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A matched case-control study comparing udder health, production and fertility parameters in dairy farms before and after the eradication of Bovine Virus Diarrhoea in Switzerland

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ABSTRACT

An obligatory eradication programme for Bovine Virus Diarrhoea (BVD) was implemented in Switzerland in 2008. Between 2008 and 2012, all bovines were tested for antigen or antibodies against BVDV. By the year 2012, eradication was completed in the majority of farms. A decrease of the prevalence of persistently infected (PI) newborn calves was observed from 1.4% in 2008 to <0.02% in 2012. The objective of the present study was to assess the effects of BVD eradication on different parameters of animal health, production and fertility in Swiss dairy herds which had completed the eradication programme.

A matched case-control study was carried out using data from two periods, before (Period 1) and after (Period 2) the active phase of eradication. Case farms had at least two PI animals detected before or during the eradication; controls were BVD-free and matched for region, herd size and use of alpine pasture. A total of 110 farmers (55 pairs) were recruited. During a phone interview, a questionnaire about farm characteristics, animal health and appreciation of the BVD eradication programme was filled in. Breeding data and milk test day records were also analyzed.

Parameters were first compared between (i) case and control herds before eradication, and (ii) Period 1 and Period 2 for case herds only. Milk yield (MY), bulk milk somatic cell count (BMSCC), prevalence of subclinical mastitis (SCM), and non-return rate (NRR) showed a p-value < 0.25 in at least one of the univariable comparisons and were thus further analyzed with a multilevel mixed-effects model to account for repeated measures over time. In order to assess whether changes in health status over time were due to BVD eradication, an interaction variable between period and group (case-control) was created (IA). Except for MY, the IA was significant for all parameters modelled. Despite an overall p-value of 0.27, case herds tended to have a higher MY after eradication ($\beta = 0.53$, $p = 0.050$). For BMSCC and SCM, case herds had higher values than controls in both periods; udder health was significantly improved in control herds and it remained stable in case herds, with a slight decrease of BMSCC ($\beta = -0.19$, $p = 0.010$). Finally, among fertility parameters, NRR showed a general improvement but it was significant only in control herds ($\beta = 0.29$, $p = 0.019$). Even though the effects of the eradication programme measured in this study were less pronounced than expected, 73% of the participants of this study had a positive attitude towards the campaign.

1. Introduction

The Bovine Viral Diarrhoea Virus (BVDV) is a cattle pathogen with worldwide distribution. Infection can cause severe clinical symptoms, especially in persistently infected (PI) animals, as well as large economic losses because of reduced milk production, premature culling, reduced reproductive performance, and abortions (Fourichon et al., 2005; Fray et al., 2000; Laureyns et al., 2013; Niskanen et al., 1995).

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In the early 1990s, the Scandinavian countries (Denmark, Finland, Norway and Sweden) were the first ones to start eradication programmes without the use of vaccines (Moennig et al., 2005b; Stahl and Alenius, 2012). All of these countries reached the final phase of eradication ten years after the beginning of their respective national programmes. After these successes, other countries in Europe planed regional and/or national eradication campaigns: the Shetland Islands (where BVD was eradicated) (Synge et al., 1999), Brittany (France) (Joly et al., 2005), the Netherlands (Berends et al., 2008), Germany (Moennig et al., 2005a,b), Austria (Rossmanith et al., 2005) and Switzerland (Presi et al., 2011).

Indeed, in 2008, the Swiss Federal Food Safety and Veterinary Office (FSVO) initiated a compulsory national eradication programme for BVD based on the detection and elimination of PI animals through antigen testing without initial antibody testing (Presi and Heim, 2010). The identified PI animals were slaughtered and the movements of all pregnant cows of the infected farm were restricted until after parturition to avoid new infections through newborn PI animals. After one year, the entire Swiss cattle population had been antigen-tested for BVD. Between 2009 and 2013, all newborn calves were tested for BVD using ear notch samples. Within four years, the proportion of newborn PI animals decreased from 1.4% in 2008 to less than 0.02% in 2012 (FSVO et al., 2015). Since 2013, the FSVO has implemented the latest phase of eradication, the "surveillance phase": instead of testing on animal level, the cattle population is tested on herd level with bulk milk (dairy) or pooled blood sample serology (beef and small holdings). In the spring of 2015, 99.8% of the Swiss dairy farms had acquired a BVD-free status (FSVO et al., 2015).

Several countries, including Switzerland, had done a cost-benefit analysis before implementing disease control (Gunn et al., 2004; Häsler et al., 2012; Weldegebriel et al., 2009). The economic analyses were considered valuable and in some cases even necessary to justify the need for mitigation measures and to budget the resources needed.

Numerous studies have reported the effects of BVDV infection on animal health and production. At the herd level, documented effects of BVDV infection on fertility are, for example, increased rates of retained foetal membranes, abortions and hormone treatments as well as longer calving intervals (Niskanen et al., 1995; Rüfenacht et al., 2001; Valle et al., 2001). Another source of economic losses for the farmer is the effect on milk yield (Beaudeau et al., 2004a,b; Fourichon et al., 2005; Houe, 2003; Waage, 2000). Only few studies quantify the effects of BVD eradication on animal health, fertility or production (Berends et al., 2008; Burgstaller et al., 2016). The difficulties associated with the realization of such studies may explain their sparsity. The definition of case and control herds depends on the definition of BVD status at the time of eradication. Furthermore, the availability and quality of herd records several years after the eradication campaign may be limiting. Finally, data on other factors influencing animal health, fertility and production, such as management, feed quality or climate, or other epidemics during the analyzed time period (e.g. bluetongue) are not always available and make the interpretation of the observed results more difficult.

An economic evaluation of the Swiss eradication programme based on literature data and epidemiological modelling predicted a net benefit (Häsler et al., 2012). However, no evaluation based on the analysis of actual field data has been available to date.

Therefore, the objective of the present study was to assess the impact of the BVD eradication on different parameters of animal health, fertility and milk production at the herd level in Swiss dairy farms.

2. Materials and methods

2.1. Study design and farm selection

The present study was designed as a matched case-control study, to compare farms with and without PI animals before the start of the BVD eradication programme during two time periods, before (July 2007–June 2008) and after the active phase of eradication (July 2012–June 2013). For the selection of case herds, a database containing all BVDV test results of Swiss dairy farms between 2007 and 2012 was used. To exclude herds with a transient BVDV infection, case herds were defined as herds that had more than one PI animal over an extended time period. Therefore, the main inclusion criterion for case herds was that at least two PI animals had been detected before the end of the initial phase of the eradication programme (end of December 2008). Furthermore, at least one of these PI animals should have been present on the farm between July 2007 and June 2008 and should have been at least 1.5 years old when detected. All herds had to have been declared free from BVDV infection since January 2011. In addition, both case and control herds had to be member of one of the three Swiss cattle breeding organizations (Brown Swiss Cattle Breeders' Association, Holstein Breeders' Association, and Swissherdbook which includes principally Simmental, Swiss Fleckvieh and Red Holstein animals), and to have production records available for both periods.

Control herds were recruited by contacting the case herds' private veterinarians and asking them to suggest potential control herds. These had to be matched with case herds considering the risk factors identified by Presi et al. (2011): geographic region, herd size and use of alpine pasture. They also had to have been tested free of BVD during and between both study periods. The geographic region was defined as the area covered by the same private veterinarian. It was the matching criteria with the highest priority. If the veterinarian could not provide a recommendation for a control farm in his/her practice area, other farmers of the neighbourhood (within a radius of 15 km or less) were asked for participation if they fulfilled the other selection criteria. Herd size was matched within a range of 20 cows. The use of alpine pasture was assessed by asking the farmer for each period: "Did you bring your animals to an alp in the summer?".

A sample size of 51 cases and 51 controls had been calculated using the tool developed by StatsToDo (StatsToDo, last accessed the 10.07.2015) in order to detect a mean paired difference in the average daily milk production of 0.6 kg per cow between case and control herds (Fourichon et al., 2005), with a standard deviation of 1.5 kg, 80% power and a 95% confidence interval (corrected for multiple testing). For binary variables, a sample size of 50 cases and 50 controls is sufficient to detect a significant difference with a Type I error of 5% and a power of 80% if in at least 40% of the pairs the outcome is worse in cases than in controls, while in maximum 12% of the pairs the outcome is better in cases than in controls.

According to the Swiss BVD database, a total of 177 herds fulfilled the case definition. The managers of all potential case farms were contacted by phone. First the study was explained to them and their eligibility to participate was then assessed with some questions. Finally, the eligible farmers were asked to participate. Thirty-four herds did not fit the case definition or made important changes between both periods (e.g. new breed, change to beef production, increased farm size) and a majority of the other farmers refused to participate ($n = 79$). The reasons indicated were diverse and included lack of time ($n = 29$), transfer of the farm to another farmer ($n = 13$) or other reasons ($n = 37$). A total of 64 farmers accepted to participate, but nine had to be excluded afterwards because they never sent the written permission for access