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Sensitivity of the integrated Welfare Quality® scores of the dairy cattle protocol to changes in individual measures

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Accurate welfare assessment is vital for improving herd animal welfare. The Welfare Quality® (WQ) protocol for on-farm dairy cattle welfare assessment describes 33 measures and a three-step procedure to integrate their values into 12 criteria scores, grouped further into 4 principle scores and finally into an overall welfare categorization with four possible levels (i.e. integrated outcomes). The relative contribution of the various welfare measures to the integrated scores has been contested. Therefore, using a large European dataset (491 herds), we investigated 1) whether there is variation in sensitivity of integrated outcomes to replacing individual observed scores with extremely low and high values of measures, criteria and principles and 2) the reasons for this variation in sensitivity. Replacements of the measures 'lean cows', 'loose/tied housing', 'QBA index', 'drinker trough length' and 'drinker cleanliness', had a bigger impact on integrated outcomes compared to other measures. Replacing measures within the criterion 'absence of diseases' (e.g. mortality and mastitis) had the smallest impact. As intended by the WQ consortium, the sensitivity of integrated scores depends on 1) the observed value of the specific measures/criteria, 2) whether the change was positive or negative, and 3) the relative

weight attributed to the measures. However, two unintended factors which appear to be unwanted side-effects of the step-wise integration method's complexity, had a considerable influence too. Namely 1) the number of integrated measures per criterion or principle, and 2) the aggregation method. Therefore, the current WQ integration method could lead to a focus on a limited set of (often resource-based) measures which is hard to justify. As this harms the credibility of the assessment protocol, we recommend a revision of the integration method, so that the relative contribution of the various welfare measures to the integrated scores more correctly reflects their relevance for dairy cattle welfare.