



HHS Public Access

Author manuscript

J Agromedicine. Author manuscript; available in PMC 2021 December 03.

Published in final edited form as:

J Agromedicine. 2013 ; 18(3): 179–183. doi:10.1080/1059924X.2013.812771.

International Dairy Health and Safety

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INTRODUCTION AND BACKGROUND

Dairy has had a transformational impact on humans. Most mammals lose the ability to digest lactose after infancy. Between 5000 and 10,000 years ago, the LCT (lactase) gene underwent rapid evolution in human populations in northern Europe, eastern Africa, and the Middle East, allowing domesticated milk products to become an important dietary staple. 1–3 Adaptation of improved plows and changes in the way work was organized allowed the Nordic countries to develop a successful dairy export industry in the 13th century. This dairy industry (structure) was well positioned to meet the increased demand from smaller populations left in Europe following the Black Death (1347–1351). Development of mechanical milking technology and pasteurization in the 19th century was another milestone, greatly increasing efficiency and safety to meet the demand in growing cities.

The past two decades have again seen dramatic changes in the dairy industry that are playing out on a global scale. Advances in milking technology and dairy animal science have facilitated a rapid increase in the size of dairy herds. Operations with 400 to 5000 head of milking cows are not uncommon in the United States, European Union, China, Russia, South Africa, Australia, and New Zealand. Given the economies of scale, this trend is spreading worldwide as the demand for dairy protein grows. Expanding dairy production has required a larger workforce, most often consisting of immigrant labor, often with little experience in agriculture. Dairy farming is also among the most dangerous occupations, with high rates of injury, illness, and employee turnover. For dairy farmers trained to manage cows, the operation of a modern dairy employing a large immigrant workforce is a daunting challenge. The global market is highly competitive. To succeed, the dairy industry must sustain a healthy, productive workforce.

In 2009, the High Plains Intermountain Center for Agricultural Health and Safety (HICAHS) partnered with the Southwest Center for Agricultural Health, Injury Prevention, and Education (SWAG) to host the High Plains and Mountain Region Dairy Health and Safety Workshop, October 15–16, 2009, in Denver, Colorado. In addition to HICAHS

and SWAG personnel, workshop attendees included faculty from the Swedish University of Agricultural Sciences, dairy extension specialists, dairy owners and managers, dairy equipment manufacturer, workers' compensation provider, and dairy producer organizations. Results of this workshop made it clear that we needed to go beyond our previous etiological and formative work to take the next steps in addressing the dairy industry's need for more comprehensive occupational health and safety programs, including risk assessment, surveillance, health care delivery, and effective interventions. It was also quite clear that this was a global need.

In response, we organized an International Dairy Research Consortium to collaborate with other international researchers involved in improving the health and safety of dairy workers. Our first meeting was in Colorado in July 2011. This consortium is intended to facilitate collaborations and to share successful injury and illness prevention strategies, tested dissemination channels, and novel approaches used to improve the health and safety of dairy workers globally. Such leveraging of resources will augment dairy research efforts and lead to greater impact regionally, nationally, and internationally. To date, members of the consortium represent the United States, Sweden, Finland, Denmark, Germany, Italy, Canada, The Netherlands, Australia, and New Zealand. Seven of the National Institute for Occupational Safety and Health (NIOSH) Agriculture Forestry and Fishing Centers are active in the consortium.

The goal of this special issue of the *Journal of Agromedicine* is to provide a comprehensive review of the status of the dairy industry, highlight current occupational health and safety research, and identify knowledge gaps and programmatic needs.

HIGHLIGHTS

The feature article describing the modern global dairy industry by Douphrate and colleagues provides the context for this issue. It addresses the growing demand for dairy protein and the unique ways that the industry has responded with changes in technology, work organization, producer cooperatives, trade regulations, and other economic strategies from a global standpoint and for selected key dairy producing countries. The commonalities and differences between markets and countries are explored. The article highlights the impact of worldwide shifts in water demand, land use patterns, food versus fuels, internationalization, and the major demographic shifts in immigrant workers.

Four articles on respiratory health, ergonomics, injury and fatality, and psychosocial and mental health summarize and evaluate current literature concerning the prevalence and risk factors for these health outcomes. Each of these papers also sought to address successful interventions.

Reynolds and 11 of his colleagues explored the impact of the dramatic changes in the dairy industry on respiratory health of workers. Workers in modern dairy operations exhibit obstructive respiratory conditions, including lower baseline pulmonary function, and cross-shift declines that are similar to, but not as prevalent as, those found among swine and poultry workers. Inhalation exposure to gram-positive bacteria and their chemical

constituents (e.g., peptidoglycan) in dairies is much higher than previously thought, and there is strong in vitro evidence demonstrating their inflammatory effects. The exposure-response relationship between aerosols and respiratory effects in dairy workers is modulated by intrinsic factors such as genetic polymorphisms. There has been very little research on the application or effectiveness of intervention strategies to reduce worker inhalation exposures on dairies. Future research needs to include development of improved methods to measure inhalation exposure to aerosols and inflammatory lung changes among dairy workers; better understanding of the relationships between early immune changes and development of future lung disease; longitudinal studies of respiratory effects associated with dairy workers' personal measures of task-specific exposure to aerosols; evaluation of the role of intrinsic factors, especially gene-environment interactions, and underlying health status, particularly obesity; and development and testing of solutions to reduce dairy farm worker exposure to inflammatory aerosols.

The paper "Ergonomics in Modern Dairy Practice" (Doupbrate et al.) describes the development of the industry and the challenges regarding increasing size of dairy operations and working conditions with high levels of exposure for ergonomic risk factors. It also points out the ergonomic research performed and the future needs involving new technologies for exposure studies in large-scale operations as well as automatic milking systems. It is also made clear that work-related mental stress and fatigue is a growing problem in new systems due to the need for farmers to conduct continuous monitoring to prevent mechanical breakdown. These new factors and their impact on worker health also need further study. In particular, risk factors contributing to upper extremity diseases (wrist and shoulder) need to be better understood, and controlled.

"Work-Related Injuries and Fatalities on Dairy Farm Operations" by Doupbrate and coauthors highlights significant gaps in data available to make international comparisons. What data are available have important limitations and there is no harmonized system for injury recording. Research from Sweden, Australia, New Zealand, the United States, and China is summarized. Dairy farming is clearly among the most hazardous of occupations. Technological changes, including manure handling and storage systems, and the greatly increased use of all-terrain vehicles (ATVs)/quad bikes have been associated with high rates of fatalities on dairies along with tractors and other machinery. Even on modern dairies with increased artificial insemination, bulls remain a major source of injuries and fatalities. An important outcome of the use of immigrant workforce is that younger, less experienced workers are at greater risk. Future research should focus on better understanding and controlling risks associated with manure handling systems, ATVs, and other machinery. Evaluations of improved facility designs are also important to minimize slip, trips, falls, and injuries/fatalities from contact with livestock including bulls. Creation of a global database for injuries and fatalities among dairies would facilitate evaluation of the effectiveness of interventions.

Lunner Kolstrup et al. point out the commonality of stressors and physical and mental health outcomes shared across countries in their article on psychosocial working conditions, mental health, and stress. There are differences between owners and their workforce, and between smaller traditional dairies and large modern dairies, but globally, dairy farmers face

a multitude of expectations and stressors, including high workload and time pressure, shift work, challenges involving immigrant and multigenerational workforces, financial debt, and other economic, regulatory, and social factors. Farm operators, workers, and their families manifest increased levels of poor mental health, depression, substance abuse, and suicide. An important point is that there is a need to find a balance with positive aspects, including the perception of meaningful work, independence, and level of control. There is a need to better understand factors contributing to stress in this rapidly changing industry. Research is also needed to develop and test interventions, including mental health care and programs, to help producers identify and manage stress and mental health.

Three papers address approaches to reduce occupational health and safety risk on dairies—including guidelines for animal handling, occupational health and safety (OHS) regulations, and leadership and management.

A disproportionate number of severe injuries and fatalities occur from contact with dairy cattle. Dairy bulls in particular are reputed to be most aggressive and dangerous. Lindahl et al. (“Occupational Health and Safety Aspects of Animal Handling in Dairy Production”) provide a review of current research on livestock-related injuries on dairy farms, and share lessons learned from studies of human-animal interactions in relation to animal welfare and productivity. A key factor in animal response causing injury in humans is fear. Interestingly, the animal’s perception of rank or status is also important, e.g., it is hypothesized that dairy bulls may see humans as competitors not handlers. Understanding an animal’s “flight zone” or personal space, point of balance, range of vision, and need for consistent routines is important in reducing the risk of creating stress or fear that can lead to kicking, head butting, or flight. The concept of “low-stress livestock handling” has been associated with increased productivity, and can utilize the animal’s behavior as a tool to improve safety. Other tools to maintain a safe distance or restrain animals are available, but there is a need for extensive appropriate training of handlers. The increasing numbers of dairy workers with minimal livestock handling skills requires development of effective safety management programs.

The paper on occupational health and safety (OHS) regulations by Reed and colleagues shows that the application of OHS legislation in the dairy industry varies throughout the world. A key issue is the size of the farm, as in the United States where the federal OHS legislation and enforcement does not apply to farms with less than 11 employees. In Italy, health surveillance of employed workers is mandatory, but this does not include self-employed and family workers who constitute the majority (90–95%) of the workforce. In these and other countries, there is a significant inequality in access to health care structures. The limited access to health surveillance, moreover, deeply affects also the quality of epidemiological data, which come from a minority of workers, and makes it impossible to assess the real burden of disease for specific risk factors. The paper concludes that there is little OHS legislation in the world that applies directly to the dairy industry. A final recommendation is that there needs to be an effective OHS training for all involved in dairy work.

Hagevoort, Douphrate, and Reynolds (“A Review of Health and Safety Leadership and Managerial Practices on Modern Dairy Farms”) found very few publications addressing the

effectiveness or return on investment of occupational health and safety risk management in any industrial sector, including dairy. There is recognition in the industry that “good dairy farming practice ensures that milk is produced by healthy animals in a manner that is sustainable and responsible from the animal welfare, social, economic and environmental perspectives,”⁴ but the sustainability of a healthy productive workforce is seldom specifically included. Managers on expanding dairies worldwide often have little training or experience in managing *people*. The transition to human resource management, especially with a largely immigrant workforce, is challenging and stressful. Lessons from other industries and the few studies of OHS management approaches on dairies suggest that there can be a competitive edge, but there is pressing need for studies evaluating OHS program effectiveness and the connection to productivity and profitability. Systematic approaches to risk management, including transformational (positive) leadership and integration of OHS with animal welfare, food safety, and productivity, need to be developed and evaluated.

GAPS AND RESEARCH NEEDS

Risk Factors and Health Care

There are major gaps in dairy research and data related to a variety of health outcomes such as zoonoses, dermatoses, and cardiovascular disease. As noted in “Systematic Review of Respiratory Health Among Dairy Workers” (Reynolds et al.), it is important to understand the multiple extrinsic and intrinsic factors that affect the health of dairy workers. Along with health outcomes there is a need to evaluate exposures to agents such as sanitizers (e.g., iodine), pesticides, hydrogen sulfide, ammonia, and other chemicals where there is again a paucity of peer-reviewed publications. Although Lunner Kolstrup et al.’s article on psychosocial and mental health touches on health care for the dairy industry, there is again a major gap in the literature on health programs and their effectiveness. A recent change in the US Migrant Clinic system to specifically include dairy workers is an important step that needs to be evaluated and optimized.

Immigrant Workforce

Although a few articles focusing on particular health outcomes indicate that immigrant workers are at higher risk for respiratory disease and injuries, there is little work in the peer-reviewed literature specifically addressing the core issues for immigrant workers on dairies. “A Review of Health and Safety Leadership and Managerial Practices on Modern Dairy Farms” calls out the need for culturally and linguistically appropriate risk management systems, but found little published evidence of successful examples in the dairy industry. “Occupational Health and Safety Regulations in the Dairy Industry” points out that even in countries with well-developed workplace health surveillance systems, dairy workers are often excluded for a number of reasons. The psychosocial article by Lunner Kolstrup et al. noted that these workers face different psychosocial work environments than domestic workers, including long work hours in a foreign country away from their family and friends, and social isolation caused by linguistic and cultural barriers. These conditions are often found to be associated with ill mental health, anxiety, depression, alcohol and drug abuse, and even suicide. One possible way forward is to explore engaging the “highly educated fraction” often present among these workers. Those who have high education in their

countries usually have their education (in some cases degrees) not recognized in the country of migration for legal reasons. Akin to the *promotoras* approach in the United States, they are a potential resource for training and other programs. The Guest Editorial, “Occupational Health in the Dairy Industry Needs to Focus on Immigrant Workers, the New Normal” (Schenker and Gunderson), shines a spotlight on this critical issue, discussing the magnitude of the workforce transformation and factors such as “precarious employment” and cultural and legal aspects that contribute to the increased risks afflicting this workforce.

Effective Interventions

All of the papers in this issue note the paucity of peer-reviewed publications regarding effective interventions. There has been very little published regarding effective engineering, organizational, medical, education, or managerial strategies specifically for the dairy industry. An integrated approach to OHS risk management would provide a systematic framework to address many of the gaps identified.

CONCLUSIONS AND RECOMMENDATIONS

Dairy in the 21st century is a dynamic industry, depending largely on immigrant employees working long hours at a high pace, under difficult environmental and social conditions. This collection of articles addresses broad aspects of OHS in dairy, especially highlighting important gaps in knowledge. Research is needed to develop and evaluate cost-effective solutions that address the business model of the dairy industry and the challenges of the largely immigrant workforce. Given the common issues around the globe, future research requires international collaboration to provide economies of scale, ensure robust methodology, and produce products and interventions with optimal impact. We believe this special issue of the journal will be a resource to help guide future research to enhance the health and sustainability of the dairy workforce.

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