year | Pathogen                      | State(s) | Number of Cases | Notes  |
|------|-------------------------------|----------|-----------------|--|
| 2013 | <i>Salmonella</i> (cheese)    | MN       | 25              | 15 hospitalized, no deaths                               |
| 2012 | <i>Campylobacter jejuni</i>   | PA       | 148             | 10 hospitalized; Same dairy had another outbreak in 2013 |
| 2011 | <i>Campylobacter jejuni</i>   | WI       | 16              | 1 hospitalized, no deaths                                |
| 2010 | <i>Listeria monocytogenes</i> | NY       | 5               | 5 hospitalized, 1 death                                  |
| 2010 | <i>Campylobacter jejuni</i>   | NY       | 20              | 1 hospitalized, no deaths                                |
| 2009 | <i>Campylobacter jejuni</i>   | WI       | 52              | 1 hospitalized, no deaths                                |
| 2008 | <i>E. coli</i> O157           | CT       | 14              | 5 hospitalized, no deaths                                |

<sup>1</sup> Center for Food Safety and Applied Nutrition. Grade "A" pasteurized milk ordinance: 2001 revision. FDA 2002. Available at <http://www.cfsan.fda.gov/~ear/pmo01.html>.

<sup>2</sup> Headrick ML, Korangy S, Bean NH, et al. The epidemiology of raw milk-associated foodborne disease outbreaks reported in the United States, 1973 through 1992. *Am J Pub Health* 1998;88:1219-1221.

<sup>3</sup> <http://www.cdc.gov/foodsafety/rawmilk/raw-milk-questions-and-answers.html#related-outbreaks>

|           |                               |                |    |   |
|-----------|-------------------------------|----------------|----|---|
| 2008      | <i>Campylobacter jejuni</i>   | PA             | 65 | 1 hospitalized, no deaths                   |
| 2007      | <i>Salmonella</i> Typhimurium | PA             | 29 | 2 hospitalized, no deaths                   |
| 2007      | <i>Campylobacter jejuni</i>   | KS             | 68 | 2 hospitalized, no deaths                   |
| 2005      | <i>E. coli</i> O157:H7        | WA, OR         | 18 | 5 hospitalized, 4 hemolytic uremic syndrome |
| 2002-2003 | <i>Salmonella</i> Typhimurium | IL, IN, OH, TN | 62 |   |
| 2001      | <i>Campylobacter jejuni</i>   | WI             | 75 | None hospitalized                           |
| 2000-2001 | <i>Listeria monocytogenes</i> | NC             | 12 | 5 stillbirths, 3 premature deliveries       |

## Vermont Outbreaks Associated with Raw Milk

### 2010 Outbreaks

In 2010 the Vermont Department of Health investigated 3 outbreaks of campylobacter infection associated with raw milk consumption. The first outbreak occurred in June among guests of a B&B and included 2 farm workers who worked on the dairy farm where the B&B was located. A total of 4 confirmed and 6 probable cases (symptoms consistent with campylobacter infection but no confirmatory lab test available) were identified. Two of the confirmed cases were small children visiting from Connecticut. One of the children experienced febrile seizures and had to be taken to an Emergency Department. The common exposure among the cases was drinking raw milk. The B&B owner did not sell raw milk but incorrectly assumed that the current law allowed her to serve raw milk to her guests.

The second outbreak occurred in August 2010 and involved inmates at a work camp associated with a correctional facility. While painting fences at a nearby dairy farm, the work crew was offered raw milk to drink by the owner of the farm. Five of the ten inmates and the Crew Officer developed a diarrheal illness within a few days of drinking the raw milk. Three of the cases submitted stool samples which tested positive for *Campylobacter sp.* All of the ill people drank the raw milk.

The third outbreak occurred in December and involved students on a field trip to a local dairy farm. Ten students and one teacher became ill with diarrheal illness after visiting the farm. Two people visited Emergency Departments and submitted stool samples which tested positive for *Campylobacter sp.* Cases were ill for an average of 6 days, and 80% missed at least one day of school. All of the cases drank raw milk which was offered during the field trip at the end of the farm tour.

In October 2010, a Vermont resident became ill with *E. coli* O157:H7 infection. This person had been traveling in Washington prior to becoming ill. An investigation by the Oregon and Washington health departments implicated a raw milk cheese that was produced in Washington.

### Outbreaks – Prior Years

In 2008 the Vermont Department of Health investigated a cluster of two *E. coli* O157:H7 cases among picnic attendees. An additional case was confirmed in a person living near the picnic site. The DNA fingerprint of the third *E. coli* isolate was closely related to that of the other two cases, suggesting that the pathogens were acquired from the same source. The only epidemiologic link between the third case and the other two is that the third case consumed raw milk from the same local farm that supplied raw milk for ice cream made at the picnic. This epidemiologic evidence suggests that the raw milk was the source of illness among these cases of *E. coli* O157:H7.

In 2003 the Department of Health investigated a campylobacter outbreak among employees at a Vermont farm. Contact with raw milk, cheese curds, and animals were statistically related to illness. There is some evidence to suggest that cattle have increased shedding of the organism during calving and weaning. This may account for the outbreak of campylobacter coinciding with calving on the farm.

In 1982 the Department of Health investigated a community outbreak of 15 cases of gastroenteritis that was linked to consumption of raw milk from a licensed dairy. The outbreak was caused by

*Campylobacter jejuni*. Over half the cases had bloody diarrhea and one child was hospitalized. The average length of illness was 7.2 days. Six additional *Campylobacter* outbreaks between 1982 and 1987 were traced to raw milk.

### PulseNet

PulseNet is a national network of public health and food regulatory agency laboratories. PulseNet laboratories perform standardized molecular subtyping (DNA “fingerprinting”) of foodborne disease-causing bacteria by pulsed-field gel electrophoresis (PFGE). PFGE can be used to distinguish strains of organisms such as *E. coli* O157:H7, *Salmonella*, *Listeria*, or *Campylobacter* at the DNA level. DNA “fingerprints,” or patterns, are used to identify common source outbreaks.

### Vermont Case Data

Between 2003 and 2013, 215 Vermonters with *Campylobacter* infection reported consuming raw milk. Most reported other risk factors as well, such as contact with farm animals. Even so, it is likely that some of those illnesses were caused by raw milk consumption.

|                            | Percentage of <i>Campylobacter</i> Cases in Vermont with Raw Milk Exposure |             |              |              |             |              |              |              |              |             |              |
|----------------------------|--|-------------|--------------|--------------|-------------|--------------|--------------|--------------|--------------|-------------|--------------|
|                            | 2003   | 2004        | 2005         | 2006         | 2007        | 2008         | 2009         | 2010         | 2011         | 2012        | 2013         |
| Cases who drank raw milk   | 32   | 6           | 15           | 19           | 11          | 24           | 25           | 24           | 24           | 15          | 20           |
| Total cases                | 142  | 105         | 104          | 110          | 154         | 158          | 158          | 195          | 233          | 169         | 184          |
| Percent who drank raw milk | <b>22.5%</b>   | <b>5.7%</b> | <b>14.4%</b> | <b>17.3%</b> | <b>7.1%</b> | <b>15.2%</b> | <b>15.8%</b> | <b>12.3%</b> | <b>10.3%</b> | <b>8.9%</b> | <b>10.9%</b> |

According to FoodNet, the CDC’s foodborne disease surveillance system, 3.0% of Americans surveyed in 2006-2007 had consumed raw milk in the seven days prior to the survey.<sup>4</sup> The percent of Vermonters with *Campylobacter* who consumed raw milk is higher than 3.0% for each of the past eleven years. This data suggests that raw milk consumption may have been the source of illness in some of these cases.

<sup>4</sup> Centers for Disease Control and Prevention. *Foodborne Diseases Active Surveillance Network (FoodNet): Population Survey Atlas of Exposures*. Atlanta: Centers for Disease Control and Prevention; 2006-2007.