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Tuesday, February 23,2021

Vermont House of Representatives Committee on Agriculture and Forestry:

Please do not vote to expand the sale of unpasteurized milk to non-producers' farm-stands and through CSAs in Vermont. To allow for full discussion around modern testing techniques and complete consumer liability protection, please consider tabling action on H.218 until the COVID pandemic subsides.

As a brief introduction, I am presenting as a Co-Chair on the VVMA Government Relations Committee with a focus on large animal topics. I am a retired dairy-exclusive veterinarian who served a wide variety of dairy farm styles in northwestern Vermont for 43 years.
The purpose of my testimony is to raise a series of questions that the VVMA Government Relations committee feels need to be fully investigated before acting on H.218. With all due respect for this committee's precious time, especially while it is addressing public health and financial recovery issues brought on by the COVID Pandemic, we feel that this bill requires time consuming examination that should be taken up after the pandemic subsides and should be tabled until next year.

As this committee has come to expect from VVMA testimony over the past twelve years, I am placing in the record updates on new food borne illness cases which originated from consumption of unpasteurized milk and products containing unpasteurized milk. Dated Friday February 12, 2021, the Maine CDC is reporting a Campylobacter outbreak associated with unpasteurized milk marketed in New Hampshire. You will find the Health Advisory Statement https://www.maine.gov/dhhs/mecdc/health-advisory.shtml?id=4155208 listed below for full details. It says that over 30 individuals were treated and 2 have been hospitalized. The notice goes on to list several CDC sites at the end, Raw Milk Questions and Answers I Raw Milk I Food Safety I CDC Raw Milk Know the Raw Facts (cdc.gov), which provide strong advice that the risk of food borne illness far outweighs any health benefits that unpasteurized milk is perceived to provide.

Another important report that was presented to this committee in 2019, deserves to be brought up again, it is listed as the Costard PDF on your reference list. In summary, it states that the number of reported food borne outbreaks continues to increase over the past decades. Take home message is "As consumption of unpasteurized dairy products grows, illnesses will increase steadily." Continued increases in availability will result in continued increases in illnesses.

Let me go back to discussing questions about H.218. As the committee is immersed in work to benefit the whole Vermont agriculture community, address climate change and water quality, and working to be sure that economically challenged Vermonters are fed, we feel that the bill's proponents should report on how many milk producers, retailers, and consumers are being assisted by expanding unpasteurized milk supply? Without this knowledge, it is hard to understand how much of this committee's capacity should be consumed with H.218. House Committee schedules and State Agencies are already overburdened dealing with the pandemic and should not be placed under further burdens until the pandemic subsides and economic recovery and food security of Vermonters are addressed.

Next question is if the state and secondary retailers are confident in the testing procedures and liability protections that are in place as unpasteurized milk producers are asking to expand their markets and include secondary retailers and off site marketing. Speaking with my former practice partner, VVMA President-Elect Dr. Jennifer Hull, she requested that I ask why is investment in Brucella and TB testing, and Rabies vaccination emphasized, and specific human pathogen testing being ignored? More routine culturing of unpasteurized milk for human pathogens would do a lot more to directly protect the consumer. Current state required tests were developed to assure proper milk handling for unpasteurized milk that is going to be pasteurized. It tests for cow health and common zoonotic diseases. It does not assure that human pathogens are not present. Please review the excellent description of a modern raw milk dairy that was owned by Essex, VT native DVM Dr. Meg Cattell. This article was presented to the National Mastitis Council in 2015 and describes more specific PCR testing that she used to protect her customers. In the past, VT may have excused smaller Tier I producers from more expensive testing, but as Tier II markets with improved profitability are encouraged to expand, it is a logical time to ask Tier II producers to also expand their techniques to protect the consumer.

At the end of the bill's walk through testimony, a need to identify liability protection for secondary retailers was mentioned. This liability issue is going to be a tough hurdle for expanded sales into secondary markets. Many of my former dairy clients would not sell unpasteurized milk directly from their bulk tank because they had not purchased an expensive specific insurance policy rider on their farm insurance in case they were asked to cover medical and hospital bills of a child or other individual that may be sickened by drinking their milk. As layers are added to this proposed supply change, this liability must be addressed. It would seem to be prudent to require farm producers to provide proof of insurance for this special policy rider when they are distributing product to secondary markets.

During the bill's walkthrough, there was a reference to a food borne outbreak that originated from ice cream that was made with unpasteurized milk. Will products like these be allowed to be sold at farm stands and CSA's? In other words what about soft cheeses under 60 days maturity, puddings, dips, and anything else that is made with unpasteurized milk and not baked or cooked? Does that liability lie with the farm producer, food preparer, or retailer?

What is the timeline on this bill? With the added responsibilities that the Health department and VAAFM Veterinary Services have taken on during COVID, is it a reasonable time to add new responsibilities and public health concerns on Agency staff?

Finally, what is the reason for eliminating the verbal requirement that farmers and retailers tell customers that the product is highly perishable and needs to maintain refrigeration? Representative Graham brought up an important point regarding the 40 F degree rule. That rule was developed by the dairy industry for unpasteurized milk that was going to be pasteurized before distribution. The suggestion of lowering the temp to 37-38 F is one that deserves further scientific investigation to see if it would be more appropriate for this highly perishable product that is not going to be pasteurized.

In closing, please do not act on reducing requirements or expanding unpasteurized milk sales at non-producers' farm-stands and/or retail CSA outlets during this legislative session. Please allow for more extensive investigation and testimony on this subject.

Thank you,
Dr. Kent E Henderson
Northwest Veterinary Associates, Inc. (retired)
VVMA Government Relations Committee

Attachments:
Costard 2017 PDF
Windsor Dairy Study
2021 Maine Public Health Alert
CDC Raw Milk Graphic

# Outbreak-Related Disease Burden Associated with Consumption of Unpasteurized Cow's Milk and Cheese, United States, 2009–2014

**Solenne Costard, Luis Espejo, Huybert Groenendaal, Francisco J. Zagmutt**

The growing popularity of unpasteurized milk in the United States raises public health concerns. We estimated outbreak-related illnesses and hospitalizations caused by the consumption of cow's milk and cheese contaminated with Shiga toxin–producing *Escherichia coli*, *Salmonella* spp., *Listeria monocytogenes*, and *Campylobacter* spp. using a model relying on publicly available outbreak data. In the United States, outbreaks associated with dairy consumption cause, on average, 760 illnesses/year and 22 hospitalizations/year, mostly from *Salmonella* spp. and *Campylobacter* spp. Unpasteurized milk, consumed by only 3.2% of the population, and cheese, consumed by only 1.6% of the population, caused 96% of illnesses caused by contaminated dairy products. Unpasteurized dairy products thus cause 840 (95% CrI 611–1,158) times more illnesses and 45 (95% CrI 34–59) times more hospitalizations than pasteurized products. As consumption of unpasteurized dairy products grows, illnesses will increase steadily; a doubling in the consumption of unpasteurized milk or cheese could increase outbreak-related illnesses by 96%.

Consumer demand for organic and natural foods (i.e., minimally processed foods) has been on the rise (*1*). However, in contrast to some perceptions (*2*), natural food products are not necessarily safer than conventional ones, as evidenced by higher rates of foodborne illnesses associated with unpasteurized dairy products (*3–6*). Pasteurization has greatly reduced the number of foodborne illnesses attributed to dairy products, and continuous efforts to reduce milk contamination pre- and post-pasteurization are further decreasing the disease burden (*3*). Yet, despite a decrease in dairy consumption in the United States (*7*), recent studies (*3*,*6*) suggest that over the past 15 years the number of outbreaks associated with unpasteurized dairy products has increased. In parallel with this increase, an easing of regulations has facilitated greater access of consumers to unpasteurized milk (e.g., through farm sales or cow share programs). The number of states where the sale of unpasteurized milk is prohibited decreased to 20 in 2011 from 29 in 2004 (*8–10*). This trend toward increased availability of unpasteurized dairy products raises public health concerns, especially because raw milk consumers include children (*2*,*4*,*6*).

Our study aimed at estimating the outbreak-related disease burden associated with the consumption of fluid cow's milk and cheese made from cow's milk (herein also referred to as milk and cheese or dairy products) that are unpasteurized and contaminated with *Campylobacter* spp., *Salmonella* spp., Shiga toxin–producing *Escherichia coli* (STEC), and *Listeria monocytogenes*. We also assessed how hypothetical increases in unpasteurized dairy consumption would affect this outbreak-related disease burden.

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## Methods

### Data Sources

We used outbreak data from the National Outbreak Reporting System (NORS) (*11*) to estimate the incidence rates of illnesses and hospitalizations. NORS is a web-based platform that stores data on all foodborne disease outbreaks reported by local, state, and territorial health departments in the United States that have occurred since 2009. We included all outbreaks that occurred during 2009–2014 in which the confirmed etiologic agents were any of the 4 pathogens of interest (*Campylobacter* spp., *Salmonella* spp., STEC, and *L. monocytogenes*) and the implicated food vehicle or contaminated ingredient was milk or cheese (Figure 1). Outbreaks associated with multiple products; processed dairy products other than milk and cheese (e.g., cream, butter, yogurt, and kefir); milk produced by species other than cows; and cheese originating from species other than cows were excluded from the analysis (online Technical Appendix 1, https://wwwnc.cdc.gov/EID/article/23/6/15-1603-Techapp1.xlsx).

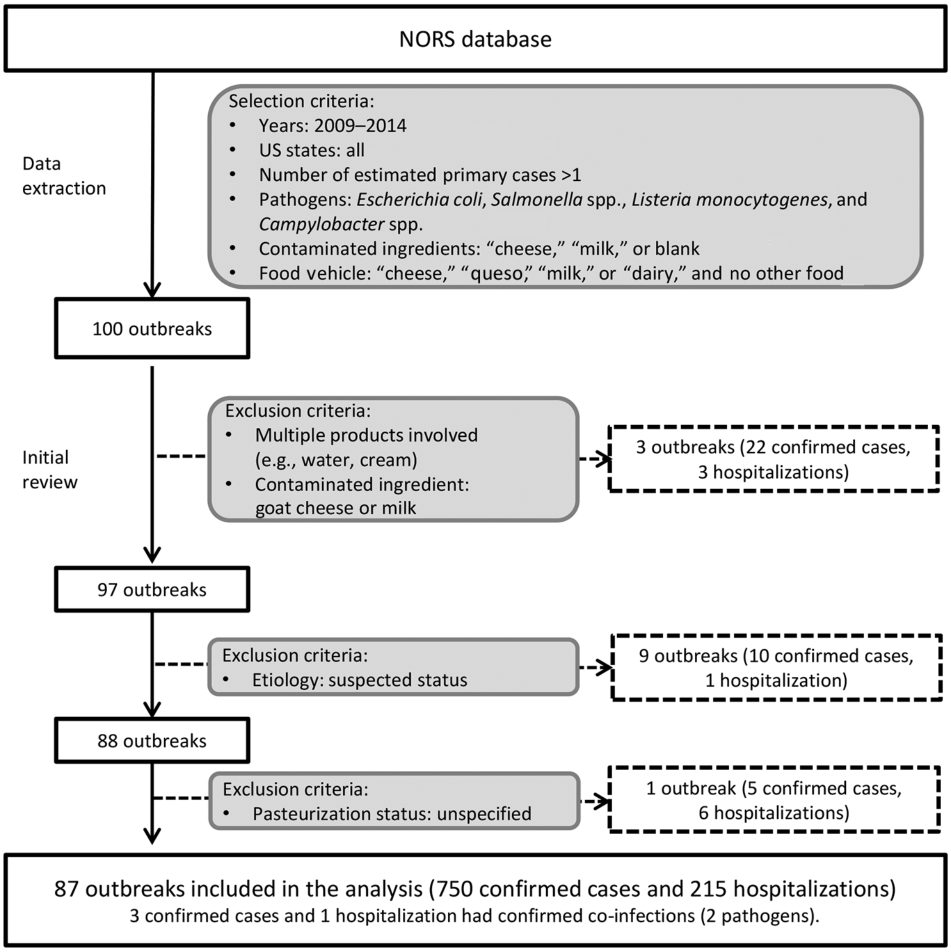


**Figure 1.** Process for selecting US outbreaks associated with cow's milk and cheese, 2009–2014. Laboratory-confirmed cases are cases with illness in which a specimen was collected and a laboratory was able to confirm the pathogen(s) or agent(s) causing illness. Hospitalizations are cases in which the patient was hospitalized as a result of becoming ill during the outbreak. NORS, National Outbreak Reporting System.

In addition, outbreaks with a suspected etiology status or associated with a dairy product with an unknown pasteurization status were excluded.

The stochastic model (Figure 2) was developed to estimate the following: the incidence rates of illness and hospitalization for pasteurized and unpasteurized dairy products, the excess risk associated with unpasteurized milk and cheese consumption, and the effect potential increases in consumption of unpasteurized dairy products would have on the outbreak-related disease burden (online Technical Appendix 2 Tables 1–5, https://wwwnc.cdc.gov/EID/article/23/6/15-1603-Techapp2.pdf). Inputs (other than the outbreak data) used in the stochastic model were derived from readily available sources of information (online Technical Appendix 2). Dairy consumption estimates were derived from the Foodborne Active Surveillance Network (FoodNet) Population Survey (*12*).

### Estimation of the Incidence of Outbreak-Related Illnesses and Hospitalizations

We modeled the uncertainty of the pathogen-specific and pasteurization status–specific incidence rates of illness and hospitalization ($\lambda$) in the United States per serving of dairy product using a conjugate gamma distribution (*13*). The number of hospitalizations and laboratory-confirmed cases occurring during the study period (2009–2014) that were caused by a given pathogen after consumption of milk or cheese of a certain pasteurization status was obtained from the NORS database. For laboratory-confirmed cases, this number was adjusted for underreporting, under testing (only a proportion of suspected cases were sampled and tested), and underdiagnosis (based on diagnostic test sensitivity), in order to estimate illnesses for 2009–2014. These pathogen-specific factors were assumed to be independent of the product consumed and its pasteurization status, and constant for the years considered. The analysis did not include adjustment factors for potential misclassification in terms of etiology or pasteurization status. These 2 outbreak characteristics were carefully reviewed, and any outbreak for which the information could not be verified was excluded. It was thus assumed that etiology and pasteurization status misclassifications were negligible in this analysis.

Because NORS is a passive surveillance system, the inherent underreporting associated with it needed to be accounted for. We estimated an underreporting factor by

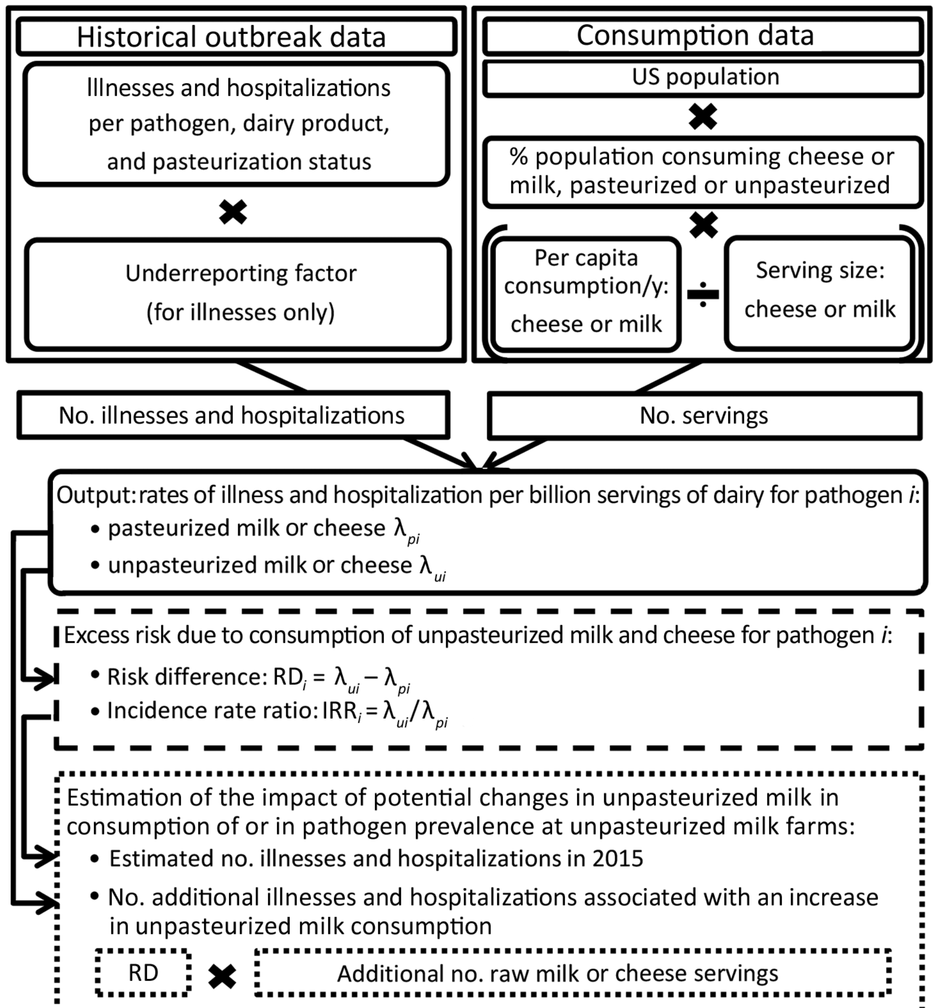


**Figure 2.** Stochastic model used to estimate the excess risk of outbreak-related illnesses and hospitalization due to unpasteurized dairy product consumption in the United States, 2009–2014. Model contains 3 main components: estimation of the incidence rates of illness and hospitalization for pasteurized and unpasteurized dairy products (elements in the boxes with solid lines), estimation of the excess risk associated with unpasteurized milk or cheese consumption (elements in box with dashed lines), and evaluation of the impact of hypothetical changes in consumption of unpasteurized dairy products (elements in boxes with dotted lines).

using FoodNet data, which is an active surveillance system assumed to include virtually all identified cases (online Technical Appendix 2). First, we extrapolated the total number of laboratory-confirmed cases in the US population during 2009–2013 using the incidence rates reported by FoodNet and considering the proportions of the US population included in FoodNet surveillance sites (*14*). Second, we estimated the total number of outbreak-related cases using the fraction of the US laboratory-confirmed cases that were outbreak-related (*15*). Third, we extracted the proportion of outbreak-related illnesses attributable to dairy (*16*). Fourth, we calculated the ratio of the number of outbreak-related, laboratory-confirmed cases linked to dairy consumption derived from the previously described calculations and the number of dairy-related, laboratory-confirmed cases reported through NORS to use as the underreporting factor in the analysis (online Technical Appendix 2). When estimating the underreporting factor, we assumed that the FoodNet surveillance population and reporting practices were representative of the entire United States and that the food source attribution pertaining to the illnesses from confirmed and suspected outbreaks (*16*) were equally relevant to laboratory-confirmed cases from outbreaks of confirmed status only. We used the sensitivity of the diagnostic tests as described in Scallan et al. (*15*) to estimate the proportion of false-negative, laboratory-confirmed cases from NORS (underdiagnosis factor). Finally, we derived the under-testing factor by using the ratio of laboratory-confirmed primary cases to the estimated total number of primary illnesses reported to NORS (*17*).

The annual number of servings of milk or cheese of a given pasteurization status was calculated as the product of the number of servings of milk or cheese per person for a certain year, the resident population in the United States for that year (*18*) and the percentage of the population of dairy consumers that consume milk or cheese of a particular pasteurization status. The annual per capita consumption of a given dairy product (*19*) was divided by its average serving size (i.e., the amount of milk or cheese that is generally served) (*7*,*20*,*21*) to estimate the annual per capita number of servings of milk and cheese. These totals were then summed across the years of the study period. The per capita consumption data (*19*) were assumed to include both pasteurized and unpasteurized dairy products. Because unpasteurized dairy products constitute a small percentage of the total consumption, this assumption (if inaccurate) would likely have only a small effect on results. We also hypothesized that the serving sizes (*7*,*20*,*21*) were the same for pasteurized and unpasteurized dairy products.

The estimates of the proportion of dairy consumers that consume milk or cheese of a given pasteurization status were derived from the FoodNet Atlas of Exposure (*12*). Answers from this FoodNet survey are provided as aggregates per survey site, rather than per respondent. Therefore, answers regarding milk and cheese consumption were treated as independent. In addition, we assumed that respondents who reported consumption of unpasteurized milk or cheese did not consume pasteurized milk or cheese. Because the information to calculate the overall proportion of the US population consuming any type of cheese was unavailable, we assumed it to be equal to the proportion of the population reporting consumption of any cheese sold as or cut from solid blocks (i.e., the type of cheese consumed most commonly). We further assumed the proportion of the US population consuming unpasteurized cheese to be equal to the proportion reporting exposure to any cheese made from unpasteurized milk in the previous 7 days.

### Estimation of the Excess Risks Attributed to the Consumption of Unpasteurized Milk and Cheese

We estimated the additional risks for illness and hospitalization for consumers of unpasteurized dairy products compared with consumers of pasteurized ones. We calculated excess risk using 1) risk difference (RD), which measures the absolute difference in the observed risks for illness and hospitalization between consumers of unpasteurized dairy products and consumers of pasteurized ones, and 2) incidence rate ratio (IRR), which provides a relative comparison of the risks for illness and hospitalization between the 2 exposure groups (*22*).

### Effects of Hypothetical Changes in Consumption of Unpasteurized Milk or Cheese

We assessed the potential public health effects of hypothetical changes in unpasteurized milk consumption. We determined the number of illnesses in 2015 in the United States using the pathogen-specific rates of illnesses and hospitalizations per serving of dairy product. The number of hospitalizations was calculated as pathogen-specific fractions of these illnesses. The pathogen-specific probabilities of hospitalization in cases of illness were assumed unconditional on the pasteurization status of the dairy product involved, but rather dependent on the severity of illness (*23*,*24*).

We estimated the additional illnesses and the additional hospitalizations for each pathogen if a hypothetical increase in consumption of unpasteurized milk or cheese occurred using 1) the change in the proportion of the population consuming unpasteurized milk or cheese, 2) the number of servings of milk or cheese for 2015, and 3) the risk difference in illnesses per serving of dairy for that pathogen. We assumed that the overall proportion of the US population consuming milk or cheese did not change; therefore, the increase in the proportion of the US population consuming unpasteurized milk or cheese corresponded to a shift of dairy consumers from pasteurized to unpasteurized. Six hypothetical scenarios were considered: 10%, 20%, 50%, 100%, 200%, and 500% increases in the proportion of the US population consuming unpasteurized milk or cheese.

### Scenario and Sensitivity Analyses

We performed a sensitivity analysis to identify the parameters that most influenced our estimates. The sensitivity of the estimates to the input parameter uncertainties was calculated by using conditional means as implemented in @RISK 6.1.2 (Palisade Corporation, Ithaca, NY, USA). In addition, we assessed the robustness of our sensitivity analysis with a scenario analysis in which we calculated our estimates with different sets of outbreak data. For the main analysis, the model was run on outbreaks of confirmed etiology and pasteurization status. In the scenario analysis, the model was then re-run with either of the 2 following sets of outbreaks added to the main data set: outbreaks of suspected etiology status (*17*) and outbreaks involving dairy products of unspecified pasteurization status assumed to be caused by pasteurized dairy products.

### Model Implementation

The model was developed in Excel 2010 (Microsoft Corporation, Redmond, WA, USA) with the Monte-Carlo simulation add-in @RISK 6.1.2. Results are expressed as means and 95% credibility intervals (CrIs, a Bayesian equivalent to the confidence interval) or prediction intervals (PIs, which provides uncertainty bounds for predictions), unless stated otherwise.

## Results

### Incidence Rates and Increased Risks Associated with the Consumption of Unpasteurized Milk and Cheese

We used a total of 87 outbreaks causing 750 laboratory-confirmed illnesses and 215 hospitalizations in this analysis (Table 1). The incidence rates of STEC, *Salmonella* spp., and *Campylobacter* spp. illnesses and hospitalizations per 1 billion servings were higher for unpasteurized dairy product consumers than for pasteurized dairy product consumers. Illnesses and hospitalizations caused by *L. monocytogenes*

**Table 1.** Dairy-related illnesses and hospitalizations from 87 outbreaks, National Outbreak Reporting System, United States, 2009–2014*

| | Outbreaks associated with milk and cheese consumption, N = 87† | | | | | |
|---|---|---|---|---|---|---|
| | Pasteurized | | | Unpasteurized | | |
| Pathogen | Outbreaks | Illnesses | Hospitalizations | Outbreaks | Illnesses | Hospitalizations |
| STEC | 0 | 0 | 0 | 14‡ | 99 | 42 |
| *Salmonella* spp. | 0 | 0 | 0 | 8§ | 83 | 29 |
| *Listeria monocytogenes* | 10 | 100 | 87 | 1 | 1 | 1 |
| *Campylobacter* spp. | 1 | 2 | 0 | 53‡§ | 465 | 56 |
| Overall | 11 | 102 | 87 | 76 | 648 | 128 |

*Illnesses and hospitalizations had confirmed etiologies and were associated with the consumption of milk or cheese of known pasteurization status. STEC, Shiga toxin–producing *Escherichia coli*.
†Out of the 87 outbreaks, 10 outbreaks reported a total of 17 deaths, 16 of them were linked to *L. monocytogenes* and 1 to *Campylobacter* spp.
‡One outbreak (38 illnesses and 10 hospitalizations) had 3 cases with confirmed coinfection (STEC and *Campylobacter* spp.). These 3 cases were duplicated because they were assigned to each pathogen.
§One outbreak (4 illnesses and 1 hospitalization) involved 2 pathogens: 3 Illnesses and 1 hospitalization were linked to *Campylobacter* spp. and 1 illness and 0 hospitalizations were linked to *Salmonella* spp.

infections were more often attributed to the consumption of pasteurized cheese than unpasteurized cheese (Table 2). Assuming no change in the consumption of unpasteurized dairy, dairy products contaminated with STEC, *Salmonella* spp., *L. monocytogenes*, and *Campylobacter* spp. were predicted to cause 761 (95% PI 598–994) outbreak-related illnesses and 22 (PI 13–32) hospitalizations in 2015. Unpasteurized dairy products caused 96% (PI 94%–98%) of these illnesses.

We calculated the excess risk attributable to the consumption of unpasteurized milk and cheese (Table 2; Figure 3). Because no reported illnesses were caused by *Salmonella* spp. and STEC during 2009–2014 and no hospitalizations were caused by *Campylobacter* spp., the corresponding incidence rates were extremely low (Table 2). Therefore, only RDs (and not IRRs) were reported for these pathogens. If all milk and cheese consumed were pasteurized, an average of 732 (95% PI 570–966) illnesses and 21 (95% PI 12–32) hospitalizations would be prevented per year in the United States. Of these prevented cases, 54% would be salmonellosis and 43% campylobacteriosis. The mean IRR of illnesses was 838.8 (95% CrI 611.0–1,158.0) overall from all 4 pathogens of interest (Figure 3), with 0.4 (95% CrI 0–1.2) from *L. monocytogenes* and 7,601 (95% CrI 3,711–15,346) from *Campylobacter* spp. The rate of hospitalization was higher for unpasteurized dairy consumers than for pasteurized dairy consumers (mean IRR 45.1, 95% CrI 33.7–59.2), with an IRR of 0.5 (95% CrI 0–1.7) for *L. monocytogenes*.

### Effects of Hypothetical Scenarios

If the percentage of unpasteurized milk consumers in the United States were to increase to 3.8% and unpasteurized cheese consumers to 1.9% (i.e., an increase of 20%), the number of illnesses per year would increase by an average of 19% and the number of hospitalizations by 21%. If the percentages of unpasteurized milk and cheese consumers were to double, the number of illnesses would increase by an average of 96%, and the number of hospitalizations would increase by 104%, resulting in an additional 733 (95% PI 571–966) illnesses/year and 22 (95% PI 13–32) hospitalizations/year, which corresponds to a total of 1,493 (95% PI 1,180–1,955) illnesses/year (Figure 4), most caused by *Salmonella* spp. and *Campylobacter* spp.

### Scenario and Sensitivity Analyses

The following conditional means sensitivity analysis reports the change in the output mean if the input variable is set to its 5th and 95th percentiles while other inputs are sampled at random. The rates of illnesses ($\lambda$) caused by the

**Table 2.** Incidence rates and risk differences for illness and hospitalization per 1 billion servings of milk or cheese, by pasteurization status and pathogen, United States, 2009–2014*

| | Illnesses | | | Hospitalizations | | |
|---|---|---|---|---|---|---|
| Pathogen | Unpasteurized | Pasteurized | Risk difference† | Unpasteurized | Pasteurized | Risk difference† |
| STEC | 3.5 (2.7–4.5) | $3.4 \times 10^{-4}$ ($3.1 \times 10^{-7}$ to $1.7 \times 10^{-3}$) | 3.5 (2.7 to 4.5) | 0.9 (0.6 to 1.2) | $3.4 \times 10^{-4}$ ($3.0 \times 10^{-7}$ to $1.7 \times 10^{-3}$) | 0.9 (0.6 to 1.2) |
| *Salmonella* spp. | 49.1 (32.7–76.7) | $3.4 \times 10^{-4}$ ($3.3 \times 10^{-7}$ to $1.7 \times 10^{-3}$) | 49.1 (32.7 to 76.7) | 0.6 (0.4 to 0.9) | $3.5 \times 10^{-4}$ ($3.4 \times 10^{-7}$ to $1.7 \times 10^{-3}$) | 0.6 (0.4 to 0.9) |
| *Listeria monocytogenes* | 0.04 (0.003–0.100) | 0.1 (0.08 to 0.12) | –0.06 (–0.11 to 0.02) | 0.03 ($2.2 \times 10^{-3}$ to 0.1) | 0.06 (0.05 to 0.07) | –0.03 (–0.06 to 0.04) |
| *Campylobacter* spp. | 39.0 (30.8–48.3) | $5.8 \times 10^{-3}$ ($2.4 \times 10^{-3}$ to $1.1 \times 10^{-2}$) | 39.0 (30.8 to 48.3) | 1.2 (0.9 to 1.5) | $3.5 \times 10^{-4}$ ($3.5 \times 10^{-7}$ to $1.7 \times 10^{-3}$) | 1.2 (0.9 to 1.5) |
| Overall | 91.7 (71.8–120.9) | 0.11 (0.09 to 0.13) | 91.6 (71.7 to 120.8) | 2.7 (2.2 to 3.3) | $6.1 \times 10^{-2}$ ($4.9 \times 10^{-2}$ to $7.5 \times 10^{-2}$) | 2.7 (2.2 to 3.2) |

*Values are shown as mean incidence (95% credibility interval). STEC, Shiga toxin–producing *Escherichia coli*.
†Excess risk is attributable to unpasteurized dairy.

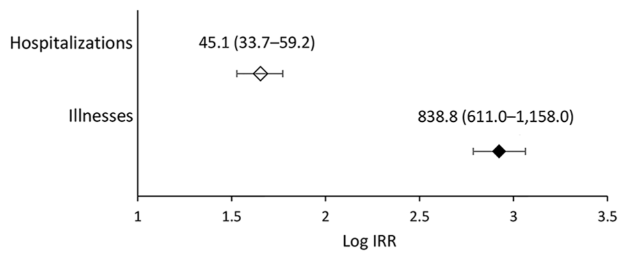


**Figure 3.** Forest plot showing, on a logarithmic scale, the excess risk for outbreak-related illnesses and hospitalizations caused by consumption of pasteurized and unpasteurized milk and cheese, United States, 2009–2014. Markers indicate mean log IRR of outbreak-related illnesses and hospitalizations caused by the food pathogens *Campylobacter* spp., *Listeria monocytogenes*, *Salmonella* spp., and Shiga toxin–producing *Escherichia coli* per 1 billion servings of unpasteurized milk or cheese relative to pasteurized products. Error bars indicate 95% credibility interval (CrI). Numbers above markers and bars are the IRR (not in log scale) and 95% CrI. log (IRR) = 0 indicates no difference in incidence rates between unpasteurized and pasteurized milk and cheese. IRR, incidence rate ratio.

consumption of unpasteurized milk and cheese were most sensitive to the underreporting factors (γ) for *Salmonella* spp. (mean range λ 34.9–72.5), *Campylobacter* spp. (mean range λ 33.1–45.3), and STEC (mean range λ 3.1–4.1), and at a secondary level to the undertesting (ρ) and underdiagnosis (μ) factors (results not shown). The overall IRR of illnesses was most sensitive to the underreporting factor for *Salmonella* spp. (mean range IRR 710.1–1,049.6). The number of illnesses per year caused by the consumption of milk or cheese was most sensitive to the rates of illnesses caused by *Salmonella* spp. and *Campylobacter* spp., as the main uncertainties apply to the incidence calculations for all pathogens (results not shown). Including the 9 outbreaks with a suspected-etiology status or the outbreak of unspecified pasteurization status (Figure 1) into the main analysis did not change the IRRs or the predicted number of illnesses or hospitalizations per year (results not shown).

## Discussion

Unpasteurized dairy products are responsible for almost all of the 761 illnesses and 22 hospitalizations in the United States that occur annually because of dairy-related outbreaks caused by STEC, *Salmonella* spp., *L. monocytogenes*, and *Campylobacter* spp. More than 95% of these illnesses are salmonellosis and campylobacteriosis. Consumers of unpasteurized milk and cheese are a small proportion of the US population (3.2% and 1.6%, respectively), but compared with consumers of pasteurized dairy products, they are 838.8 times more likely to experience an illness and 45.1 times more likely to be hospitalized. Illnesses caused by *L. monocytogenes*, however, were found to be more often associated with the consumption of pasteurized cheese, albeit only causing 1 additional outbreak-related illness per year on average.

An easing of regulations has allowed greater access to unpasteurized milk in recent years (*8–10*), and this study shows that illnesses and hospitalizations will rise as consumption of unpasteurized dairy products increases. If such consumption were to double, the mean number of outbreak-related illnesses that occur every year would increase by 96%. Most unpasteurized dairy–related outbreaks are caused by pathogen contamination at the dairy farm (versus postpasteurization contamination for pasteurized products) (*3*); thus, one could assume that decreasing pathogen prevalence in bulk milk tanks on raw milk farms would help reduce illnesses. STEC has been found in 2.5% (95% CrI 0.1%–9.1%), *Salmonella* spp. in 4.6% (3.7%–5.6%), *L. monocytogenes* in 2.5% (0.1%–9.0%), and *Campylobacter* spp. in 4.7% (2.8%–7.0%) of bulk milk tanks on US raw milk farms (*25–29*). Given these low prevalences, strategies for further reduction are limited and involve multiple aspects of unpasteurized milk production (*30*). Boiling of milk before consumption seems to be a more realistic mitigation strategy, but this practice is unlikely to be implemented by unpasteurized dairy product advocates because it would affect the perceived benefits.

This study focused on the outbreak-related illnesses, which is only a fraction of all dairy-related illnesses in the United States. Two studies have documented the fraction of outbreak-related cases among FoodNet laboratory-confirmed cases (*15*,*31*); the fraction ranges from 0.5% for *Campylobacter* spp. to 19.0% for STEC according to Ebel et al. (*31*). These data suggest that the number of sporadic illnesses caused by contaminated dairy products in the United States might be much larger than that for outbreak-related illnesses. However, because of the lack of information on the characteristics of sporadic illnesses (such as food source attribution), we restricted the scope of this analysis to outbreak-related disease burden.

Our analysis relied on outbreak data from NORS (*11*), which is a passive reporting system affected by underreporting. We used dairy-related outbreak cases from FoodNet (*14–16*) as a comparison to estimate underreporting; therefore, any potential bias of this comparison was carried over to our estimation of outbreak-related illnesses. By extrapolating incidence rates of cases from the FoodNet catchment areas to the overall United States, we assumed that the FoodNet surveillance population and reporting practices were representative of the entire United States. However, the FoodNet catchment population represents only 15% of the US population from 10 nonrandom sites. Also, a recent study (*31*) suggested state-to-state variations in reporting practices; these variations might be even greater between FoodNet and non-FoodNet states. This difference might influence state-specific incidence rates or underreporting

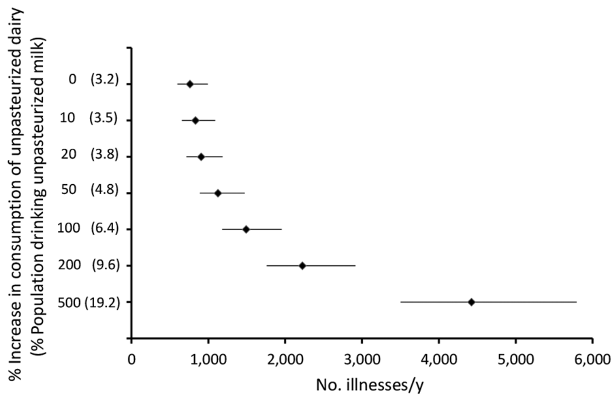


**Figure 4.** Number of dairy-related outbreak illnesses predicted per year in the United States if unpasteurized cow's milk and cheese consumption increases 0%, 10%, 20%, 50%, 100%, 200%, and 500%. Numbers in parentheses indicate percentage of total population consuming unpasteurized cow's milk. The illnesses graphed are those from outbreaks associated with cow's milk or cheese contaminated with Shiga toxin–producing *Escherichia coli*, *Salmonella* spp., *Listeria monocytogenes*, and *Campylobacter* spp. Markers indicate means; bars indicate 95% prediction intervals. The consumption estimates were based on the year 2015, and a 0% increase corresponds to the current proportion of the US population consuming unpasteurized dairy products.

ratios, as well as other characteristics of the reported cases. For example, if a state reported the incriminated food source as the food item (e.g., homemade yogurt), it would not have been selected for inclusion in this analysis, but if they reported the ingredient used for preparation (e.g., in the case of homemade yogurt, fluid milk), it would have been included in our analysis. However, the size and direction of such biases and uncertainties associated with these complex surveillance systems (NORS and FoodNet) are difficult to quantify because of the paucity of data.

The rates of illnesses were most sensitive to the estimated underreporting factors, which were assumed to be associated with the severity of symptoms (*23*,*24*) and other factors, such as state health department resources, and thus independent of the pasteurization status. Also, because this analysis only considered outbreaks involving milk and cheese (and no other dairy products), we are probably underestimating the incidence of illnesses and hospitalizations. However, milk and cheese are the most commonly consumed dairy sources and cause the most outbreaks (milk and cheese caused 99% of dairy-related outbreaks reported to NORS during the study period), so the underestimation is likely limited. Nonetheless, the overall comparison of risk between consumers of pasteurized and unpasteurized products should remain valid.

Estimates of the proportion of the population consuming dairy products were derived from the FoodNet population survey (*12*). We assumed that respondents who reported consumption of unpasteurized milk or cheese were not consuming pasteurized dairy. However, if unpasteurized milk or cheese only represented a fraction of their dairy consumption, the number of servings of unpasteurized dairy products could have been overestimated, and thus the risk for consumers of unpasteurized dairy products might have been underestimated. Also, the FoodNet population survey is based on a relatively small convenience sample and might therefore not be accurate. For example, the self-reported estimates of consumption of unpasteurized milk and cheese (3.2% and 1.6%, respectively) (*12*) might be underestimates or overestimates, potentially caused by consumers confusing the terms raw, organic, and natural (or other reasons). In addition, consumption might have changed since the 2007 FoodNet population survey (*12*), which might have resulted in an under- or overestimation of the risk from unpasteurized milk products. However, because the proportion of dairy consumers using unpasteurized products remains small, and the IRRs are very large, this overestimation is likely limited, and the trend for additional illnesses as unpasteurized dairy consumption grows remains valid. Similarly, estimates of the consumption of pasteurized cheese are underestimates: data available only provide estimates of the highest exposure to a single type of cheese, rather than to any type of cheese (*12*), potentially resulting in a risk overestimation for consumers of pasteurized dairy products. This is a limitation, notably for outbreaks linked to queso fresco and other Mexican-style soft cheeses. Despite these limitations, to the authors' knowledge, this study is based on the best available data and builds upon other well accepted risk attribution methods (*15*,*16*,*32*).

In conclusion, outbreaks linked to the consumption of cow's milk and cheese were estimated to cause on average 761 illnesses and 22 hospitalizations per year in the United States. Unpasteurized products are consumed by a small percentage of the US dairy consumers but cause 95% of illnesses; the risk for illness was found to be >800 times higher for consumers of unpasteurized milk or cheese than for consumers of pasteurized dairy products. Therefore, outbreak-related illnesses will increase steadily as unpasteurized dairy consumption grows, likely driven largely by salmonellosis and campylobacteriosis.

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# WINDSOR DAIRY MILK QUALITY PRACTICES FOR GRASS FED, DIRECT TO CONSUMER, UNPASTEURIZED MILK PRODUCTION

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## Presentation Summary

Windsor Dairy produces milk from cows that are 100% grass-fed. It is distributed direct-to-consumers as unpasteurized milk. Our history as a dairy farm includes conventional milk production and certified organic bulk milk production.

Our milk is obtained by Colorado residents through Colorado's raw milk cow share law, passed in 2005. We will present our current milk quality practices, some typical and some quite different.

Our typical production practices include pre-milking and post-milking teat dipping, parlor machine milking, monthly DHI testing, a closed herd, cow level culturing, and bulk tank cooling. Our special milk quality practices include no dry cow or lactating cow treatment and weekly pre-release bulk milk PCR pathogen testing.

## Who Are We?

Marguerita B. Cattell, DVM, MS, and Arden J. Nelson, DVM have a combined dairy experience totaling 77 years. This experience includes dairy labor, dairy veterinary practice, teaching, dairy management, dairy research, dairy consulting with dairymen, veterinarians, and companies. In 2000, Meg and Arden purchased a dairy farm.

## Where Are We?

Windsor Dairy is located in northern Colorado, about half-way between metro Denver and the Wyoming border. Windsor Dairy sits on the short-grass prairie just east of the Rocky Mountains. Our area receives approximately 10-12 inches of total precipitation per year, and our elevation is 4800 feet above sea level. We live on the high desert and irrigation is required for most crop production. Weld County, Colorado produces dry land wheat, and row crops of corn, soybeans, dry beans and sugar beets. Weld county ranks #9 in the U.S. for agricultural income right behind 8 counties in the Central Valley in California. Weld County is ranked #1 in number of oil wells. Colorado ranks #1 in millet and #2 in winter wheat production. Colorado's Dairy Industry in 2012 ranked #1 among U.S. states for production per cow per year, and 15$^{th}$ in total milk produced. Weld county ranks among the top 20 milk producing counties in the U.S. The dry climate and productive soil will provide ample crops if irrigation is used.

## Pioneers

Pioneering for Windsor Dairy is normal. We were the first certified organic dairy in Colorado. We were the first farmstead cheese producer in Colorado. We were the only certified organic and grade A and grass fed dairy in Colorado. We were the first 100% grass-fed dairy in Colorado. We were the first and only dairy in the U.S. that tests every batch of raw milk for pathogens with PCR testing before milk release to the consumer.

## What Do We Produce?

Windsor Dairy produces grass fed raw milk, raw milk cheese, raw beef, raw pork and raw eggs. Our milk is 100% grass fed, our cows and young stock receive no grain. Our raw milk cheeses are made and aged on-farm for a minimum of 60 days. This allows sales of raw milk cheeses to anyone in the U.S. and the world.

## What is Our Milk Production History?

When we purchased our dairy in 2000, we produced conventional milk for DFA. In 2002, we sold 400 milking cows, and purchased 400 head of certified organic heifers to start certified organic milk production for Horizon. Joining Organic Valley in 2004, we grew into a 550 cow milking herd, which was sold in July 2007 in anticipation of a negative monthly cash flow of $25,000. This was due to a fixed organic milk price, and to organic forage and feed costs that were to rise between 30% and 125% during the next six months!

We had started a small side-line business of raw milk production when Colorado passed the Cow-Share Law in May of 2005. Little did we know then that this sideline dairy would dominate our lives for the next 10 years.

## Who Eats Our Food?

Raw milk is available only to Cow-Share members of Windsor Dairy, LLC. A member must purchase a portion of one of our cows, and pay a monthly boarding fee to us for feeding, milking, and bottling of the member's milk. The boarding fee is the cost of the raw milk to the member. All of our other animal foods are available to anyone desiring locally produced artisan foods.

## How Do We Feed Our Animals?

The diet that we feed our food animals dictates the nutritional quality of the animal foods we produce. *The diet determines the differences in the food.*

Our dairy cows and all young stock receive no grain ever; they are 100% grass fed. They are on pasture, grazing for 7 months of the year, and eat hay and standing forage in pastures during the winter months. Our milk and cheese is made from milk from cows fed 100% grass or hay (grass fed milk).

Our beef is 100% grass fed, with intact bull calves reaching slaughter weight of 1200 pounds at 24-28 months. Our beef is marketed to consumers as bulk quarters, halves and wholes that are cut, wrapped and frozen.

Our pork is fed whey from cheese making, High Hops wet brewer's grains from a neighbor artisan brewery, waste vegetables, waste cheese, leftover milk, waste fruit, and occasionally our custom formula layer grain. Our pork is marketed in bulk quarters, halves, and wholes, that are cut, wrapped and frozen.

Our layers receive a diet that produces high omega-3, high DHA, low Omega-6, and vibrantly colored eggs.

The *diet makes the differences* in the animal foods we produce.

## How Do We Milk Our Cows?

Our milking procedures are typical of many dairies. We pre-dip with .5% iodine foam, wipe teats with individual cow microfiber towels that are washed with bleach and dried, apply machines, remove machines after vacuum shut-off, and post-dip with .5% iodine foam.

## How Do We Treat Mastitis?

We do not treat mastitis. None, zero, zip, nada! We do not use any lactation treatment. We use no dry cow treatment. This practice started as a requirement of the National Organic Program Rules for Certified Organic milk production.

## How Do We House Our Cows?

Our cow housing is rotated grass and legume pasture for 7 months of the year. From November 15 to April 15, cows are housed in dry lots and in our freestall barn.

Bedding is used when necessary, which is typically after big rain events and after big snow storms. We use hay or straw for bedding after piling and removal of snow from our dry lots. We use sand in the freestall barn. Our cows will choose a dry lot for a bed over the freestall barn 99% of the time, with the $250,000 barn serving merely as an out of the weather feeding area for hay.

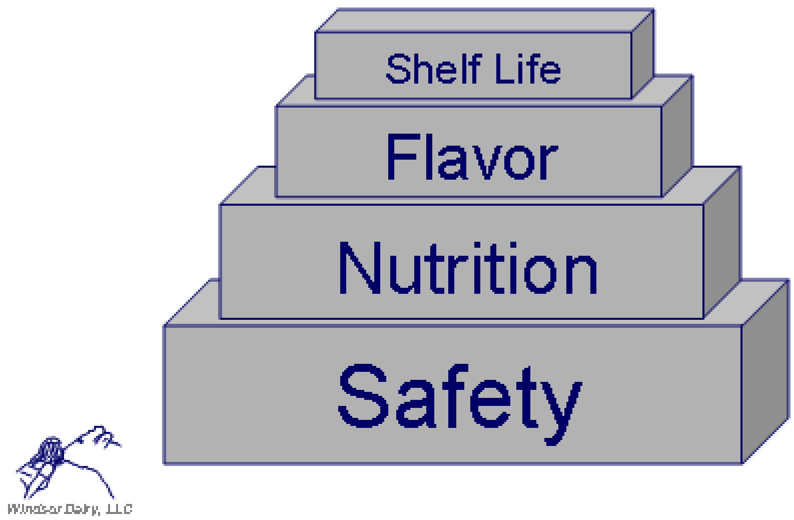
## What Are Our Cow Hygiene Practices?

Tails are clipped and udders are singed as necessary. Straw or hay bedding is used during the winter for significant precipitation events. Manure is only removed from lots to our composting area after it snow or rains, otherwise it is dried in situ into bedding. Harrowing of dry lots assists the Colorado sun in drying of manure during cloudy or cool weather.

What is Our Definition of Milk Quality?

We define milk quality as milk that is free of pathogens, milk that is nutritionally superior, milk that has exquisite flavor, and milk that is low in harmful bacteria for extended refrigerator life.

Figure 1
Windsor Dairy Milk Quality Priorities




## *Safety*

Safety is the foundation for our milk quality priorities. Without the PCR pathogen screening, we would not produce direct to consumer raw milk on our dairy farm!

What is Our Test and Hold Pathogen Testing?

Test and hold Polymerase Chain Reaction (PCR) pathogen testing is performed every week prior to release of our bottled milk to our cow share members. The milk is sampled, tested, and held from release to our members until tests are all completed.

Milk is harvested into the bulk tank from Friday pm through Wednesday am for bottling for our members. Bulk milk is sampled Wednesday am after milking, and sent to a USDA Certified Food Lab in Greeley, Colorado (IEH Warren). Test results are available early Friday afternoon. If all tests are negative, milk is distributed to members Friday evening, Saturday and Sunday. Cheese is made immediately after milking the cows from the milk that is harvested from Wednesday pm through Friday pm.

PCR testing was chosen for its exquisite sensitivity and specificity. We desired the best testing system, and we insisted on knowing test results prior to release of our raw milk to cow share members.

We test for the four major pathogens found in milk: Campylobacter species, Listeria species, E.coli 0157:H7, and Salmonella species. As of 4.16.14, we have been testing for all shiga-toxin producing coliforms (STEC).

Bulk Tank Zoonotic Pathogen Monitoring at Windsor Dairy

From July 5, 2006 until November 12, 2014, every batch of Windsor Dairy raw bulk milk was tested in a USDA Certified food safety laboratory (Warren Analytical Laboratory, Greeley CO) *prior to release* to consumers.

Over 8.5 years of continuous weekly testing of Windsor Dairy bulk milk, we identified 0.5% (2/437) Salmonella spp., 0% (0/437) Listeria spp., 0.2% (1/437) E. Coli 0157H7 or STEC, and 0.9% (4/437) Campylobacter spp.. Milk was not distributed from bulk tanks with any positive result. All positive PCR tests were found to be negative upon re-sampling.

Pathogen Presence Comparison Data

Data provided from NAHMS Dairy (USDA, 2011) and other published studies showed a high prevalence of milk borne pathogens on dairy farms based on fecal and bulk tank milk sampling. We decided that standard regulatory testing for SPC, LPC and coliform counts was inadequate to ensure food safety. Routine bulk milk bacteriology was not easily available. A nearby food safety laboratory (EIH Warren) had begun offering PCR testing for specific pathogens. We elected to include Salmonella spp., Listeria spp., Campylobacter spp. and E. coli 0157:H7. A study published in 2007 by Karns (Karns, 2007) showed that bulk tank milk PCR prevalence in samples from NAHMS 2002 for E. coli 0157:H7 was 0.2% but increased to 4.2% for all shiga-toxin positive samples.

Salmonella spp. prevalence in dairy cattle in the United States in the NAHMS 2002 survey (USDA, 2011), showed 31.3% of premises and 7.3% of cows positive by fecal culture. A follow up study using bulk tank milk and filters in 2007 identified Salmonella spp. in 28.1% of premises, 24.7% of filters and 10.8% of bulk tank milk samples. Jayarao (Jayarao, 2001) found 6.1% of bulk tank milk samples from South Dakota and Minnesota to be positive for Salmonella spp. by bacteriological culture.

Listeria spp. prevalence based on PCR of bulk tank milk and filters from the NAHMS 2007 (USDA, 2011) study identified 32.1% of herds positive, 28.3% of filters and 9% of milk samples. Jayarao et al (Jayarao, 2001) found 4.6% of bulk tank samples positive for Listeria monocytogenes by bacteriological culture.

Campylobacter spp. were identified by fecal PCR from 51.4% of cows and 97.9% of premises in the NAHMS 2002 (USDA, 2011) survey. In the 2007 follow up study, prevalence was found to increase with herd size with the smallest farms having the lowest prevalence at 22.1%. In all three NAHMS surveys, essentially all herds had at least one positive cow. Jayarao (Jayarao, 2001) found C. jejuni in 9.2% of bulk milk samples.

E. coli 0157:H7 was found at a much lower level, for example in 1.8% of premises and 0.4% of cows, but with potentially much greater consequences due to the small infectious dose and severe systemic disease in humans. E. coli 0157:H7 was found in 0% of bulk milk samples but STEC was found in 3.8% in one survey (Jayarao, 2001).

Windsor Dairy results closely follow those reported by Italian researchers recently (Amagliana, 2011). This study was designed to compare real time multiplex PCR with bacteriology to screen raw bulk milk for unprocessed distribution and consumption. In a herd of similar size 80 cows and similar bulk milk sample volumes (25 ml sampled from up to 1,000 liters) at the same weekly sampling frequency, no Listeria monocytogenes, Campylobacter spp., Salmonella spp. or E. coli 0157:H7 were identified over 27 weeks from bulk milk. Milk filters were found to be positive in 28% (7/25) and 48% (12/25) for EC by VIDAS bacteriology and RT PCR respectively. PCR identified EC twice as often from manure samples. Listeria was found in filters at the same rate by PCR and VIDAS. Shortly after we initiated our testing protocol, government agencies in Italy (Italian Republic, 2007) developed regulations requiring monthly tests to be negative by RT PCR for the same four pathogens monitored at Windsor Dairy. The authors proposed that rapid screening methods could be used to rapidly assess raw milk safety with high frequency and accuracy. Ideally, these methods would allow screening of each batch prior to release of product.

Rapid, just-in-time screening is scientifically possible and economically justifiable for producers distributing raw milk to retail customers or large numbers of herd share members. Advocates of raw milk consumption fear that the financial burden of mandated testing would inhibit small, very localized production and distribution which is held as an ideal. Our position continues to be that a national standard could be created that requires testing prior to release of all raw milk distributed through retail outlets or in large volumes. An exemption could be made, with a limit on volume, for small producers that would restrict any food borne disease to a small population.

***Nutrition***

Why is Grass Fed Milk Different?

It's the diet! *The diet makes the differences!*

Milk is a very changeable animal origin food product. Change the diet of the cow and within days, the nutritional value of the milk to the consumers of the milk changes!

Milk is Not Milk

Grass fed milk is different in nutrition content than conventionally produced milk. Organic milk is different in nutrition content than conventionally produced milk. We believe that the milk industry in the U.S. should celebrate the fact that milk is not milk, and educate the public that milk is not milk! We should be providing milk of different nutritional contents, different flavors, different prices. Maybe just like the microbrewery explosion, we could foster an interest intensity much like the artisanal beer brewer's have already done! After all, the cow is also a "brewer!"

When we advertize that "Milk is Milk," it is insulting and non-glamorous to the consumers. Any consumer with taste buds knows that different milk tastes different. Flavored water anyone? Wine anyone? Microbrews anyone? How many different coffee drinks anyone? How about "real food with real flavor variety"? "Real milk, real flavor"? "Savor the flavor of real milk!"

Let's tell the real truth about nutritional differences in milk, and learn more about the real nutritional needs of real people! Let's elevate the usage of our dairy producers' promotion dollars. Perhaps we should also begin the job of producing real milk with the end in mind! Milk should supply nutrition that cannot be gotten elsewhere. It already does this, but we are sadly afraid to say so to our public…..

*The diet determines the difference in the milk.*

Fat Makes a Difference in Our Health

Polyunsaturated fats (PUFA) make up only 4% of the fats in milk, but that 4% is very changeable and very important to humans. PUFA in milk include omega-3, omega-6 and CLA.

Omega-3 and Omega-6 are the two essential fatty acids for *Homo sapiens*. "Essential" means we cannot make these important fats, and therefore we need them in sufficient quantities, or we get sick, or fail to reproduce, or at least, fail to flourish. We believe that omega-3 deficiency is a very important causation in many chronic diseases in the U.S. today.

CLA (conjugated linoleic acid) is the most potent naturally occurring cancer fighter known to man. CLA is made by rumen bacteria, and is only available in significant quantities in food products that ruminants make. Milk for anyone?

We humans need 30-40% of our energy in the form of fats in our diets. The "fear of fat" mongers have convinced us to eat "low fat," "no fat," and this has damaged our health! We have coincidentally changed our food fats from good fats to bad fats. At the same time, we have changed the fats we are feeding to our food animals, too. End result is that we are not eating enough fats so that we are hungry all the time, and we are consuming the wrong fats, resulting in bad consequences for our health.

Our species has been evolving for 2.5 million years. During 99.9% of that time, we have been consuming omega-6 and omega-3 PUFA in a ratio of ~1.5:1. For the last 60 years (.002% of that time), we have changed our diet, so that we are now consuming a diet that is >10:1 in O6:O3, sometimes as high as 20:1.

WHAT! Talking about ratios!? Really? That is a no-no to dairy nutritionists. We talk of requirements in Mcal/cow/day, grams of calcium per day. Not ratios! Ratios are out-dated and too simplistic. Why here?

Ratio of O-6 to O-3 is important because the two short chain basal fatty acids (O-6 is linoleic acid, O-3 is alpha linolenic acid) compete with each other for conversion-elongation into long chain PUFA. All of the enzymes in the process steps are exactly the same for O-6 as for O-3. This enzyme competition allows the fatty acid present in higher amounts to dominate the conversion process and therefore dominate the regulation of cell level hormonal directives. In simplistic terms, O-6 promotes inflammation, and O-3 decreases inflammation.

Current knowledge suggests the best O6:O3 ratio is 2.3:1 for humans today (Benbrook, 2013).

***So, how is that O-6:O-3 ratio of >10:1 working for us so far?***

<u>Our American Diseases (**)</u>

| | |
|---|---|
| Diabetes | Schizophrenia |
| Obesity | Insulin Resistance |
| Heart Attacks | Asthma |
| Depression | Arthritis |
| Alzheimer's | Lupus |
| Cancer | ADHD |
| Stroke | PP Depression |

Every one of these diseases has researched links to O-6:O-3 ratio imbalance (Robinson, 1999)!

<u>Causes of Death in U.S. 2007 (CDC data)</u>

1. Heart attack
2. Cancer
3. Stroke
4. Chronic resp disease
5. Accidents
6. Alzheimer's
7. Diabetes
8. Flu/pneumonia
9. Kidney disease
10. Septicemia

Five of these, 1,2,3,6 and 7, have researched links to O-6:O-3 imbalance (Robinson, 1999)….

<u>How Did We Get Here?</u>

We ate ourselves here! We changed our diets, we changed our food animal diets, and we eat less fat to boot. We are a hungry people, and we are starved for the right fats! We eat too much omega-6 and too little omega-3. See Figure 2 for the U.S. per capita consumption of different dietary fats (USDA). Notice how consumption has changed over the years with some fats increasing in our diet and some fats decreasing. If we group the fats by lower O6:O3 ratios, we end up with what we have called good fats (butter, cream, lard and tallow) and bad fats (margarine and shortening). The big fat intake change involved decreasing good fats and increasing bad fats in our diet (see Figure 3).

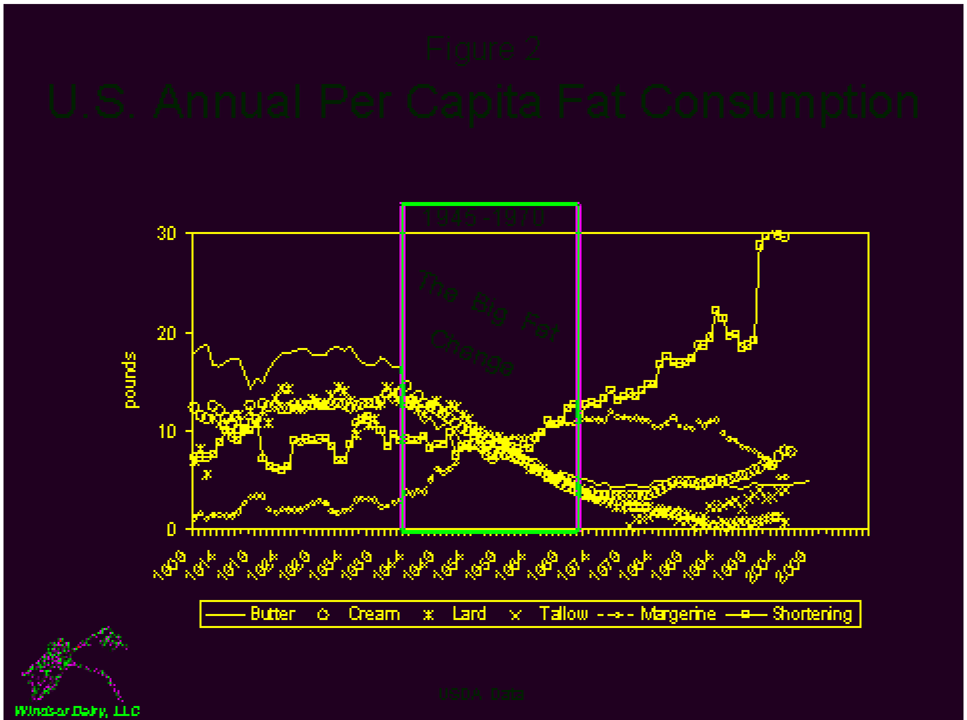


Figure 2
U.S. Annual Per Capita Fat Consumption
1945-1970
The Big Fat Change
pounds
30
20
10
0
Butter
Cream
Lard
Tallow
Margerine
Shortening
Windsor Dairy, LLC
USDA Data

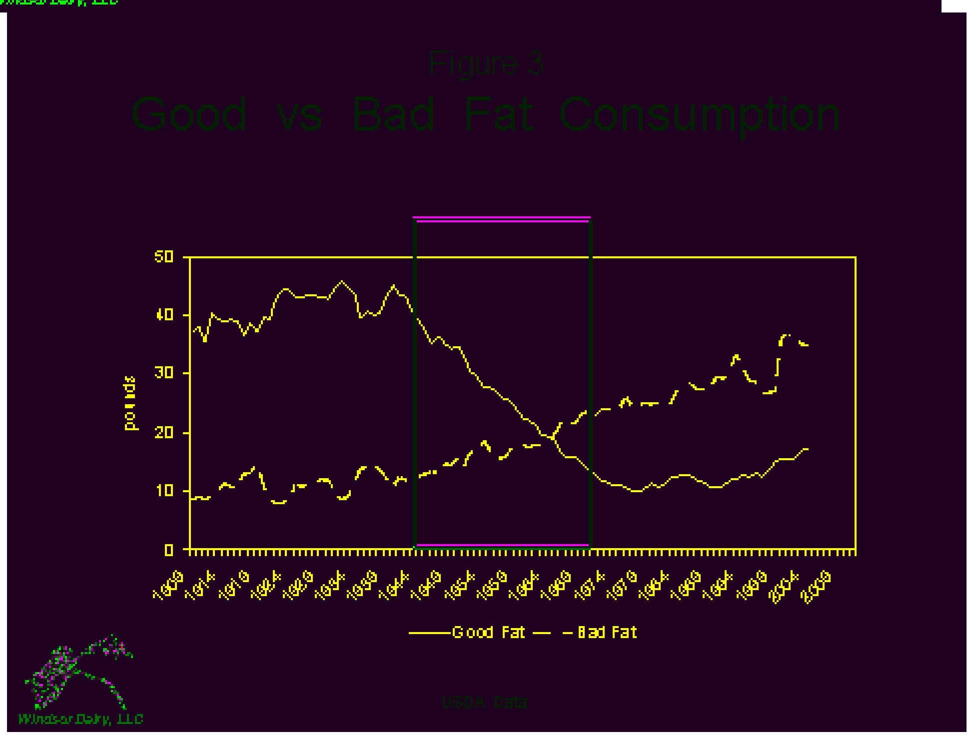
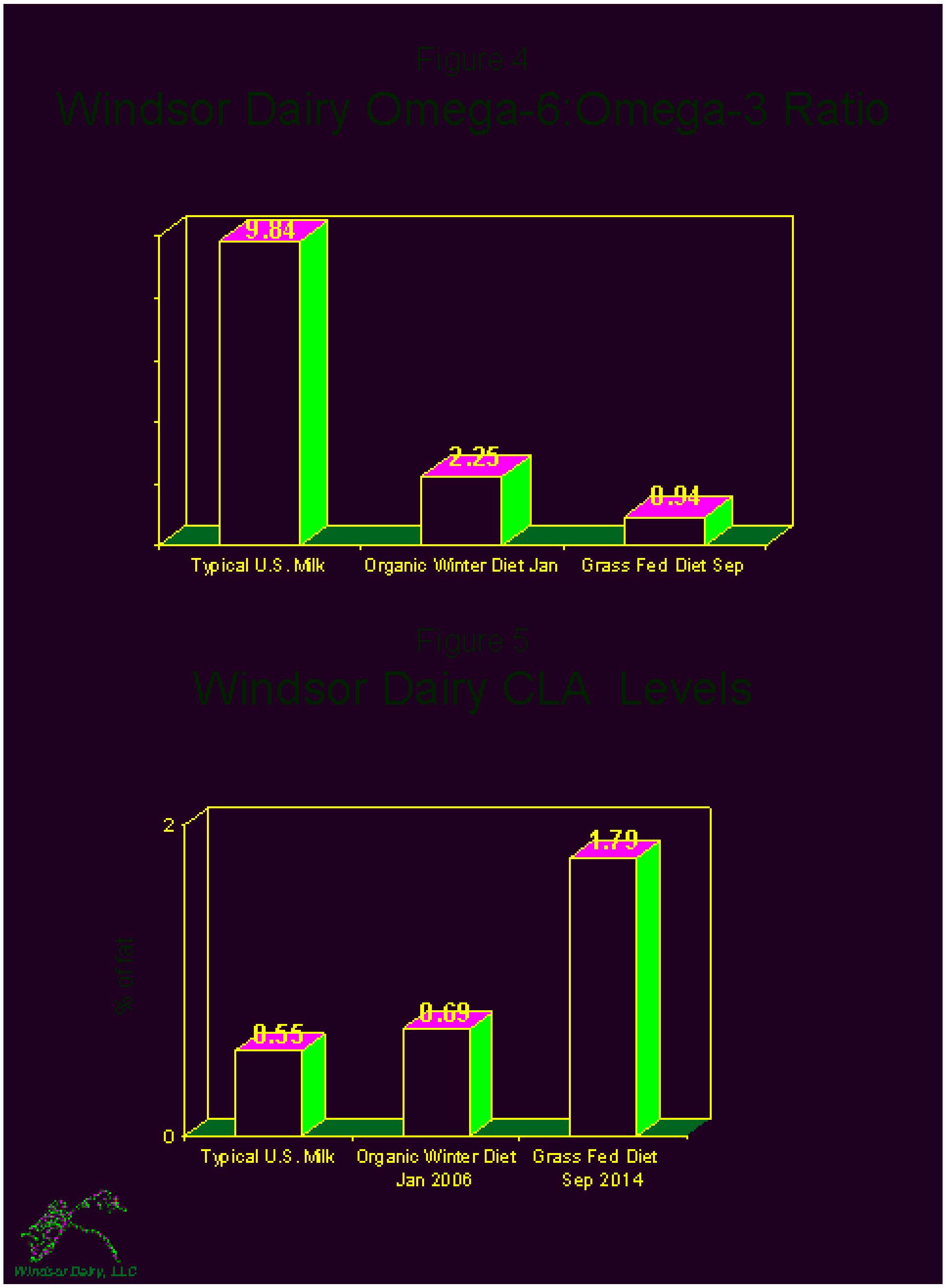


Figure 3
Good vs Bad Fat Consumption
pounds
50
40
30
20
10
0
Good Fat
Bad Fat
Windsor Dairy, LLC
USDA Data

Windsor Dairy Milk Fatty Acid Test Results

We have had our milk tested for fatty acids a few times to be sure that our goals are being met for producing the highest quality nutrition available in milk. The typical U.S. milk data is from a recent U.S. wide milk survey on samples collected in 2008 (O'Donnell-Megaro, 2011).




We have been happy that the levels of O-6 and O-3 and CLA have been as research has predicted.

*The diet makes the differences.*

***Flavor***

Taste Bud Sensitivity

Our cow share members have very discriminating palates! Perhaps that is one reason they are consuming raw grass-fed milk. They come to appreciate the different milk flavors across the seasons and diets. Pasture changes percentages of plants seasonally which changes the milk flavor.

Many members feel like a part of our dairy farm; after all they own part of our herd. They give us feedback on all kinds of management topics. They communicate with us through e-mails, texts, phone calls and in person at milk pickup times.

Our members tell us very quickly if we have a pipeline cleaning problem. They tell us quickly when we have a cooling problem in the bulk tank. They help us manage our milk quality!

In spring of 2013, we turned our milk cows out to pasture around 15 April. Cows were on pasture for the time between morning milking and afternoon milking for one day only. It started raining enough that we put the cows back in the barn and they did not return to pasture for six days. The milk in the tank that was bottled that week had only 5 hours of pasture grazing in 5 days worth of milk production. Members told us that they could taste that the cows had been turned out to spring pasture even though the pasture milk represented <5% of the milk that was bottled!

***Refrigerator Life***

Shelf Life

Windsor Dairy grass fed raw milk should last easily in the refrigerator for 7-10 days after milk pickup. Remember, this includes milk that was held in our bulk tank for 7 days before bottling day. So, our milk lasts for at least two weeks as fresh, sweet milk. In fact, our raw milk is 1.0 pH unit higher than milk from conventionally fed cows. After that, it will gradually change first to yogurt, then to curds and whey, and lastly to solid cheese in the half gallon glass container.

Speed of this transformation (it is not *spoilage* from bacteria, it is natural *fermentation* from bacteria) depends on the temperature of the location where it is stored. All during the fermentation process, it is edible! It does not putrefy like pasteurized milk.

Non-refrigerator Shelf Life

I have a standing bet with any doubters of raw milk's fermentation abilities: You place a ½ gallon carton of your favorite pasteurized milk in ***your*** refrigerator at home. I place a ½ gallon glass jar of Windsor Dairy milk on top of *your* refrigerator, no matter the season. We meet weekly. I will consume more of my transforming raw milk than you will consume of your refrigerated milk. Pasteurized milk spoils from growth of putrefying bacteria. Raw milk ferments from the growth of Lactobacillus bacteria. I will be consuming (first drinking and later chewing) my raw milk long after you have thrown your pasteurized milk out of your refrigerator because of the stench. Bets anyone?

***Udder Health Monitoring at Windsor Dairy***

Windsor Dairy collected udder health data and process control charts of summary statistics developed for consulting clients across the time periods when management ranged from conventional to certified organic and grass fed. These data provide an interesting case study and support observations made in consulting practice and published study data. Ruegg (Ruegg, 2009) reviewed studies of udder health and milk quality in conventional versus organic herds. Although bulk tank milk was not different, clinical mastitis incidence was approximately 1/2 as high in organic herds across studies. It was speculated that organic farmers had different diagnostic criteria and definitions of cure. In a separate herd survey (Pol, 2007), clinical mastitis was 41 cases per 100 cow years in conventional herds and 21 cases per 100 cow years in organic herds.

Windsor Dairy clinical mastitis incidence declined from 43 cases per 100 cow years in the conventional herd 2000-2002, to 9.3 cases per 100 cow years in the grazing, certified organic herd 2002-2007 and 4.2 cases per 100 cow years in the grass fed herd 2007-2014 (See Figure 6). Diagnostic criteria and personnel remained the same throughout the three periods. No intramammary treatments or dry cow antibiotics were administered in the organic or grass fed herds. All animals in the raw milk herd were screened for contagious mastitis pathogens prior to herd inclusion.

Based on DHI monthly individual cow SCC results several interesting trends were observed in our Windsor Dairy data.

New intramammary infection rates remained the same at about 4% per month but spontaneous resolution increased from 35% to 43% and 53% for the three consecutive periods (See Figure 7).

New infections during the dry period decreased (30%, 23% and 18%) and the rate of subclinical resolution during the dry period increased (49%, 58% and 82%) despite increasing average age and decreasing annual culling (28%, 16%, 8%).

Decreased metabolic stress with lower milk production (78, 66 and 30 lbs per cow per day) may explain apparently improved udder health. Decreased rumen acidosis and increased omega 3 fatty acid production may also influence immune competence. Controlled studies of omega 3 supplemented diets and udder health are not available.

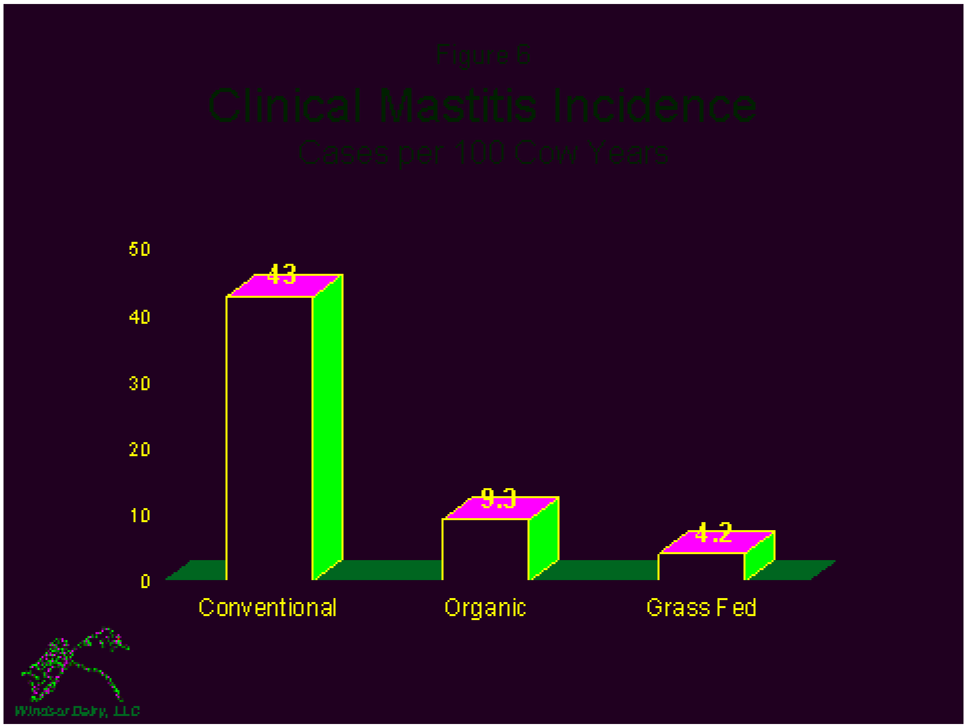


Figure 6
Clinical Mastitis Incidence
Cases per 100 Cow Years
50
40
30
20
10
0
43
9.3
4.2
Conventional
Organic
Grass Fed
Windsor Dairy, LLC

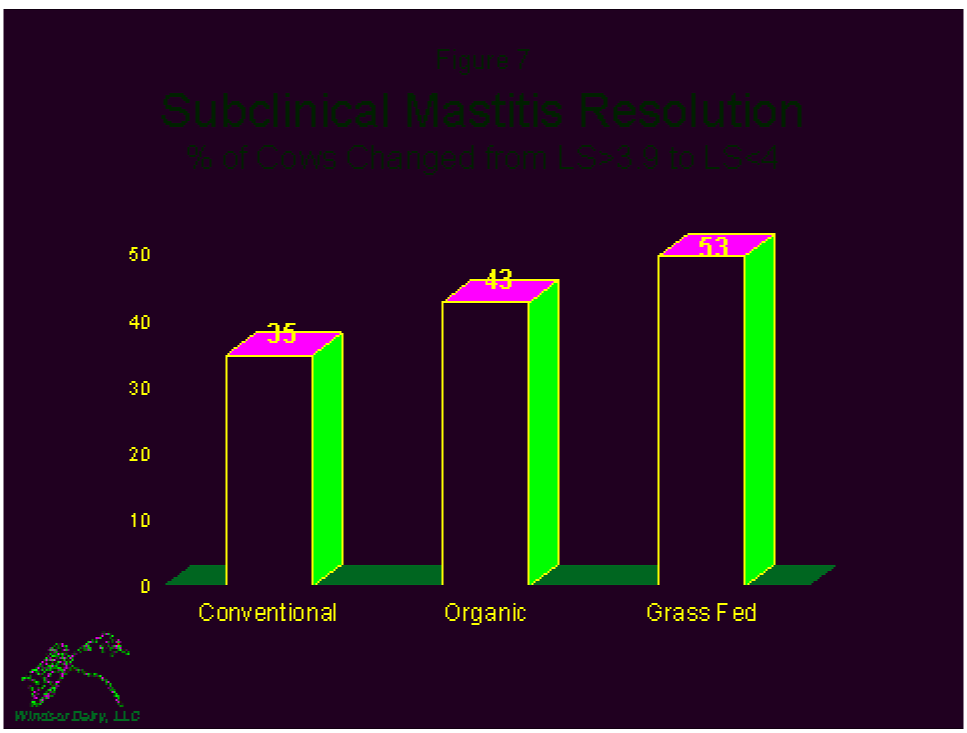


Figure 7
Subclinical Mastitis Resolution
% of Cows Changed from LS>3.9 to LS<4
50
40
30
20
10
0
35
43
53
Conventional
Organic
Grass Fed
Windsor Dairy, LLC

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# RAW MILK
## KNOW THE RAW FACTS

Many people choose raw milk thinking it will improve their health, but it can cause serious illness in anyone.

## WHAT IS RAW MILK ANYWAY?

**Raw milk** has not been pasteurized to kill harmful, disease-causing germs, including bacteria, viruses, and parasites.

**Pasteurization** is the process of heating milk to kill harmful bacteria.

Before most milk in the U.S. was pasteurized, raw milk was a common source of foodborne illness.

## HOLY COW! RAW MILK OUTBREAKS ARE ON THE RISE IN THE U.S.

**150x** The risk of an outbreak caused by raw milk is at least 150 times higher than the risk of an outbreak caused by pasteurized milk.

**4x** The average number of outbreaks linked to raw milk was 4 times higher from 2007-2012 compared to 1993-2006.

**81** In all, 81 outbreaks in 26 states were linked to raw milk from 2007-2012.

### Some germs linked to raw milk outbreaks

- *Campylobacter*
- *E. coli*
- *Salmonella*
- *Listeria*

## SOME GROUPS ARE MORE LIKELY TO GET SICK FROM RAW MILK

**Children** >>>>>>>> 59% of outbreaks reported from 2007-2012 included at least one child under 5 years

**Older adults** *(65 or older)*

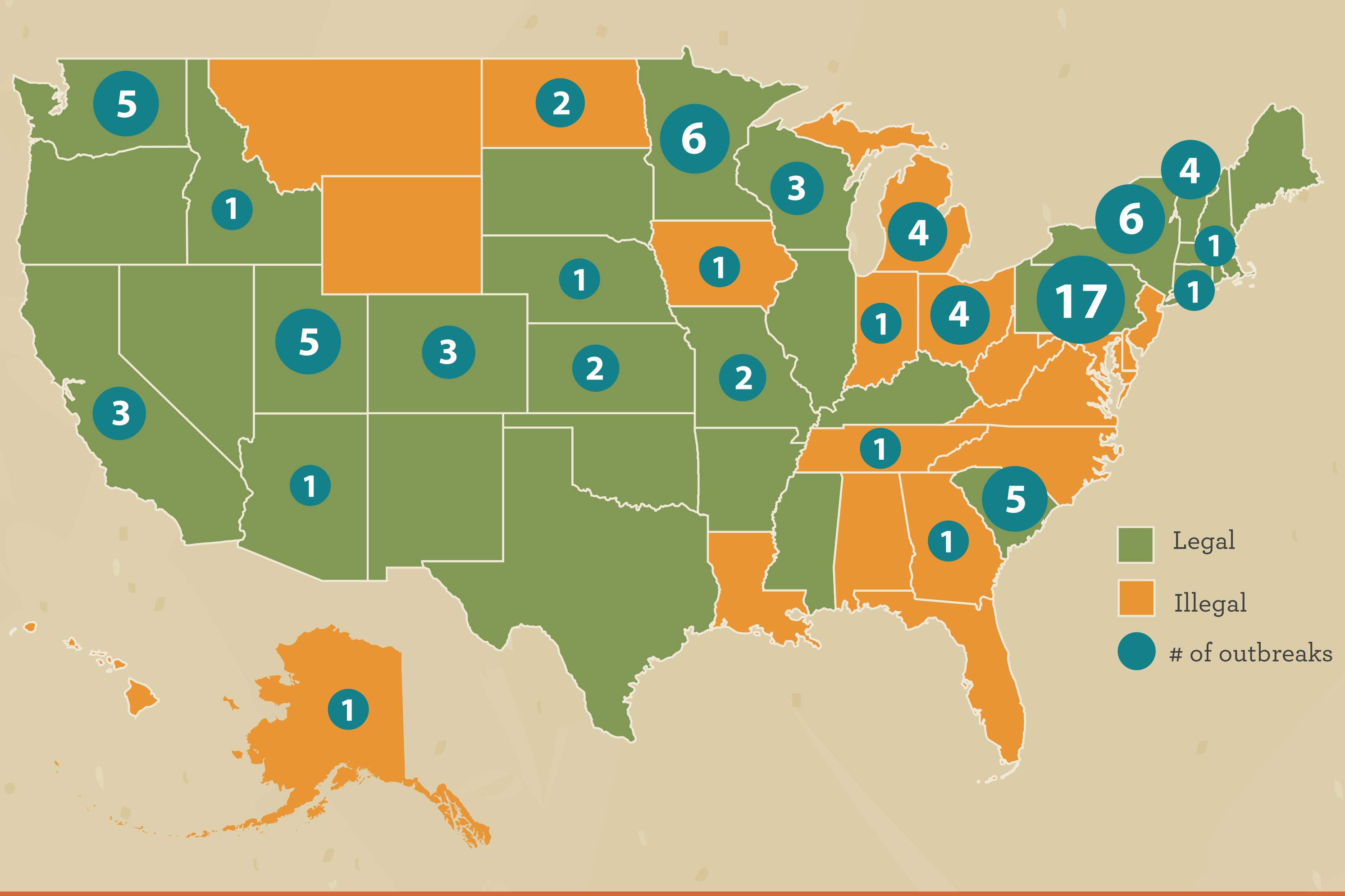
**People with weakened immune systems** *(including people with HIV/AIDS and chronic diseases such as diabetes and cancer)*

## RAW MILK IS BECOMING MORE AVAILABLE

In **2004**, selling raw milk was **legal in 22 states**. By 2011, this **increased to 30 states.**

Most **outbreaks** (81%) happened in states where **selling raw milk was legal.** 81%

### RAW MILK OUTBREAKS BY STATE (from 2007-2012)




## WHAT CAN YOU DO TO LOWER YOUR RISK OF GETTING SICK?

**Choose pasteurized milk and dairy products.** Buy and eat products that say "pasteurized" on the label. If in doubt, don't buy it!

**Refrigerate dairy products at 40°F or below.**

**Throw away any expired product.**

## BE WISE. ONLY DRINK MILK THAT'S PASTEURIZED!

CS274205-C

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

For more information on raw milk, please visit www.cdc.gov/foodsafety/rawmilk