J. Dairy Sci. 98:1–20
http://dx.doi.org/10.3168/jds.2015-9377

Invited review: Changes in the dairy industry affecting dairy cattle health and welfare

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ABSTRACT

The dairy industry in the developed world has undergone profound changes over recent decades. In this paper, we present an overview of some of the most important recent changes in the dairy industry that affect health and welfare of dairy cows, as well as the science associated with these changes. Additionally, knowledge gaps are identified where research is needed to guide the dairy industry through changes that are occurring now or that we expect will occur in the future. The number of farms has decreased considerably, whereas herd size has increased. As a result, an increasing number of dairy farms depend on hired (nonfamily) labor. Regular professional communication and establishment of farm-specific protocols are essential to minimize human errors and ensure consistency of practices. Average milk production per cow has increased, partly because of improvements in nutrition and management but also because of genetic selection for milk production. Adoption of new technologies (e.g., automated calf feeders, cow activity monitors, and automated milking systems) is accelerating. However, utilization of the data and action lists that these systems generate for health and welfare of livestock is still largely unrealized, and more training of dairy farmers, their employees, and their advisors is necessary. Concurrently, to remain competitive and to preserve their social license to operate, farmers are increasingly required to adopt increased standards for food safety and biosecurity, become less reliant on the use of antimicrobials and hormones, and provide assurances regarding animal welfare. Partly because of increasing herd size but also in response to animal welfare regulations in some countries, the proportion of dairy herds housed in tiestalls has decreased considerably. Although in some countries access to pasture is regulated, in countries that traditionally practiced seasonal grazing, fewer farmers let their dairy cows graze in the summer. The proportion of organic dairy farms has increased globally and, given the pressure to decrease the use of antimicrobials and hormones, conventional farms may be able to learn from well-managed organic farms. The possibilities of using milk for disease diagnostics and monitoring are considerable, and dairy herd improvement associations will continue to expand the number of tests offered to diagnose diseases and pregnancy. Genetic and genomic selection for increased resistance to disease offers substantial potential but requires collection of additional phenotypic data. There is every expectation that changes in the dairy industry will be further accentuated and additional novel technologies and different management practices will be adopted in the future.

Key words: herd size, antimicrobials, biosecurity, automated milking system, automated calf feeder

INTRODUCTION

Economic pressures, technological innovations, demographic shifts, consumer expectations, and an evolving regulatory framework have contributed to the impetus for changes in the global dairy industry. These changes have had, and will likely continue to have, profound effects on the health and welfare of dairy cows and on management practices and systems for dairy herds. This paper presents an overview of some of the most important recent changes in the dairy industry that

Received January 23, 2015.
Accepted July 17, 2015.
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affect health and welfare of dairy cows, as well as the science associated with these changes. Finally, we identify knowledge gaps where research is needed to guide the dairy industry through changes that already are underway or that we predict will occur in the future.

Although the primary focus of this paper is the dairy industry in North America, Europe, Australia, and New Zealand, implications of the changes described herein will be relevant for the dairy industry in most developed and developing nations. Although we strive to minimize biases from our own professional and personal experiences, as well as cultural influences, we recognize that this no doubt influenced some of the arguments presented herein.

HERD SIZE AND MILK PRICE

The average size of dairy herds has continuously increased over recent decades in all developed countries (Figure 1). Concurrently, the number of dairy farms has decreased in most countries, with the exception of New Zealand, where the number of dairy farms has been stable since 2007, but given the 2-fold increase in herd size compared with 1996, the national dairy herd has doubled since 1990 (DairyNZ, 2013; Figure 1). In the United States, the number of dairy farms decreased from 139,670 in 1995 to 49,331 in 2012 (USDA-NASS, 1999, 2013a). However, since 1995, the total US dairy herd decreased by only 2.5% (9.46×10^6 versus 9.22×10^6 cows in 1995 versus 2013, respectively; USDA-NASS, 1999, 2013b). Consequently, cows are increasingly managed in fewer, albeit larger, herds (Figure 2). In 2012, the 32% of US dairy herds with <30 cows had 1.6% of the national herd, whereas the 1.3% of US herds with >2,000 cows had 33% of the national herd (Figure 2A). In Germany, the situation is similar, albeit less pronounced (Figure 2B). In New Zealand (Figure 2C) and Denmark (Figure 2D), there is a paucity of small herds, although the proportion of cows in very large herds is also not very high. Notwithstanding, there are regional differences in herd sizes. For example, in the United States, dairy herds in the Southwest and West are much larger than those in the Upper Midwest and Northeast (USDA-NASS, 2013c). Similarly, dairy herds in the eastern states of Germany are considerably larger than those in the western states and particularly Bavaria (König et al., 2005). The increase in herd size is driven by economies of scale—the cost of production per unit decreases with an increasing herd size (Wolf, 2003; Wilson, 2011). The increase in average herd size has been less pronounced in countries with a supply management system (e.g., countries within the European Union until March 2015 and Canada; Richards and Jeffrey, 1997). Given that the supply-managed system in Canada is based on domestic consumption, total milk production in Canada increased from 74 to 78 million hectoliters from 1997 to 2014 (Canadian Dairy Information Centre, 2015), reflecting increased demand due to population growth. However, this increase in milk production in Canada has been achieved almost exclusively through increased milk production per cow, with cow numbers having declined by 13% since 2000 (Canadian Dairy Information Centre, 2015). Concurrently, the average Canadian dairy herd increased from 52 cows in 1996 to 79 cows in 2014 (Figure 1), again reflecting a reduction in the number of farms. These developments are mirrored in other countries that have a milk supply management system but are in contrast to countries that are not supply managed (included those that recently abandoned this system) and are subject to the fluctuations in world milk price (e.g., Australia, New Zealand, United States); in these cases, we see dramatic increases in herd size (Figure 1).

The association between herd size and health and welfare is complex and affected by many factors, including the managerial skills of the farmer, rate of herd expansion, facilities, training and experience of personnel, and the ratio of caretakers to animals. Although few studies have critically assessed effects of herd size on animal health and welfare, it appears that herd size does not have a consistent, predictable association with health or welfare. For instance, Chapinal et al. (2014a,b) provided evidence that larger farms in both the United States and China have a lower prevalence of lameness. However, herd-level and within-herd prevalence of infectious diseases such as Johne's disease, bovine tuberculosis, and Q-fever in general increase with increasing herd size (e.g., Anastácio et al., 2014; Doyle et al., 2014; Wolf et al., 2014a). This association may be confounded by recent herd expansion, including purchase and mixing of animals from multiple sources, rather than being an effect of herd size itself. However, mortality rates in US dairy herds increase with increasing herd size (Shahid et al., 2015). In contrast to herd size, increased milk production is often associated with decreased health of dairy cows. For example, the incidence of clinical mastitis, lameness, and other diseases may be increased in higher-producing dairy cows (Koeck et al., 2014). Partly due to a lack of large, valid data sets on health outcomes, there is limited literature on the level of milk yield as a risk factor for disease. However, a structured review (Ingvartsen et al., 2003) concluded that there was an association of milk yield with clinical mastitis but not with dystocia, retained placenta, metritis, or left-displaced abomasum. Those authors emphasized that the problems of confounding