

Monitoring farm and cow level prevalence of bovine digital dermatitis in New Zealand

D YANG^{1*}, R LAVEN¹, KR MUELLER¹, WD VINK², RN CHESTERTON³

¹IVABS, Massey University, Palmerston North, New Zealand; ²Operations Branch Ministry for Primary Industries, Upper Hutt, New Zealand; ³Energy Vets Taranaki, Inglewood, New Zealand

*D.Yang@massey.ac.nz

Abstract

In the 2014-15 dairy season, bovine digital dermatitis (BDD) was found in 64% of 224 herds in Taranaki, a region on the west coast of the North Island (NI) of NZ. This level of disease was much higher than expected, which indicated BDD is an emerging infectious disease. This prompted the development of a nationwide monitoring process to investigate the likely prevalence of BDD across NZ. This paper describes the development of that monitoring process. It may encourage future surveillance program based on importance stressed by this pilot monitoring process.

Introduction

Bovine digital dermatitis (BDD) is painful, infectious skin disease has been found all over the world. Since its identification, BDD has continued to spread widely between farms and within herds. A Dutch study in 2006 found BDD in 91% of herds and within-herd prevalences up to 83%. Overall the prevalence at the cow level was 21.2%, nearly double that reported in 1991 (1). The situation has not improved since then; in 2012, BDD was still recorded in 20.5% of cows in a longitudinal Dutch study (2) despite the development of a huge range of treatment and control strategies (3). This clearly suggests that once established in a population, BDD infection is very difficult to control.

BDD affects welfare and productivity. BDD has a high impact on welfare due to its high incidence and long duration (4). In terms of economics, BDD does not always cause clinical lameness, so its impact on productivity can be inconsistent. For example, although direct milk loss due to BDD has reported from the UK (5), in Mexico, milk production was not found to be significantly different between cows with and without BDD (6). This inconsistency is also found in studies of the impact of BDD on fertility. In Mexico, a significant increase of 20 days in calving to conception intervals was found in BDD cows (6). However in the US, no significant effect was found (7). However, economic losses from treatment and control strategies (necessary for animal welfare even if economic costs are unclear) are large, but are often not included when the costs associated with BDD are calculated.

The impact of BDD in NZ has been very limited even though the disease has been present for at least 16 years; perhaps because of the pasture-based system which predominates in NZ. However, increasing reports of disease, together with concern that BDD were becoming increasingly aggressive in pasture-based dairy systems (e.g. Southern Chile) resulted in a pilot study in the Taranaki region. BDD was present on 143/224 (64%) farms; mean cow level prevalence on affected farms was 1.7% with a peak within-farm prevalence of 12.7%, prompting the development of a NZ-wide project to identify the prevalence of BDD across NZ. This paper describes the development of the surveillance process used in that study.

Keywords: *symptom monitoring, bovine digital dermatitis, prevalence, nationwide, visual assessment*

Materials and methods

The primary focus of the monitoring process was to identify the proportion of infected farms (i.e. the proportion of farms with at least one infected cow); the secondary focus was to estimate the proportion of cows infected in a region.

So the key questions to answer in the creation process were:

1. Whether to choose farms across the country or to focus, as the pilot study had, on regions, so that BDD prevalence could be compared across regions
2. How many farms to sample based on both statistics and feasibility
3. The number of cows to sample within a farm taking into account both statistics and feasibility
4. The sampling process – how many farms per day, when sampling would start, and how long the process would take.

Regions vs. country

Dairying in NZ varies significantly depending on region – herd size, genetic make-up, standard management procedures and milk production all vary depending on region. Thus region may significantly affect BDD prevalence and region-level data could identify patterns that would not be identified if we chose farms spread across NZ. In addition, sampling within a region, means that we could use a few veterinary practices as a base to identify farms included in the survey.

Farms within region and cows within farm

Two sampling methods were compared:

- One-stage cluster sampling: select number of farms according to total number of farms in a region, and then test every cow within the selected farms.
- Two-stage cluster sampling: select number of farms based on total number of farms in a region, and then sample number of cows within the selected farms.

The number of farms (n) to be selected could be calculated based on the following equation:

$$n = \frac{N * p * (1 - p)}{\frac{d^2}{1.96^2} * (N - 1) + p * (1 - p)}$$

Where N=total number of farms in a region, p=designed farm level prevalence and d=desired precision.

Given a farm having M cows including exactly X diseased cows, we must test M-X+1 cows to be 100% sure that the farm was infected. As a low cow level prevalence was expected (~2%), M-X+1 was expected to be close to M, sampling cows would not therefore reduce the labour required. In addition if sampling was used, systematic sampling would be required which would mean that the examiner would have to stay for the whole milking. So sampling would not save time or increase the number of farms that can be done in a day. Hence, the option a) was preferred.

Inspection process

Farm screening was performed using visual assessment. Two farms were booked to be inspected per day, six days a week starting in 01/09/16, to minimise as much as possible any potential seasonal effect. Only the rear feet of cattle were inspected as front foot infection without rear foot infection is very rare. During inspection, cows' rear feet were hosed carefully, after which a hand torch was used to aid observation of the feet. Presence/absence of lesions was recorded for each cow. Colour pictures of lesions from random selected cows were taken to ensure correct recognition of lesions (Figure 1). To avoid disrupting the normal milking routine, the time spent inspecting cows in a milking shed was minimised.

Figure 1. Different appearances of bovine digital dermatitis lesions in NZ (Photographs D.Yang).

**Results**

Four regions were chosen: Waikato, Manawatu, West Coast and Canterbury. Waikato was chosen as it is the predominant dairy region of NZ; Manawatu was chosen on convenience as Massey University which is located in the Manawatu; the West Coast was selected due to its differences from other regions in climate, geography and management; Canterbury was chosen as a representative region for the large SI herds kept on predominantly irrigated pasture. The regions were first visited in a north/south order (based on planned start of calving to maximise the proportion of the milking herd present at inspection). Half the calculated farms were visited in each region before moving on to the next. The intention was to then reverse the order starting in Canterbury and going north. However illness and workload issues meant that second phase was not completed.

Details of prevalence would not be analysed and reported until the whole process completed. The preliminary analysis suggested that based on a 60% farm-level prevalence (equivalent to that seen in Taranaki) and a desired precision of 15% the numbers of farms to be sampled were 41, 38, 36, and 37 in Waikato, Manawatu, Canterbury and West Coast, respectively. A desired precision of 15% was decided after considering heavy labour workload and long time consuming. As of 01/12/16, 21 farms in Waikato have been inspected with a further 21 farms being inspected next January. Currently 18 Waikato farms were infected. So far 25 farms in the Manawatu have been inspected (eight infected farms found), and herd screening is currently ongoing in this region. Nineteen farms in Canterbury have been inspected (14 infected farms found), but this region was the most difficult to inspect so no further farms will be inspected

decreasing the precision to 18%. In West Coast, 18 farms have been inspected so far, with no convincing lesions seen in any farm. This region will therefore be revisited but the farm number calculation has been changed from confirming prevalence $\pm 15\%$ to confirming disease absence. Based on this reference (8) we need to inspect a total of 29 farms to confirm BDD freedom with 80% confidence given a new estimated prevalence of 5%, and a herd level sensitivity of 99%. The required 10 farms will be examined in February.

Discussion

The process of development of this survey required a balance of feasibility and statistics, and clearly demonstrated the need for a clear question and for flexibility when workload and illness meant the original plan was no longer feasible, and when significant differences from expected prevalence occurred.

BDD is an emerging disease in New Zealand, which has the potential to cause significant problems, particularly on dairy farms. The results of this study show that looking at farms on the regional level is essential as there are differences between regions and that whole herd examination is the best use of time as within-herd prevalence is currently low. Continued surveillance using this model developed for this study is essential if we are to maintain awareness of the disease, and detect significant rises in herd and cow-level prevalence, but as it is neither a new/exotic disease (which would attract government funding) or a disease that currently causes significant losses (which would attract industry money), funding is likely to be a significant issue.

We believe that the best approach is to use our surveillance programme, but rather than having a single observer, we train multiple observers who can easily monitor farms within their region and thus provide ongoing data with minimal costs except for the occasional farm visit. This would provide both ongoing surveillance and increased awareness of BDD and would be likely to get industry support.

References

1. **Holzhauer M et al.** *J Dairy Science* 89(2), 580-588, 2006
2. **Holzhauer M et al.** *The Veterinary Journal* 193(3), 633-638, 2012
3. **Berry SL, et al.** *The Veterinary Journal* 193(3), 654-658, 2012
4. **Brujinis M et al.** *Animal* 6(6), 962-970, 2012
5. **Green L et al.** *J Dairy Science* 85(9), 2250-2256, 2002
6. **Argáez-Rodríguez F et al.** *Prev Vet Med* 32(3), 275-286, 1997
7. **Hernandez J, Shearer JK, Webb DW.** *JAVMA* 218(10), 1611-1614, 2001
8. **Mintiens K et al.** *ISVEE, Proc of the 11th meeting*, 2007