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## Improving the time efficiency of identifying dairy herds with poorer welfare in a population

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### ABSTRACT

Animal-based welfare assessment is time consuming and expensive. A promising strategy for improving the efficiency of identifying dairy herds with poorer welfare is to first estimate levels of welfare in herds based on data that are more easily obtained. Our aims were to evaluate the potential of herd housing and management data for estimating the level of welfare in dairy herds, and to estimate the associated reduction in the number of farm visits required for identification of herds with poorer welfare in a population. Seven trained observers collected data on 6 animal-based welfare indicators in a selected sample of 181 loose-housed Dutch dairy herds (herd size: 22 to 211 cows). Severely lame cows, cows with lesions or swellings, cows with a dirty hindquarter, and very lean cows were counted, and avoidance distance was assessed for a sample of cows. Occurrence of displacements (social behavior) was recorded in the whole barn during 120 min of observation. For the same herds, data regarding cattle housing and management were collected on farms, and data relating to demography, management, milk production and composition, and fertility were extracted from national databases. A herd was classified as having poorer welfare when it belonged to the 25% worst-scoring herds. We used variables of herd housing and management data as potential predictors for individual animal-based welfare indicators in logistic regressions at the herd level. Prediction was less accurate for the avoidance distance index [area under the curve (AUC) = 0.69], and moderately accurate for prevalence of severely lame cows (AUC = 0.83), prevalence of cows with lesions or swellings (AUC = 0.81), prevalence of cows with a dirty hindquarter (AUC = 0.74), prevalence of very lean cows (AUC = 0.83), and frequency of displacements (AUC = 0.72). We compared the number of farm visits

required for identifying herds with poorer welfare in a population for a risk-based screening with predictions based on herd housing and management data and a full screening of herds. Compared with a full screening, the number of farm visits required for identifying almost all herds with poorer welfare reduced by 5% (avoidance distance index) to 37% (prevalence of severely lame cows) when using risk-based screening. For identifying 70% of herds with poorer welfare, the number of farm visits reduced by 43% to 67%. The number of farm visits required for identifying dairy herds with poorer welfare can be reduced when herds are first screened using herd housing and management data.

**Key words:** dairy cow, monitoring, herd data, health, housing, management

### INTRODUCTION

On-farm assessment of dairy cattle welfare is time consuming and, therefore, expensive. This is especially true for assessment of animal-based indicators (which measure the state of the animal) compared with resource-based indicators (which measure the animal's environment, such as housing and management; Whay et al., 2003a). However, animal-based indicators are increasingly preferred for assessing animal welfare, because they are more closely linked to the welfare of the animals than resource-based indicators (Webster et al., 2004). Examples of animal-based indicators that reflect poor dairy cattle welfare are lameness, leg injuries, mastitis, colliding with equipment when getting up and lying down, and body condition (EFSA, 2012). In the European Welfare Quality assessment protocol for dairy cattle, 60% of indicators are animal-based, but they take 90% of the on-farm assessment time, depending on herd size (Welfare Quality, 2009). According to the information in this protocol, on-farm assessment takes approximately 4.4 to 7.7 h for herds of 25 to 200 cows. The time needed to assess animal-based indicators hampers the implementation of welfare assurance schemes and, as a consequence, improvement of animal welfare in a dairy herd population.

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The total time required for welfare assessments in a dairy herd population can be lowered by reducing the time per farm visit—using automatic measures to replace direct visual observations, for example (Pluk et al., 2012)—or by reducing the number of farms to be visited in the dairy herd population. To reduce the number of farms to be visited, several studies have explored the possibility of predicting dairy cattle welfare based on herd data available in national databases (Sandgren et al., 2009; Nyman et al., 2011; de Vries et al., 2014; Nielsen et al., 2014; Otten, 2014). Particularly in developed countries, herd data are routinely collected from dairy farms relating to identification and registration, productivity, and fertility. So far, however, the accuracy of predicting dairy cattle welfare based on routine herd data has not been high (Sandgren et al., 2009; Nyman et al., 2011; de Vries et al., 2014; Nielsen et al., 2014; Otten, 2014), leading to the risk of incorrect estimates of the level of welfare in herds. Although previous research has implied that routine herd data cannot be used for direct assessment of welfare in herds, it has also shown that routine herd data has potential as a screening test to identify herds at higher risk of poor welfare (i.e., risk-based sampling). Based on such a screening test, the level of welfare in herds is first estimated based on routine herd data, and then herds at higher risk of poor welfare are visited to determine the true welfare status using the more time-consuming on-farm assessment. Application of this screening test reduces the number of farms that need to be visited for welfare assessment, because visits to herds with a lower risk of poor welfare are avoided. To identify farms with more than 12% severely lame cows, for example, it has been estimated that the number of farm visits can be reduced by 19% when the level of welfare in herds is first screened based on herd size, on-farm mortality, access to pasture, average DIM, and average proportion of milk fat to protein (assuming that 20% of herds in a population have more than 12% severely lame cows; de Vries, 2013).

To further reduce the number of farm visits required to identify herds with poor welfare, it has been suggested that additional, easily obtainable data could contribute to more accurate predictions of dairy cattle welfare (de Vries et al., 2014). In contrast to animal-based welfare indicators, data on housing and management of dairy cattle (e.g., surface of the lying area or frequency of claw treatment) can be collected in relatively little time and require little assessor training. The use of housing and management (**HM**) data for direct animal welfare assessment is not favored because housing and management are less closely linked to animal welfare than are animal-based indicators (Webster et al., 2004; Blokhuis et al., 2008). However, HM data might hold value in

predicting of animal-based welfare indicators, because these 2 types of indicators are associated (e.g., Müller et al., 2007; Dippel et al., 2009; de Vries et al., 2015). A combination of routine herd data and HM data might improve the accuracy of risk-based screening of dairy cattle welfare in a herd and, therefore, reduce the number of farm visits required to identify herds with poor welfare. Our aims were to evaluate the potential of routine herd data and HM data for estimating the level of several animal-based welfare indicators in dairy herds, and to estimate the associated reduction in the number of farm visits required to identify dairy herds with poorer welfare.

## MATERIALS AND METHODS

### *Animal Welfare Indicators*

Animal welfare is a multidimensional concept (Fraser, 1995). Assessment of dairy cattle welfare requires a combination of different indicators. We chose to use animal-based dairy cattle welfare indicators in the Welfare Quality protocol for dairy cattle (Welfare Quality, 2009) that had a high relative importance in a study by Lievaart and Noordhuizen (2011). In the study, the suitability of 70 indicators for assessing dairy cattle welfare were ranked based on the preferences of 24 internationally acknowledged European welfare experts (Lievaart and Noordhuizen, 2011). Based on this ranking, 23 indicators were considered to have a high relative importance. Six of these appeared as animal-based indicators in the Welfare Quality protocol for dairy cattle (Welfare Quality, 2009) and were included in the present study: prevalence of severely lame cows; prevalence of cows with lesions or swellings; prevalence of cows with a dirty hindquarter; prevalence of very lean cows; index score for avoidance distance at the feeding rack; and frequency of displacements (social behavior).

### *Herd Selection*

For an effective evaluation of associations between routine herd data, HM data, and animal-based welfare indicators, we aimed for data from herds that spanned a wide range of levels of animal welfare. Because visiting a very large number of herds was not feasible, we selected herds to ensure variation in animal welfare. Therefore, herds were selected from approximately 5,000 participating in a health program of a Dutch dairy cooperative. Selection was based on a composite health score consisting of 5 variables shown to be associated with animal welfare (de Vries et al., 2011): cow and young stock mortality, SCC in bulk tank milk, new udder infections, and fluctuations in standardized milk

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