

Needs and Opportunities for Applying Voluntary Occupational Health and Safety Management Systems in the High-Hazard U.S. Dairy Production Industry

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Abstract. The U.S. dairy industry has had consistently high rates of occupational injuries. Occupational health and safety management systems (OHSMSs) have potential to reduce injury rates, but lacking a regulatory mandate for such a system, it is uncertain if U.S. dairy farmers will adopt an OHSMS. Needs assessment interviews were developed and validated to assess the attitudes, experiences, and interests of dairy workers and managers about OHSMS approaches to worker safety. Non-parametric statistical methods were applied to determine whether there were differences between the mean responses of workers and managers and whether their expressed attitudes and interests were significantly strong in favor or against OHSMSs. Thirty-two dairy workers and four managers from four farms completed the interviews. There were no significant differences in attitudes or interests between dairy workers and management. Most of the attitudes and interests were strongly favorable of OHSMS approaches, suggesting that dairy farmers may be willing to adopt an OHSMS voluntarily.

Keywords: OHSMS · Injury and illness prevention program · Occupational safety and health program · Farm safety · Needs assessment

1 Introduction

Occupational injuries and illnesses are common in the U.S. dairy production industry. Between 2006 and 2015, the rate of injuries per 100 full-time workers averaged 5.7, ranging from 3.9 to 7.3 [1]. This was higher than the average rates during the same 10-year span across all U.S. employment sectors and in the broader agriculture sector specifically, which were 3.6 and 5.1, respectively [1]. Common hazards among dairy farm workers include being crushed by cattle, contact with heavy machinery, ergonomic stresses among workers who milk cows or handle calves, and respiratory exposures [2].

The causes of these events and conditions are multifactorial including direct, indirect, and systemic risk factors. Important direct risk factors include insufficient training, poor ergonomic design of dairy equipment, and environmental exposures [3, 4]. A largely immigrant, migrant, non-English speaking workforce, many of whom have a fear or distrust of government authorities are some important indirect risk factors for occupational injury and illness among dairy farm workers [5]. Furthermore, the dairy industry has historically been neglected by regulators responsible for occupational health and safety (OHS), with fewer than 700 federal regulatory inspections having occurred on dairies between 2003 and 2012 despite there being more than 45,000 U.S. dairy farms in operation [6]. Systemic risk factors include a lack of training, lack of standard operating procedures and poor leadership [3, 7].

Given the objectionably high rates of injuries and wide range of occupational morbidities and risk factors, comprehensive risk management methods are needed to protect workers employed on U.S. dairy farms. Occupational health and safety management systems (OHSMSs) have shown promise as a means to reduce overall injury rates. Studies have demonstrated that voluntary OHSMSs in the U.S. can reduce hazards, reduce costs, and reduce injuries in general [8, 9]. Unfortunately, little has been published on whether these results are applicable to the dairy industry. An Australian study published in 2011 evaluated how well different agriculture industries had adopted OHSMS-like regulations [10]. The study revealed that dairy was one of the highest performing agricultural industries (ranked third out of seven), but that fewer than half had adopted a farm health and safety plan (39%) or provided introductory safety training for farm workers (43%) [10]. In the U.S., it has been reported that pork producers were willing to adopt OHSMSs, particularly when checklists and guides are included [11]. In a 2016 study of U.S. dairy farms that had participated in a free government health and safety consultation program, farms with higher levels of OHSMS programming were generally associated with lower rates of injuries and illnesses [12]. However, the study was correlational and observational in nature and examined only coincident injury rates and OHSMS programming [12]. To date, no OHSMS intervention studies have been published in the dairy industry, although a replication study found similar associations in the poultry production industry [13].

One potentially important barrier to an OHSMS intervention program for dairies is the acceptability of such an intervention for dairy farmers and farm workers. In the U.S., there is no federal government mandate for businesses to adopt an OHSMS, and few states require any type of systemic approach to worker safety. California is the most noteworthy exception, having enacted an “Injury and Illness Prevention Program” (IIPP) rule for most employers since 1991 [14]. However, employers with fewer than 20 employees are exempted from most of the IIPP requirements and most U.S. dairy farms employ fewer than 20 people [14]. Thus, OHSMS adoption would be a voluntary measure for most U.S. dairies, 95% of whom employ fewer than 20 workers [15].

The study presented here was conceived to ascertain whether U.S. dairy farmers and farm workers would be interested and supportive of adopting a voluntary OHSMS. The objectives of this work were to measure the attitudes toward, experiences with, and interest in, systemic OHSMS approaches among U.S. dairy workers and employers. The needs assessment results should provide evidence for or against the development of an OHSMS intervention to reduce occupational injuries and illnesses among dairy farm workers.

2 Methods

2.1 Interview Instruments

A needs assessment interview instrument was developed to assess the attitudes, experiences, and interests of dairy workers and dairy managers/owners as they relate to systemic approaches to occupational health and safety. The worker instrument consisted of eight questions on attitudes that used a four-point forced-choice scale, eight experience questions that used yes or no answers, and seven more four-point scale questions about how interested dairy workers were in participating in OHSMS-related activities. The scaled responses to interview questions about attitudes and interests were worded as 0 = strongly disagree or very disinterested; 1 = slightly disagree or somewhat disinterested; 2 = slightly agree or somewhat interested; and 4 = strongly agree or very interested, respectively.

A second interview instrument was developed for dairy owners and managers. This instrument had the same number of questions on attitudes and experiences, but had six additional questions assessing interests. The additional questions focused on management aspects of systematic occupational health and safety, such as demonstrating support for safety, getting workers involved in safety, and contractor safety.

Both interview instruments were assessed for content validity using an expert opinion panel. This panel of national expert reviewers included researchers experienced with dairy health and safety, OHSMSs, and dairy management. Each one of these experts provided their opinions on the interview instruments and offered suggestions for improvement. In addition, we had a dairy owner and a dairy worker review and evaluate their relevant instruments. This preliminary validation (face, consensual, and content validity) is consistent with methods used to develop interview instruments for medical services needs assessments [16], and education research assessments [17]. Neither the criterion validity nor the reliability of the interview instruments was assessed.

Both interview instruments were written in English. They were then translated into Spanish by an independent third party. A Spanish-speaking former dairy worker and a bi-lingual dairy management researcher verified the accuracy of the translated interview instruments.

2.2 Subject Recruitment and Interview Process

A convenience sample of four dairy farms in a western U.S. state that had participated in a local university extension program on dairy management in 2014 was targeted for this study. The sample represented a variety of dairy farm sizes that included small (100 to 999 head of cattle), medium (1,000 to 2,499 head), and large (2,500 + head, according to National Agriculture Statistics Service classifications), and a variety of processes (organic and non-organic) [18]. A bi-lingual member of the research team visited each farm and interviewed all of the available workers and either the farm owner (for smaller farms) or the farm general manager (for larger farms). Dairy farm workers and owners/managers were approached using an Institutional Review Board Approved recruitment script. All participants were interviewed in either English or Spanish

depending on which language was preferred. Resource limitations prevented additional dairy farm visits within the study period. The subject recruitment and interview process was conducted according to methods approved by the Colorado State University Institutional Review Board.

2.3 Data Analysis

The goals of the data analyses in this study were (1) to examine if there were any significant differences in the opinions of dairy workers and owners/managers; and (2) to determine if the opinions of dairy farm workers and management were convincingly strong for or against a number of aspects related to an OHSMS.

The first goal was assessed using a two-sided Wilcoxon Rank-Sum Test for concordant items on the worker and owner/manager interview instruments. The null hypothesis was that there was no difference between the mean score of either group for a particular question.

The second goal was assessed by analyzing the responses to attitude and interest questions from workers and owners/managers using a one-sided, one-sample sign test. The null hypothesis was set to a value of 3 out of 4 for each question included in the analysis. If the median response was significantly greater than three for a question, then that was considered evidence of a significantly strong opinion in favor of that particular construct of an OHSMS. If the mean response was not significantly strong, then a second one-sample sign test was conducted using a null of two and a less-than alternative. This would be considered strong evidence against a particular interview item.

Non-parametric statistics were employed to address both goals because the interview items cannot be considered interval or ratio scale, which precluded the use of other analyses. Minitab 17 Statistical Software (State College, PA, U.S.A.) was used to perform all analyses in this study.

3 Results

3.1 Participant Demographics

Thirty-two farm workers and four owners/managers participated in the interviews from four dairy farms. The farms included a large organic dairy and a large non-organic dairy, a medium-sized non-organic dairy, and a small non-organic dairy farm. No one refused to participate in the study.

Of the 32 dairy workers who participated in this study, 23 were male (72%) and all of the workers who reported their country of origin (25/32, 78%) were born outside of the U.S. The most common country of origin reported was Mexico (15/25 reporting, 60%) followed by Guatemala and El Salvador (3/25 reporting, 12% each); Ukraine (2/25 reporting, 8%); and Peru and China (1/25 reporting, 4% each). All of the seven workers who did not report a country of origin spoke Spanish, resulting in a total of 29 out of 32 dairy worker respondents who completed the interviews in Spanish (91%). The mean age of the worker participants was 34.6 years (range 19 to 64 years) among the 24 who reported their age.

Of the four dairy owners/managers who participated, one was an owner and three were farm general managers. Three of the four owners/managers (75%) completed their interviews in English. Only two of the four owners/managers (50%) provided an age. The average reported age was 33.5 years, ranging from 30 to 37 years.

3.2 Interview Results

Attitudes Toward Systematic OHS. In the first portion of the interviews, dairy farm workers and owners/managers were asked how strongly they agreed or disagreed with seven statements about systematic approaches to OHS. The individual questions and the responses of worker and owner/manager participants are summarized in Table 1.

During the instrument validation process, an eighth item was added to this section. The results of this question are presented separately because it did not specifically gauge an attitude toward systematic OHS. The mean response to the eighth statement “I know where to find information about workplace safety issues”, was 2.8 (range 1 to 4) for both workers and owners/managers.

Table 1. Attitudes about systematic occupational health and safety among dairy farm workers (n = 32) and dairy owners/managers (n = 4).

Attitude statement	Worker responses ^a mean (Range)	Management responses ^a mean (Range)
1. Safety is better addressed at the organization level rather than at the individual level	3.7 (2 to 4)	3.8 (3 to 4)
2. Safer environments for workers are also safer environments for livestock	3.7 (2 to 4)	4.0 (4 to 4)
3. Injury prevention is everyone’s responsibility on a dairy farm rather than just one person’s	3.7 (1 to 4)	3.8 (3 to 4)
4. There is a relationship between worker safety and work quality	3.7 (2 to 4)	3.5 (3 to 4)
5. There is a relationship between worker safety and worker productivity	3.5 (2 to 4)	3.3 (3 to 4)
6. Worker safety needs improvement on my farm	3.2 (1 to 4)	3.0 (2 to 4)
7. Worker safety represents a significant challenge to dairy farming	3.2 (1 to 4)	3.3 (3 to 4)

^aParticipants rated each statement either 1 (strongly disagree), 2 (somewhat disagree), 3 (somewhat agree), or 4 (strongly agree)

Experiences with Systematic OHS. In the second portion of the interviews, participants were asked if they had experience with any of eight OHSMS-related behaviors in the previous year. Among the 32 dairy worker participants, 17 (53%) indicated they had performed preventive maintenance on farm equipment; 20 (63%) had found and fixed workplace safety hazards; 6 (19%) had participated in farm safety inspections;

23 (72%) had received safety training; 16 (50%) had reported safety concerns to their supervisor; 17 (53%) had discussed safety concerns with other workers; 10 (31%) had suffered a workplace injury; and 12 (38%) had reported a workplace injury to their supervisor.

Among the four participating dairy owners/managers, 2 (50%) indicated they had attended training or conferences on worker safety; 4 (100%) had identified and controlled workplace safety hazards; 3 (75%) had conducted farm safety inspections; 2 (50%) had provided farm safety training to workers; 2 (50%) had documented a workplace injury; 4 (100%) had communicated safety concerns to workers; 3 (75%) had discussed farm safety concerns with colleagues and/or other farmers; and 2 (50%) had created farm safety goals for their farm.

Interest in OHSMS Approaches. In the final part of the interviews, dairy farm workers and owners/managers were asked how interested they were in participating in (for workers) or learning more about (for owners/managers) several OHSMS-related activities. Dairy workers were asked seven questions in this section and management participants were asked 12. The individual activities and participant responses are summarized in Table 2.

Table 2. Interest in occupational health and safety management system approaches among dairy farm workers (n = 32) and dairy owners/managers (n = 4).

Interest activity	Worker responses ^a mean (Range)	Management responses ^a mean (Range)
1. Creating a safety policy for your farm	3.3 (2 to 4)	4.0 (4 to 4)
2. Creating safety goals and objectives for your farm	3.2 (1 to 4)	4.0 (4 to 4)
3. Identifying unsafe work conditions on your farm	3.7 (3 to 4)	3.5 (3 to 4)
4. Correcting workplace safety hazards on your farm	3.6 (2 to 4)	4.0 (4 to 4)
5. Worker safety training and education	3.9 (2 to 4)	4.0 (4 to 4)
6. Investigating the causes of workplace injuries	3.2 (2 to 4)	3.5 (3 to 4)
7. Emergency response and preparedness	3.6 (2 to 4)	3.5 (3 to 4)
8. Demonstrating to workers that you support worker safety	Not applicable	3.8 (3 to 4)
9. Getting workers to participate in farm safety	Not applicable	3.5 (3 to 4)
10. Safety documentation and recordkeeping	Not applicable	3.5 (3 to 4)
11. Contractor safety	Not applicable	3.3 (2 to 4)
12. Occupational Safety and Health Administration (OSHA) worker safety regulations	Not applicable	3.5 (2 to 4)

^aParticipants rated each statement either 1 (very disinterested), 2 (somewhat disinterested), 3 (somewhat interested), or 4 (very interested)

An additional question was added to this section for owners/managers during the instrument validation process. Owners/managers only were asked, “How concerned are you about OSHA regulations and inspections.” Possible responses ranged from 1 = not at all concerned, 2 = a little concerned, 3 = somewhat concerned, and 4 = very concerned. The mean rating of management participants was 3.3 out of 4 (range 2 to 4).

3.3 Comparison Between Workers and Owners/Managers

There were no significant differences between the ratings of dairy workers and dairy owners/managers on any of the concordant attitude and interest interview questions, as assessed using a Wilcoxon Rank-Sum test. However, one of the attitude statements and four of the interest questions could not be assessed using this method because there was no variability in the owner/manager responses. The results of these comparative analyses are provided in Tables 3 and 4.

Table 3. Results of a comparison between dairy worker (n = 32) and dairy owner/manager (n = 4) responses to systematic occupational health and safety statements

Statement	Difference in median rating	Significance level ^a
1. Safety is better addressed at the organization level rather than at the individual level	0.0	p = 1.00
2. Safer environments for workers are also safer environments for livestock	0.0	N/A ^b
3. Injury prevention is everyone’s responsibility on a dairy farm rather than just one person’s	0.0	p = 1.00
4. There is a relationship between worker safety and work quality	0.5	p = 0.29
5. There is a relationship between worker safety and worker productivity	1.0	p = 0.47
6. Worker safety needs improvement on my farm	0.0	p = 0.57
7. Worker safety represents a significant challenge to dairy farming	0.0	p = 1.00
8. I know where to find information about workplace safety issues	0.0	p = 0.78

^aAs measured using a Wilcoxon Rank-Sum test.

^bNot applicable; there was no variability in the manger responses for this item.

Table 4. Results of a comparison between dairy worker (n = 32) and dairy owner/manager (n = 4) responses to occupational health and safety management system approaches

Interest activity	Difference in median rating	Significance level ^a
1. Creating a safety policy for your farm	0.0	N/A ^b
2. Creating safety goals and objectives for your farm	0.5	N/A ^b
3. Identifying unsafe work conditions on your farm	0.5	p = 0.48
4. Correcting workplace safety hazards on your farm	0.0	N/A ^b
5. Worker safety training and education	0.0	N/A ^b
6. Investigating the causes of workplace injuries	0.5	p = 0.54
7. Emergency response and preparedness	0.0	p = 0.76

^aAs measured using a Wilcoxon Rank-Sum test.

^bNot applicable; there was no variability in the manager responses for this item.

3.4 Strength of Opinions

The mean dairy worker rating on six of the eight attitude statements was significantly higher than a three out of four ($p < 0.05$ for all six statements). The two statements which were not were “Worker safety needs improvement on my farm”, (mean 3.2, $p = 0.057$) and “I know where to find information about workplace safety issues”, (mean 2.8, $p = 0.74$). These two statement ratings were also not significantly less than a two out of four.

Similarly, the mean dairy worker ratings for five of the seven interest activities were significantly above a three out of four ($p < 0.05$). The two interest activities that were not rated significantly above a three were “creating safety goals and objectives for your farm” (mean 3.2, $p = 0.09$), and “investigating the cause of a workplace injury” (mean 3.2, $p = 0.20$). Neither of the statements was rated significantly below a two out of four.

None of the management attitude statement mean ratings were significantly positive (greater than 3) or negative (less than 2), with a range of $p = 0.063$ to $p = 0.750$.

4 Discussion

Mean responses to all of the attitude statements among dairy farm workers and management were positive, and worker ratings on six out of the eight statements were significantly strong (above a three out of four). These findings indicate that participants had a generally favorable opinion of systematic approaches to OHS. Further, there were no significant differences between the average attitude ratings of dairy workers and owners/managers, suggesting there are similarities between these groups in terms of desire for systematic OHS approaches. This is encouraging because OHSMS regulations are lacking in the U.S. and OHS regulatory attention in the industry has been

generally sparse. Thus, any adoption of an OHSMS in the dairy industry would need to be voluntary.

Participants from both groups also indicated that there was a lack of knowledge in terms of being able to find available OHS information, as evidenced by it rating the lowest out of all of the statements and being the only statement with a mean rating below a three out of four. Providing information to dairy workers and management may therefore be a good first step when considering potential OHSMS interventions in the U.S. dairy industry.

Responses to the experience questions among workers and owners/managers provide insight into OHSMS-related activities already being accomplished on dairy farms, which could make OHSMS interventions more accessible. Half or more of the dairy worker participants had performed preventive maintenance, fixed hazards, reported safety concerns to a supervisor, and received safety training. Notably, over 30% of worker respondents reported being injured on the job in the previous year. While attempting to assess the injury experience of dairy workers was not a focus of this study, the high proportion is consistent with findings from a previous study that found a 16.6% per year injury rate among 600 dairy workers, which was substantially higher than U.S. Bureau of Labor Statistics reports over that same time period and the result is indicative of the need for OHS related interventions for dairy farm workers [15]. It was a surprise to see that more workers reported an injury to their supervisor (38%) than had experienced an injury (30%). This discrepancy may be due to how the interview question was worded. The question about reporting an injury did not specify a worker's own injury, and therefore the result may have included workers reporting injuries to themselves and their fellow workers.

Dairy owners/managers also reported experience with a number of OHSMS-related activities. Fifty percent or more participants indicated they had experience with each one of the eight experience questions in the previous year. These worker and management experiences can be used to tailor an acceptable OHSMS intervention for dairy farms that builds upon practices that may already be in place.

Worker and management participants also indicated an overall strong interest in participating in (for workers) or learning more about (for owners/managers) OHSMS approaches to OHS. All interest activities had a mean response above a three out of four, and five out of the seven worker rating averages were significantly above a three, indicating that they were very interested in participating in most of the OHSMS-related activities. Again, a high degree of agreement between workers and management was indicated by the lack of any significant differences between the interest ratings of the two groups. However, a lack of variability among the owner/manager responses limited this analysis to only three of the seven corresponding interest questions.

4.1 Limitations and Strengths

Several important limitations should be considered when interpreting the results of this study. Conducting interviews on only four farms in a single U.S. state largely limits the degree to which the participants can be considered representative of the larger U.S. dairy industry population. In addition, because farms were selected based on their

managements' participation in a local university extension program focused on dairy management, these farms may be different from those that did not participate in these programs, especially with regard to owner/manager beliefs and opinions. The small sample size also limited our ability to analyze similarities and differences between workers and management on some items, and to statistically assess the strength of opinions in the management group. In five separate instances, there was too little variability in the management responses to allow for a rank-based non-parametric comparison with the worker responses. Further, the small sample size increased the likelihood that random chance could explain any observed findings. The lack of quantitative psychometric data on the criterion validity and reliability of the interview instruments is another important limitation of this study. While this was a small needs assessment study that did not require any additional instrument analyses, these should be considered before the instruments are adopted for other research in other contexts.

There were also several strengths of this study. In particular, the needs assessment included the opinions of both dairy workers and management. This is critical because management support and employee participation are commonly considered to be important determinants of OHSMS success [19, 20]. Another strength was that the interviews were conducted in Spanish and English to match the preferred language of most participants. The interview instruments were also validated by national experts on dairy management, OHSMS, and agricultural OHS research. Finally, this is the first study to document the attitudes, experiences, and interests of U.S. dairy personnel with regard to a comprehensive risk management approach to OHS.

5 Conclusion

There are four main conclusions that can be drawn from this study. First, the overall attitudes of participant dairy workers and owner managers toward systematic OHS were generally positive. Second, dairy workers and owners/managers who participated in this study had experience with a number of OHSMS-related activities. Third, dairy workers and owners/managers were generally interested in participating in and learning more about OHSMS approaches to OHS. And lastly, there were no significant differences between the opinions of dairy workers and dairy owners/managers who participated in this study.

Although the limitations of this study prevent extrapolation of our findings to the dairy industry as a whole, the results provide additional evidence that OHSMS interventions may be appropriate to attempt to reduce the rate of injuries and illnesses among U.S. dairy workers. This study should help to inform the design of intervention studies for dairy farms by highlighting areas where some dairy personnel have experience with and interests in OHSMS-related activities and areas where there is potential agreement between dairy workers and managers. Further research is needed to determine if the opinions of our participants are similar to those in the broader U.S. dairy industry.

U.S. dairy producers who employ fewer than 250 workers and are interested in establishing an OHSMS can request free, confidential assistance through the OSHA On-Site Consultation Program. Larger producers interested in an OHSMS can find consultant services through the national organizations of OHS professionals.

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