HHS Public Access

Author manuscript

Zoonoses Public Health. Author manuscript; available in PMC 2024 August 01.

Published in final edited form as:

Zoonoses Public Health. 2024 August ; 71(5): 480–488. doi:10.1111/zph.13117.

Responding to outbreaks of illness linked to unpasteurized milk: A needs assessment of state health and agriculture departments

Michael Ablan[1], **Michelle Canning**[1], **Lia Koski**[1], **Lisa Landsman**[2], **G. Sean Stapleton**[1], **Megin Nichols**[1], **Misha Robyn**[1]

[1]Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

[2]Public Health Law Program, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

Abstract

Aims: Consumption of unpasteurized milk can result in severe illness or death. In the United States, the number of people who regularly consume unpasteurized milk is relatively low, but outbreaks resulting from unpasteurized milk outnumber outbreaks linked to pasteurized milk. The sale of unpasteurized milk for human consumption through interstate commerce is prohibited at the federal level, but laws among states vary considerably with respect to the sale of unpasteurized milk. Each state has a different perspective on responding to and preventing outbreaks of illness linked to consuming unpasteurized milk.

Methods and Results: We conducted a needs assessment of state health and agriculture departments to gather information on state-level strategies to prevent illnesses linked to consuming unpasteurized milk, characterize challenges states face, and identify areas where partners can support state efforts to prevent illnesses. We deployed a survey from 6 January 2021 to 1 March 2021, using a snowball sampling strategy and had 158 respondents. Of 115 respondents, 46 (40%) believed that state laws were ineffective in preventing illnesses, and 92 (80%) agreed that consumers continue to find ways to get unpasteurized milk despite laws restricting sale. Respondents from 19 states were aware of future legislative or regulatory efforts surrounding unpasteurized milk in their state, with 14 (74%) indicating these efforts would expand consumer access. The most common outbreak prevention strategies respondents mentioned included

Correspondence: Michael Ablan, Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention: 1600 Clifton Rd NE, Atlanta, GA 30329, USA., oth8@cdc.gov.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

ETHICS STATEMENT

This investigation was reviewed by the Centers for Disease Control and Prevention (CDC) and was conducted consistent with applicable federal law and CDC policy: 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

DISCLAIMER

The findings and conclusions in this article are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention (CDC).

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

sharing knowledge and experiences with other public health and agriculture officials, providing information to inform legislative efforts, and communicating to the public about outbreaks. Most respondents (41/50, 91%) were interested in pursuing further efforts to prevent unpasteurized milk-associated illnesses in their state.

Conclusions: The results from this needs assessment can be used to inform future strategies for preventing illness outbreaks associated with unpasteurized milk consumption.

Keywords

needs assessment; prevention; unpasteurized milk

1 | INTRODUCTION

Consumption of unpasteurized milk can result in severe illness or death, from transmission of pathogens such as *Brucella*, *Mycobacterium bovis*, *Campylobacter*, *Cryptosporidium*, Shiga toxin-producing *Escherichia coli* (STEC), *Listeria monocytogenes*, and *Salmonella enterica* (Adetunji et al., 2020; Michel et al., 2015; Mungai et al., 2015; Williams et al., 2023). In 1924, the United States adopted pasteurization of milk which led to significant decreases in foodborne illness during the twentieth century (Weisbecker, 2007). The consumption rate of unpasteurized milk is relatively low in the United States; as 1%–2% of the United States adult population report consuming unpasteurized milk weekly (Lando et al., 2022; Rhodes et al., 2019). However, reported outbreaks resulting from unpasteurized milk are occurring more frequently and outnumber outbreaks linked to pasteurized milk (Koski et al., 2022; Langer et al., 2012). During 2013–2018, there were 75 outbreaks linked to unpasteurized milk accounting for 675 illnesses, 98 hospitalizations, and 2 deaths; in comparison, only one outbreak including 32 illnesses was linked to pasteurized milk during this same time period (Koski et al., 2022).

The sale of unpasteurized milk is regulated at both the federal and state levels. At the federal level, sale of unpasteurized milk for human consumption through interstate commerce is prohibited.[1] Laws governing the sale of unpasteurized milk within state borders vary considerably across states. As of May 2019, 23 states and Washington D.C. prohibited the sale of unpasteurized milk for human consumption, while 27 states allowed sale of unpasteurized milk in some capacity. Of these 27 states, 14 allowed sales at retail stores, and 13 restricted sales to the farm where the milk was produced (Koski et al., 2022).

Given the variability in state laws, it is likely each state has a different experience and perspective on responding to and preventing outbreaks associated with unpasteurized milk. A needs assessment is an approach used to inform decision-making on the planning and deploying of resources to address health priorities (Tobi, 2016). We conducted a needs assessment of state health and agriculture departments to identify resource gaps and challenges in preventing outbreaks linked to unpasteurized milk. The goals of this project were to gather information on state-level strategies to prevent illnesses associated with unpasteurized milk, characterize challenges that states encounter regarding unpasteurized

[1]See 21 C.F.R. § 1240.61.

milk, and identify areas where federal governmental partners such as the Centers for Disease Control and Prevention (CDC) can support states' efforts to prevent illnesses.

2 | MATERIALS AND METHODS

2.1 | Key informant interviews

We completed four semi-structured interviews (DiCicco-Bloom & Crabtree, 2006) with representatives from governmental health and agriculture departments for two states (one interview from each department in each state) to help identify relevant topic areas for our needs assessment survey. The two states selected had differences in laws around the distribution of unpasteurized milk: one state prohibiting sale and the other allowing sale in retail stores. Through these interviews, we identified three primary topic areas to focus our needs assessment: legal context (i.e., state and federal laws pertaining to the sale of unpasteurized milk), outbreak investigations (i.e., identification of and response to human illness outbreaks associated with unpasteurized milk), and prevention work (i.e., any activity that is done with the intended purpose of preventing illnesses or outbreaks caused from unpasteurized milk consumption). Prevention interventions could include but were not limited to activities related to public communication for ongoing outbreaks, consumer education on the risks of consuming unpasteurized milk, or sharing relevant research findings with lawmakers.

2.2 | Needs assessment survey design and sampling methodology

The needs assessment survey consisted of 39 questions (Supplemental Materials in Data S1). The survey was divided into four sections: respondent demographics, legal context, outbreak investigation, and prevention activities. Demographic data collected included the state where the respondent worked, the agency for which the respondent worked, role within the agency, and the length of time the respondent had been in their role. Questions in the legal context section sought to characterize respondents' knowledge of laws pertaining to unpasteurized milk sale and distribution within their respective states, including potential legal loopholes and efforts to change legislation. The outbreak investigation section asked respondents to describe their perceptions of how consumers acquire unpasteurized milk (regardless of state regulation), of consumers' awareness of health risks associated with unpasteurized milk consumption, and of the challenges faced during outbreak investigations. The prevention work section asked respondents to describe strategies or projects conducted at the state level to prevent unpasteurized milk-associated illnesses or outbreaks; these included informing lawmakers, working with milk producers, and providing consumer education on the risks of unpasteurized milk consumption. The survey was created and administered using Epi Info™.

We distributed the survey to milk and dairy experts working within state health and agriculture departments; this population was selected because we believed they had expertise regarding issues related to unpasteurized milk-associated illness outbreaks and were the most likely individuals to be aware of their respective department's activities within the subject area. Often, there are not specific offices or positions within public health or agriculture departments that focus on unpasteurized milk exclusively; therefore, we relied on a snowball sampling strategy for survey recruitment (Johnson, 2014). A survey invitation

was initially sent via email to the National Association of Dairy Regulatory Officials (NADRO) membership list, state public health veterinarians, state veterinarians, and other partners that CDC works with during multistate outbreak investigations. Individual email addresses were acquired from public sources and internal databases and were sent to at least one contact within each of the 50 states and Washington D.C. The total amount of emails initially sent out was 258, however, since we utilized a snowball sampling strategy a response rate could not be calculated. The survey invitation explained the purpose of the survey and asked recipients to forward the invitation to others within their departments who were milk and dairy experts (Supplemental Materials in Data S1). There were no restrictions on how many surveys could be completed by a single department; however, a single respondent was only permitted to submit one survey. The survey was open from January 6th, 2021 to March 1st, 2021.

2.3 | Analysis

We calculated response frequencies for each survey question. Select questions were stratified by the legal status of the sale of unpasteurized milk in the respondent's state to understand the impact of laws within states on the respondent's perception of consumer behaviours and of the effectiveness of these laws. States were classified as either prohibiting the sale of unpasteurized milk or allowing sale in accordance with methods previously described (Koski et al., 2022). Frequencies and stratifications were examined, and patterns, inconsistencies, and uniformities were identified in the data. These patterns in the data were then evaluated by two independent reviewers who extracted common themes from the data. Each survey response accounted for a single observation for frequency calculations and all responses were unweighted across all calculations. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[2]

3 | RESULTS

3.1 | Demographics

Of 158 respondents, 123 (78%) reported the state in which they worked; respondents were from 46 states and Washington D.C., with a min of 1 and a max of 6 respondents from each state. The only states not represented in this survey included Mississippi, Iowa, Wyoming, and Hawaii (Figure 1). Seventy-three of 158 (46%) respondents worked for a state health department, 51 (32%) worked for a state agriculture department, 10 (6%) worked for another department, and 24 (15%) did not provide their departmental affiliation (Table 1). Information on each respondent's position within their agency was available for 157 people, and the length of time in their current position was reported for 135 respondents (Table 1).

3.2 | Legal context

Of the 134 respondents who answered the question reporting the legal status of the sale or distribution of unpasteurized milk in their state, respondents most commonly reported that sale is legal on the farm where the milk was produced (n = 46, 34%), 27% (n = 36) reported that sale is legal via cow or herd shares,[3] 25% (n = 33) reported that sale is legal when

[2]See e.g., 45 C.F.R. part s46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

sold as pet food, 21% (n = 28) reported that sale is illegal, 14% (n = 19) reported that sale is legal at farmers' markets (n = 19, 14%), and 13% (n = 18) reported that sale is legal in retail stores. Forty-four (40%) of 111 respondents who answered the question regarding herd shares reported that cow or herd shares are not specifically regulated in their state. Twenty-nine (26%) responded that cow or herd shares are expressly allowed by state regulation, and 9 (8%) responded they are expressly prohibited. Regarding which government entity has authority to enforce statutes and regulations around unpasteurized milk sale and distribution, respondents most frequently selected state agriculture departments (85/134, 63%), followed by state health departments (48/134, 36%), and local health departments (22/134, 16%).

We asked respondents whether they considered their state laws effective in preventing illnesses associated with unpasteurized milk consumption (n = 115); 41 (36%) agreed or strongly agreed and 46 (40%) disagreed or strongly disagreed. When asked if unpasteurized milk consumers continue to find ways to get unpasteurized milk despite laws restricting sale, 92 (80%) respondents agreed or strongly agreed while 5 (4%) disagreed or strongly disagreed. Finally, when asked whether the laws about unpasteurized milk sales are strictly enforced, 58 (50%) agreed or strongly agreed and 24 (21%) disagreed or strongly disagreed.

Three questions sought to understand potential legal barriers to enforcing laws about the sale of unpasteurized milk: (1) whether there are local ordinances that make it difficult to enforce state laws; (2) whether there are state laws that contradict one another; and (3) whether there are local ordinances that restrict consumer access to unpasteurized milk more than state laws. Seventy-seven (93%) of 83 respondents reported that they were not aware of local ordinances presenting challenges to enforcing state laws, and eight respondents were aware of local ordinances within their state that restricted consumer access to unpasteurized milk beyond state laws. Thirteen (14%) of 94 respondents reported that laws about the sale of unpasteurized milk in their state contradicted one another. Some respondents explained that their state prohibits sale of unpasteurized milk for human consumption but permits sale for pets. Others cited that the contradiction between state laws arises when sale is prohibited in certain locations (such as restaurants or at retail) but permitted via herd shares or on the farm where produced.

Respondents from 19 states were aware of future legislative or regulatory efforts impacting consumer access to the sale of unpasteurized milk in their state. Respondents from 14 of these states (74%) indicated these future legislative or regulatory efforts would expand consumer access to unpasteurized milk. Respondents from 18 (95%) states described these regulatory efforts using free text, and 91% of the free text responses addressed one or more of three points. First, respondents reported the persistence of proposed bills being introduced consistently in their state:

> Legislation [to expand access] is introduced almost every year

> Bills [are] constantly being introduced to expand access

[3]In some jurisdictions, consumers can access unpasteurized milk by purchasing an ownership interest in a cow or herd, which entitles them to a portion of the unpasteurized milk produced.

Second, others described future legislative or regulatory efforts as loosening regulations surrounding unpasteurized milk and expanding sale:

> Each year the legislature hears from farmers wanting to have no regulations on raw milk and when that doesn't work, they push for regulations to be downsized and expansion of where sales can occur

> Bill has been submitted to legislative assembly that would allow raw milk sales on farm

Finally, some respondents were specifically aware of future legislative action to legalize cow shares:

> Groups are always trying to get laws passed allowing the sale or cow sharing for purposes of raw milk consumption

3.3 | Outbreak investigations

We asked respondents to select all ways by which consumers obtained unpasteurized milk within their state. Overall, the most frequently selected methods included (n = 118): from a consumer's own cow(s) (74/118; 63%), from friends and/or neighbours (68/118; 58%), from purchase on farms of production (65/118; 55%), through any illegal sale inside the state (57/118, 48%), or through cow or herd shares (54/118, 46%). Among respondents from states that prohibit sale of unpasteurized milk, the most perceived method by which consumers obtained unpasteurized was via their own cow(s) (69%) (Figure 2). The least common response among respondents from states prohibiting sale and respondents from states allowing sale was purchase at restaurants (prohibit: 0% and allow: 4%). Even among the states that allow sale, more than 50% of respondents selected 'through illegal sales inside the state' as a perceived method of how consumers acquire unpasteurized milk in their state. Most respondents from both states that allow sale and states that prohibit sale agreed that despite current state laws restricting unpasteurized milk sales, unpasteurized milk consumers continue to find ways to access unpasteurized milk (allow: 86%; prohibit: 73%).

We asked respondents to indicate their agreement about barriers or outcomes of unpasteurized milk-associated outbreak investigations. Most (64/83, 77%) agreed or strongly agreed that state or local authority could be used to cease operations of facilities that were implicated as a source of an illness outbreak (Figure 3). However, 44% (31/70) believed that it was easy for facilities to continue to sell unpasteurized milk even after they were implicated in an outbreak, and 36% (27/74) considered producers or farmers generally uncooperative during outbreak investigations. In comparison, 54% (44/81) of respondents considered consumers to be uncooperative during investigations. Forty percent (33/83) of respondents agreed that consumers were aware of the risks of consuming unpasteurized milk before they became ill, while 30% (25/83) did not agree with this (Figure 3).

3.4 | Prevention work

Respondents were asked to report their perception of any changes in the frequency of consumption of unpasteurized milk within their state; 43% (43/100) reported they have not noticed a difference in the frequency of consumption, 40% (40/100) reported that

they believed consumption was increasing, and 2% (2/100) perceived consumption was decreasing. When asked about their perception of consumers' behaviour after the consumers learn that they became sick from unpasteurized milk, 42% (43/102) of respondents believed consumers continue to consume unpasteurized milk, and 12% (12/102) thought consumers generally stop consuming unpasteurized milk. Survey respondents also stated that during illness investigations, consumers would deny unpasteurized milk was the source or their illnesses. Additionally, it was the perception of some respondents that consumers who become ill and are part of an illness outbreak linked to unpasteurized milk are more likely to be frequent consumers (i.e., consume unpasteurized milk weekly) versus consuming unpasteurized milk for the first time or only a few times a year.

Fifty-five (59%) of 93 respondents agreed or strongly agreed that communicating to the public about unpasteurized milk outbreaks is an effective tool for outbreak prevention, and 15 (16%) disagreed or strongly disagreed. Respondents reported a variety of strategies to reduce illnesses associated with unpasteurized milk consumption. Most commonly, this included sharing experiences with other states/agencies (67/112, 60%), providing information to inform legislative efforts aimed to change existing laws pertaining to unpasteurized milk (54/112, 48%), and communicating to the public about outbreaks linked to unpasteurized milk (45/112, 40%). Few respondents reported that their agency's website had a page with current unpasteurized milk prevention information (19/112, 17%) or that they try to educate the public either with targeted educational materials (15/112, 13%) or by working with consumer groups (17/112, 17%). Some respondents work to prevent illnesses by promoting best practices for unpasteurized milk production (28/112, 25%), and others target educational materials towards producers (11/112, 10%).

Respondents most relied on previous outbreak data and press/media releases to inform prevention efforts (57/108, 53%). Some utilized information presented at conferences (34/108, 31%), infographics or communication materials generated by external organizations (26/108, 24%), or informational materials generated internally (19/108, 18%). Most respondents (41/50, 91%) were interested in pursuing further efforts to prevent unpasteurized milk-associated illnesses in their state. Finally, respondents were asked what their agency might need to pursue prevention work surrounding unpasteurized milk consumption and responses commonly included resources (financial and personnel) and evidence/information for consumers.

4 | DISCUSSION

Unpasteurized milk consumption is a well-recognized public health risk and is increasingly linked to illness outbreaks in the United States (Koski et al., 2022; Langer et al., 2012; Mungai et al., 2015). Regulations pertaining to the sale and distribution of unpasteurized milk vary state-to-state, and the magnitude of unpasteurized milk-associated outbreaks and illnesses is associated with the accessibility of unpasteurized milk in each jurisdiction (Koski et al., 2022). Therefore, each state faces different barriers and has unique needs related to preventing illnesses associated with unpasteurized milk consumption. Through our survey of subject matter experts, we have identified prevention work being done at the state level,

challenges states are facing in investigating and preventing outbreaks linked to unpasteurized milk, and areas needing additional support.

Most respondents believed that unpasteurized milk consumption continues to occur, even when the sale of unpasteurized milk is prohibited by state law. Respondents from 14 states reported that they were aware of efforts to increase consumer access to unpasteurized milk and that there was a recurrent need to prevent such legislation. Most respondents indicated that their prevention efforts at the state level were focused on resisting expansion of legal access to unpasteurized milk proposed by the unpasteurized milk lobbyists through providing information and education to inform legislative decision-making. While this is certainly an important component of prevention work pertaining to unpasteurized milk, it is a resource-intensive effort, and recent legislative changes have moved in the direction of increasing consumer access to unpasteurized milk (Koski et al., 2022). A recent example of this can be seen in Georgia, where on 13 May 2022, the Georgia Raw Dairy Act passed in the state legislature to allow unpasteurized milk to be sold in the state starting on 1 July 2023 (Bohnert, 2022). Even in jurisdictions that prohibit sale of unpasteurized milk, respondents reported that the public accesses unpasteurized milk via personally owned animals or animals owned by friends or neighbours. Respondents were also aware of other opportunities for the public to access unpasteurized milk, such as through cow or herd shares, by purchasing unpasteurized milk marketed as pet food, or by driving to states where unpasteurized milk is sold. These reported loopholes are consistent with methods that have been documented in past outbreak investigations (Burakoff et al., 2018). Though prohibition of unpasteurized milk sale is associated with fewer outbreaks and outbreak-associated illnesses (Koski et al., 2022), survey respondents' perceptions about unpasteurized milk consumption despite regulation is consistent with previous reports (Lando et al., 2022). Collectively, this indicates the need for varied approaches beyond legislation to reduce unpasteurized milk consumption and prevent illnesses.

The myriad state laws and ways to access unpasteurized milk potentially create a nuanced situation, wherein each state needs a prevention approach tailored to how its consumers most commonly access unpasteurized milk. Public health interventions based in social behavioural science theory have been proven to be more effective than those without a strong theoretical basis (Glanz & Bishop, 2010). Social behavioural theory provides a framework to ensure interventions are grounded in a theoretical structure that considers the influence of knowledge, attitudes, and practices (KAP) of people and how they interact with others and their environment. For example, A KAP-grounded approach can utilize a deeper understanding of the audience to craft messaging specific to the audience's personal KAP towards unpasteurized milk as opposed to an approach where messaging is only highlighting facts without considering KAPs influence on a person's behaviour. More work is needed to better understand the KAP of unpasteurized milk consumers in specific states and geographic regions to best tailor state-level interventions around how individuals are obtaining and consuming unpasteurized milk. Respondents reported consumers acquiring unpasteurized milk in different ways based upon if the state prohibits or allows sale (Figure 2). For example, in states where retail sales are legal, a consumer-driven educational approach rooted in behavioural theory could be effective at preventing first-time unpasteurized milk consumers from purchasing unpasteurized milk in retail stores

through education of the health risks associated with unpasteurized milk consumption. For states where retail sales are illegal, a different approach might be warranted because of possible differences in consumer attributes: the type of consumer acquiring unpasteurized milk through methods that require greater persistence or illegal methods might be different from the average consumer. Furthermore, respondents were under the general impression that individuals will continue to acquire and consume unpasteurized milk even after they discover they have become sick and that patients included in unpasteurized milk-associated outbreaks are aware of the risks of unpasteurized milk prior to becoming sick. This further demonstrates the need to understand the various types of people who consume unpasteurized milk as their KAP may be different among various types of consumers. Research into KAP of unpasteurized milk consumers should seek to describe behaviours and beliefs of people at the level of a specific state or jurisdiction rather than the United States collectively. Federal agencies might consider how best they can support state-based or national efforts to explore KAP and create tailored-messaging for the various types of people who consume unpasteurized milk.

A substantial proportion of respondents indicated their agency would like to pursue more prevention work; however, there was need for more resources and educational materials to implement more prevention efforts. This highlights a need for public health and agricultural organizations to increase the capacity for unpasteurized milk prevention efforts at the state level by providing additional resources and support for the development of tailored educational materials and other state-specific prevention efforts. Interestingly, respondents also indicated that communications about the risk of consuming unpasteurized milk are effective, yet less than half of respondents use this type of prevention strategy. This could be an example of an opportunity to bolster prevention efforts at the state level by more systematically communicating about the health risks of consuming unpasteurized milk. While many respondents indicated that they communicate about outbreaks linked to unpasteurized milk, there were only a small proportion of respondents that stated their agency provides focused educational materials to consumers, works with consumer groups to educate the public, or utilizes their website to provide current prevention information. Greater collaboration in these areas is needed to prevent unpasteurized milk-associated outbreaks.

This needs assessment of state health and agriculture departments has multiple limitations. First, our survey captured the thoughts and perceptions of individual respondents; their responses might not fully describe the unpasteurized milk landscape within their state and may not represent the official positions of their respective organizations. Second, we used a snowball sampling strategy. This method allowed for a greater number of responses to the survey; however, we may have missed important perspectives from partners across the states. Finally, we did not receive an equal number of responses across states or across organizations. Some United States jurisdictions were not represented in this survey, and many only had one representative who completed the survey. A more systematic survey of state and local governments could have strengthened our conclusions.

Understanding the challenges faced by states in the prevention of outbreaks linked to unpasteurized milk consumption can inform tailored intervention strategies at the state

level as outbreaks continue to occur. This needs assessment identified key areas for public health focus: (1) consumers continue to obtain unpasteurized milk for consumption, though the methods of obtaining the product may differ; (2) potential changes to the state's law might make it easier to obtain unpasteurized milk; and (3) states want to pursue more prevention work but need more support. If pressure on state legislatures to allow the sale of unpasteurized milk succeeds, greater public health resources may be needed to combat illness and outbreaks associated with unpasteurized milk consumption. Prevention efforts should be tailored to account for the nuanced situations created by varying state laws, the state-specific mechanisms used to obtain unpasteurized milk, and the differences in KAP for various types of consumers (e.g., first-time vs. regular consumers) obtaining unpasteurized milk.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGEMENTS

We would like to thank Amy Lando and others at FDA for their review of the survey instrument along with our state partners and NADRO for providing information on this topic and survey participation and dissemination. We would also like to thank our survey participants for the information they provided.

FUNDING INFORMATION

The authors have no sources of funding to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

Adetunji SA, Ramirez G, Ficht AR, Perez L, Foster MJ, & Arenas-Gamboa AM (2020). Building the evidence base for the prevention of raw milk-acquired Brucellosis: A systematic review. Frontiers in Public Health, 8, 76. 10.3389/fpubh.2020.00076 [PubMed: 32232023]

Bohnert K (2022). Georgia to begin allowing raw milk sales. https://www.dairyherd.com/news/dairy-production/georgia-begin-allowing-raw-milk-sales#:~:text=The%20bill%20goes%20into%20effect,and%20follow%20food%20safety%20regulations

Burakoff A, Brown K, Knutsen J, Hopewell C, Rowe S, Bennett C, & Cronquist A (2018). Outbreak of fluoroquinolone-resistant *Campylobacter jejuni* infections associated with raw milk consumption from a herdshare dairy — Colorado, 2016. Morbidity and Mortality Weekly Report, 67, 146–148. [PubMed: 29420460]

DiCicco-Bloom B, & Crabtree BF (2006). The qualitative research interview. Medical Education, 40(4), 314–321. 10.1111/j.1365-2929.2006.02418.x [PubMed: 16573666]

Glanz K, & Bishop DB (2010). The role of behavioral science theory in development and implementation of public health interventions. Annual Review of Public Health, 31, 399–418. 10.1146/annurev.publhealth.012809.103604

Johnson TP (2014). Snowball sampling: Introduction. In Balakrishnan N, Colton T, Everitt B, Piegorsch WW, Ruggeri F & Teugels JL (Eds.), Wiley StatsRef: Statistics Reference Online. John Wiley & Sons. 10.1002/9781118445112.stat05720

Koski L, Kisselburgh H, Landsman L, Hulkower R, Howard-Williams M, Salah Z, Kim S, Bruce BB, Bazaco MC, Batz MB, Parker CC, Leonard CL, Datta AR, Williams EN, Stapleton GS, Penn M, Whitham HK, & Nichols M (2022). Foodborne illness outbreaks linked to unpasteurised milk and relationship to changes in state laws – United States, 1998–2018. Epidemiology and Infection, 150, 183. 10.1017/s0950268822001649

Lando AM, Bazaco MC, Parker CC, & Ferguson M (2022). Characteristics of U.S. consumers reporting past year intake of raw (unpasteurized) milk: Results from the 2016 food safety survey and 2019 food safety and nutrition survey. Journal of Food Protection, 85(7), 1036–1043. 10.4315/jfp-21-407 [PubMed: 35333921]

Langer AJ, Ayers T, Grass J, Lynch M, Angulo FJ, & Mahon BE (2012). Nonpasteurized dairy products, disease outbreaks, and state laws-United States, 1993–2006. Emerging Infectious Diseases, 18(3), 385–391. 10.3201/eid1803.111370 [PubMed: 22377202]

Michel AL, Geoghegan C, Hlokwe T, Raseleka K, Getz WM, & Marcotty T (2015). Longevity of *mycobacterium bovis* in raw and traditional souring milk as a function of storage temperature and dose. PLoS One, 10(6), e0129926. 10.1371/journal.pone.0129926 [PubMed: 26121261]

Mungai EA, Behravesh CB, & Gould LH (2015). Increased outbreaks associated with nonpasteurized milk, United States, 2007–2012. Emerging Infectious Diseases, 21(1), 119–122. 10.3201/eid2101.140447 [PubMed: 25531403]

Rhodes TM, Kuchler F, McClelland K, & Hamrick KS (2019). Consumer food safety practices: Raw milk consumption and food thermometer use, EIB-205, U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/publications/pub-details/?pubid=91109

Tobi P (2016). Health needs assessment. In Regmi K & Gee I (Eds.), Public health intelligence: Issues of measure and method (pp. 169–186). Springer International Publishing. 10.1007/978-3-319-28326-5_9

Weisbecker A (2007). A legal history of raw milk in the United States. Journal of Environmental Health, 69(8), 62–63.

Williams EN, Van Doren JM, Leonard CL, & Datta AR (2023). Prevalence of *Listeria monocytogenes*, Salmonella spp., Shiga toxin-producing *Escherichia coli*, and Campylobacter spp. in raw milk in the United States between 2000 and 2019: A systematic review and meta-analysis. Journal of Food Protection, 86(2), 100014. 10.1016/j.jfp.2022.11.006 [PubMed: 36916568]

Impacts

- State health and agriculture department officials desire to do more to prevent illnesses associated with unpasteurized milk consumption but need more resources.
- State experts report that the public accesses unpasteurized milk through a variety of means, some of which might be illegal. Prevention efforts should be tailored to account for the specific mechanisms used to obtain unpasteurized milk in each state.
- Legislation to expand access to unpasteurized milk has been proposed in multiple states, presenting an ongoing challenge to public health.

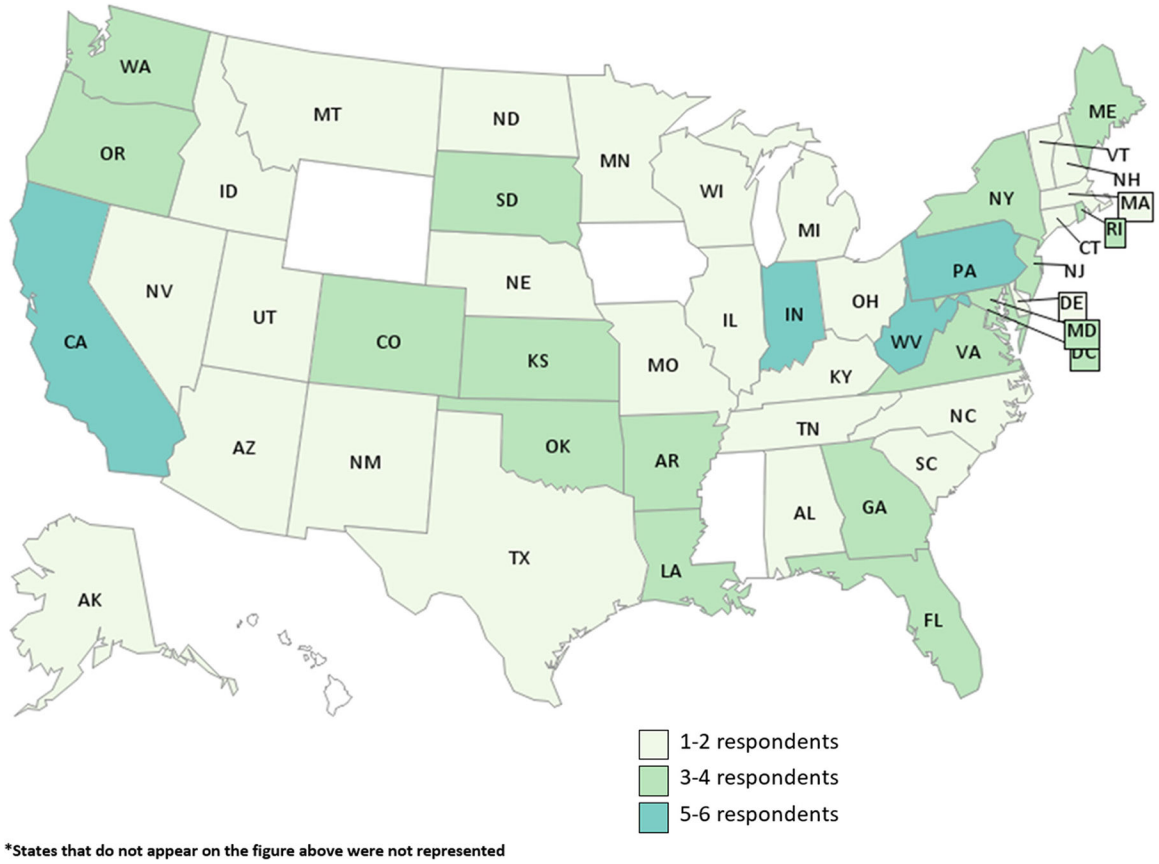

FIGURE 1.

Number of respondents who completed the survey, by state—United States, 2021. *States that do not appear on the figure above were not represented.

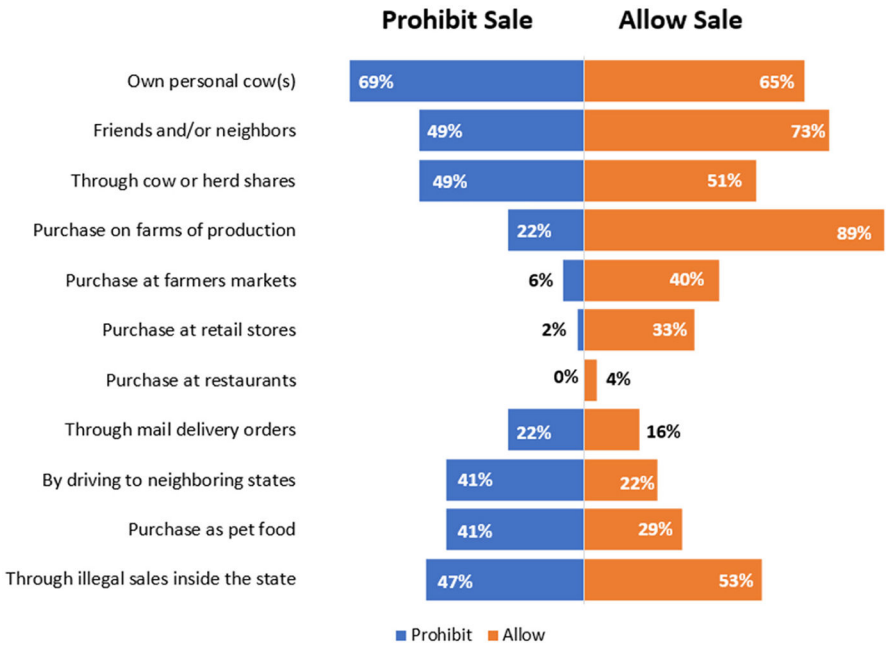

FIGURE 2.

Methods by which consumers access unpasteurized milk as perceived by state governmental officials in web-based needs assessment survey. Results are stratified depending on whether the respondent's state prohibits (n = 49 respondents) or allows (n = 55 respondents) sale of unpasteurized milk.

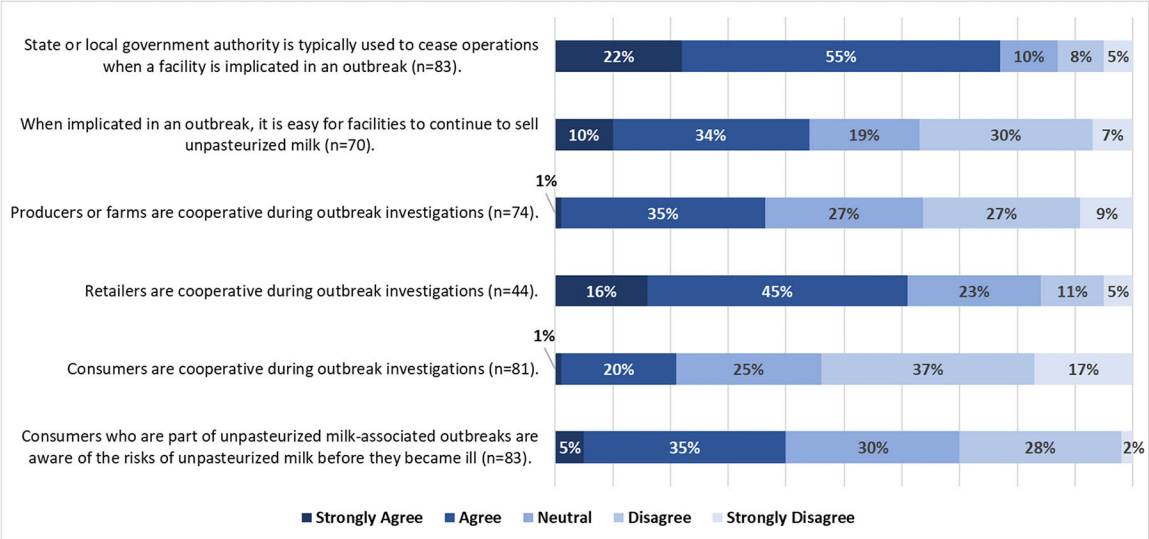

FIGURE 3.

Barriers and outcomes of unpasteurized milk-associated illness outbreak investigations as reported by state governmental officials in web-based needs assessment survey.

TABLE 1

Characteristics of 158 state governmental officials administered a web-based needs assessment survey pertaining to unpasteurized milk—United States, 2021.

	State agriculture department *N* = 51 (32)	**State health department *N* = 73 (46)**	**Other state department *N* = 10 (6)**	**Missing *N* = 24 (15)**
Respondent's position within department				
Employee position available[a]	50 (98)	72 (99)	10 (100)	1 (4.2)
Environmental health specialist/sanitarian	13 (26)	13 (18)	0	1 (100)
Epidemiologist	1 (2)	36 (50)	2 (20)	0
Public Health Analyst	0	0	0	0
Physician	0	4 (6)	0	0
Public Information Officer/Public Affairs Specialist	0	0	0	0
Veterinarian	9 (18)	3 (4)	3 (30)	0
Other[b]	23 (46)	2 (3)	4 (40)	0
Multiple[c]	3 (6)	14 (19)	1 (10)	0
Prefer not to answer	1 (2)	0	0	0
Length of time in current position				
Length of time available[a]	51 (100)	73 (100)	10 (100)	1 (4.2)
Less than 1 year	4 (8)	10 (14)	0	0
1–5 years	16 (31)	27 (37)	5 (50)	0
5–10 years	8 (16)	14 (19)	0	0
10 years or more	23 (45)	22 (30)	5 (50)	1 (100)

[a]Available refers to instances where the information was reported by the respondent (i.e., not missing).

[b]Among the 36 respondents who selected this response, 29 (81%) selected only 'other'. Among the 29 respondents who selected only 'other', 28 (97%) provided a free-text response. Ten of these 28 (36%) specifically mentioned 'dairy' in their title/position.

[c]Question prompt requested respondent to select all positions within agency that applied. If respondent selected more than one of the positions, their position is counted in the table under 'multiple'.