Control of BVD on a dairy farm – *Convincing strategies*

Case-report written for the BVDzero Awards by Angela Damaso (MVetMed, DVM, MRCVS)
Lecturer in Population Medicine and Veterinary Public Health at The Royal Veterinary College, University of London, UNITED KINGDOM

e-mail address: adamaso@rvc.ac.uk

History

A Welsh dairy farm belonging to an agricultural college comprised an autumn and a spring calving herds of crossbred British-Friesian and Jersey cows. Both herds were expanded in size from approximately 150 animals in each herd in 2011 to approximately 260 in 2015. The farm runs in a closed system since 2009, when they last bought in 30 cows from Dumfriesshire (Scotland). Both herds graze on pasture in good weather in separate fields, and are housed under the same roof in the winter, where they are offered grass silage. Cake is supplemented in the parlour, according to seasonal milk yields, on a flat rate.

The herd is free of IBR and vaccinating against Leptospirosis, and has a moderate profile for Johnes infection, with a constant high risk cows' average of 10% (J3 to J5, in the Herdwise classification system). Due to the high prevalence of bovine Tuberculosis (bTB) in the region, the farm has been on and off under movement restrictions and is currently down to this disease.

In 2011, poor production and fertility performance led to suspicion of BVD. Although the herd had been vaccinated against BVD, the farmer commented that the protocol was not thoroughly followed, due to lack of engagement from the staff in completing the dual shot course.

An investigation started with a bulk milk antigen and a spot-test (serology in ten calves from 9 months up to 15 months of age), in each herd. All results came back positive, revealing that the virus was circulating in the two herds, and an eradication program commenced on the farm.

At the time, the 12-month rolling conception rate and average milk yield was 67% and 4,900l/cow/year, respectively for the spring herd, and 37% and 5,900l/cow/year, for the autumn herd (source: National Milk Recordings, NMR; 2011). All youngstock were being reared on site at that time.

The strategy used to eradicate BVD in this farm was by means of elimination of persistently infected (PI) animals only, and vaccination was not pursued. All adult cattle and young stock over 30 days old on farm were blood sampled between June and September 2011. Blood heparinized samples were sent to the lab for BVDV PCR pooled test or BVD Ag ELISA, if a 10-blood pool was not complete. Results revealed seven positive pools and the animals were resampled and retested, three to four weeks later. A second positive result indicated persistent viraemia and these animals were interpreted as persistently infected (PI) and culled; however, in some cases, culling occurred as late as 8 months post-confirmation.

All newborns over 30 days of age were tested till April 2013, and due to the negative results at that time, the farmer decided to stop testing and the eradication program ceased.

In August 2013, as a consequence of the farm expansion, a management decision was made to shift the youngstock rearing to a contractor, after the end of the bTB restrictions. Calves and bulling heifers were sent in seasonal batches and brought back few months prior to calving date.

After the phase of elimination of PI from the herds, the BVD control program moved to a monitoring stage, where the herds were checked quarterly for BVD PCR and antibody ELISA in the bulk milk tank. High levels of antibodies were observed since and expected so due to the past vaccination; absence of Ag detection was the target for a BVD-free herd. The results of the monitorisation were showing a clear status from BVDV from 2012 to 2015, until a 34.9 viral CT value was reported on

20/03/2015 in the autumn herd and 32.4 CT in the spring herd on 09/06/2015 (CT - Cycles to Threshold; positive if <45 CT).
The farm manager questioned the reasons behind the recent outbreak and whether it was cost-beneficial to carry out a new PI hunt, which led to an impasse in the investigation.
Therefore, the aims of this report were firstly, to discuss the risk factors that led to the detection of BVDV in the milking herd in 2015; and secondly to demonstrate the impact of the disease and its control on the farm.

Initial Problems List

- BVDV PCR positive on bulk milk tank two years after eradication program ceased
- Higher biosecurity and biocontainment challenges on farm, namely rearing contract and increased herd size
- Lack of motivation from farm manager to carry out new cycle of disease control and eradication

Herd assessment and Results

Analysis of the risk factors for the new BVD outbreak

Eradication strategy and test result analysis

Several risk factors identified might have contributed to the recent outbreak:

1. PI animals were not removed immediately from the farm upon confirmation. The Cattle Tracing System (CTS) Online shows that two of the calves identified as PI in the second month of life did not exit the herd until they were 7 and 9 months old, respectively. This increased the risk of spreading the virus within the herd and potentially infecting pregnant susceptible animals. This was likely to have happened during the beginning of 2013, which corroborates with the finding of a PI heifer entering the milking herd in first half of 2015.
2. Testing of newborn calves was ceased too early in the process. Due to the increased risk of transmission of disease within the herd, a more cautious consideration of potential new infections should have been taken, and testing should have carried out for at least 12 more months.
3. Absence of vaccination against BVD. Although BVD can be eradicated without recurring to vaccination, this procedure reduces the number of susceptible animals, and reduces the epidemiological measure of the capacity of a disease to spread - basic reproduction number, R_0, having a positive effect on the disease control.
4. The movement of the youngstock to other premises removed the PI(s) from the farm, keeping the virus away from the milking herd for almost two years (bulk milk Ag negative), which masked the failure of eradication of BVDV from the herd.

Biosecurity

The premises of the college farm were constantly visited by visitors and agricultural students, many from a farming background, with their own livestock enterprises or assisting other farms, who help with the milking. Haulier lorries did not come into contact with the livestock.

There were major biosecurity faults on the dairy farm:

- No signs reinforcing the use of protective clothing;
- No clear zone of change of clothing on farm (dirty to clean) when entering the premises
- A bootdip was available; however it was positioned 20 metres away from the entry/exit point of the parlour, and it was diluted due to infrequent changing and rain waters
- The fields were contiguous to other farms of unknown BVD status and divided by hedges, which allowed nose-to-nose contact at places
- The vehicles' cleaning and disinfection facility was not in use
- The in-calf heifers brought in from the youngstock rearing contractor were not isolated nor tested at arrival to the dairy
- If there was a biosecurity plan on farm, the two herdsmen were not aware of its existence

The youngstock premises were also assessed for risk factors for introduction of the virus into the in-calf heifer population. These were the findings:

- No signs reinforcing the use of protective clothing;
- No footbath or disinfection solution available at any entry/exit points of the sheds or fields;
- Bulling and in-calf heifers were in fields, contiguous to a sheep farm and divided by hedges, which allowed nose-to-nose contact at places. The close genetic relationship between BVDV and Border disease virus (BDV) makes sheep susceptible of becoming infected with BVDV and able to pass in onto cattle; however, it is uncommon.

Analysis of fertility and production data

Conception rates and milk yield

In order to understand the impact of the disease and of the intervention in the farm, NMR data were analysed with InterHerd+ (PAN Livestock Services, UK) computer software.

Figure 1 represents the variation of the conception rates in 12-month rolling periods and the average milk yield in litres per cow per year, from 2011 till 2015. Although there are many variables that might contribute to the differences found along time, an association with BVD control and the improvement in the conception rates in 2013, 2014 and 2015 in both herds, along with an increase of the milk yield from 2011, is very likely. The spring herd slightly dropped its yield in 2014, but other factors might have been involved in poor production, such as overstocking and consequent repercussions on the nutritional status of the herd (not enough grass or decreased provision of concentrates), foot health (increased lameness) and others.

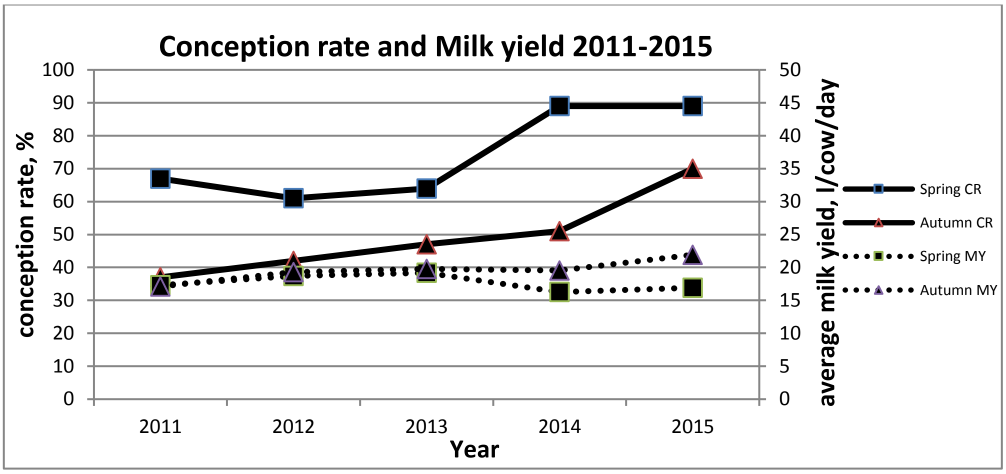


Figure 1: Variation of the 12-month rolling conception rates and the average milk yield per cow per day in the herds (spring and autumn), from 2011 till 2015.

Age at first calving

Figure 2 shows the variation on the age at first calving in the autumn herd. There was a clear improvement in this parameter in 2014, which indicate that the control of BVD by eliminating PI animals from the farm in 2012 and 2013 had positive results potentially on calf health, growth rates and fertility of bulling heifers.

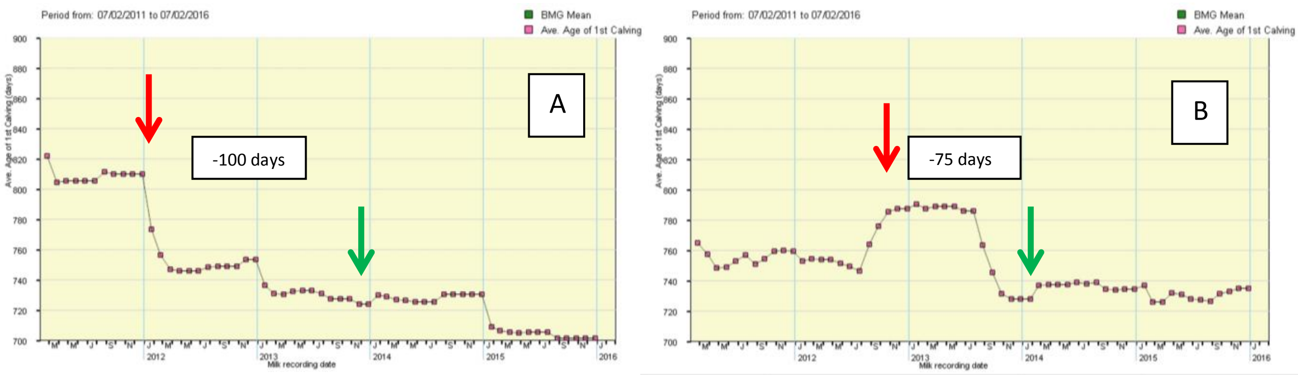


Figure 2: Variation in the age at first calving, in the spring herd (A) and autumn herd (B), from 2011 till 2016.

Partial budget analysis

A superficial 2-year partial budget analysis was conducted for comparison between the economical situations in 2012, when disease was present on farm, and in 2014, after the control program took place. These were the variables considered in the analysis:

a. **New costs**:

- *Testing*: the total charges of the laboratory work totalized just under £5,000. This is a very low figure, because it does not include vet charges, as the farm was used for teaching vet students practical skills. This figure could be tripled if vet charges would apply (£15,000).

- *Heifer rearing*: the BVDV is generally associated with poor calf health. A 5% increase in the number of calves in the herd was estimated. Accounting for 1,000 calves born in two years, half female, and an average cost of rearing since birth till calving of £2.31 (1), the increased number of calves would add to the rearing costs just over £42,000.

b. **Revenue foregone**: No revenue was considered foregone in the absence of the disease in the farm.

c. **Costs saved**:

- *Heifer rearing*: there was a decrease of 100 and 75 days (average=87.5 days) in the age at first calving of the herds. The daily cost of heifer rearing is £2.31 (1). Considering that approximately 1,000 calves were born in two years, half were female, and accounting for a calf mortality of 5%, the farm saved almost £50,000 per year, by rearing these heifers for fewer days.
- *Open days*: both herds had an improvement of around 30% in the conception rates, meaning that 30% of the cows had their open days reduced in the farm by an average of 21 days. The cost of an open day was estimated by the farmer to be £1.5/animal/day. Fewer open days resulted in almost £5,000 of costs saved.

d. **New revenue**:

- *In-calf heifers*: Assumptions were made that an improvement in conception rates resulted in fewer barren cows, so less need to replace them. Allied to a more successful heifer rearing, we estimated that the farm had an extra 20% of in-calf heifers available for sale, at an average market price of £1500, bringing over £140,000 extra to the enterprise.

Table 1 shows the positive outcome in the two years following the control of the disease, with gains of approximately £100,000 per year or £600 per cow per year.

Table 1: Summary of the partial budget analysis of the BVD control in the farm, within two years of intervention.

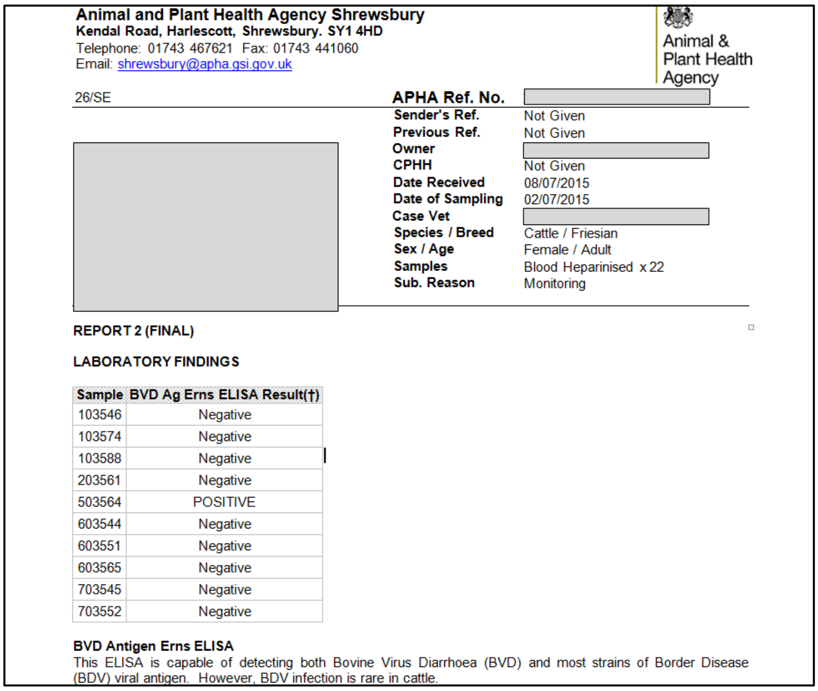
Additional costs		Additional benefits	
New Costs	£	***Costs Saved***	£
testing	4,947	heifer rearing (fewer days)	96,009
heifer rearing (more heifers)	42,158	open days	4,914
Revenue Foregone		***New Revenue***	
non-applicable		heifer sale	142,500
Total additional costs	**45,105**	**Total additional benefits**	**243,423**
Benefits minus costs	**Per herd**	**+£198,319**	
	Per head	**+£1,224/cow**	

Diagnostics

Blood sampling and testing

Following the economic gains uncovered from the analysis above had been discussed with the farm manager, he agreed to take the investigation further.

By analysing the history of the case, the most likely scenario in the farm was thought to be the presence of a PI amongst the heifers that hadn't been tested after April 2013, which had recently entered the spring herd. So, the first step was to look for PI animals in all first calvers. A total of 65 primiparous were tested for BVD antigen and one was identified as a PI. The farmer was advised to cull this animal immediately. **Error! Reference source not found.** shows the laboratory report of the testing, showing a second positive result for BVD ELISA Ag, which followed a positive PCR result on pooled blood four weeks before.



Animal and Plant Health Agency Shrewsbury
Kendal Road, Harlescott, Shrewsbury. SY1 4HD
Telephone: 01743 467621 Fax: 01743 441060
Email: shrewsbury@apha.gsi.gov.uk

Animal & Plant Health Agency

26/SE

APHA Ref. No.	
Sender's Ref.	Not Given
Previous Ref.	Not Given
Owner	
CPHH	Not Given
Date Received	08/07/2015
Date of Sampling	02/07/2015
Case Vet	
Species / Breed	Cattle / Friesian
Sex / Age	Female / Adult
Samples	Blood Heparinised x 22
Sub. Reason	Monitoring

REPORT 2 (FINAL)

LABORATORY FINDINGS

Sample	BVD Ag Erns ELISA Result(†)
103546	Negative
103574	Negative
103588	Negative
203561	Negative
503564	POSITIVE
603544	Negative
603551	Negative
603565	Negative
703545	Negative
703552	Negative

BVD Antigen Erns ELISA
This ELISA is capable of detecting both Bovine Virus Diarrhoea (BVD) and most strains of Border Disease (BDV) viral antigen. However, BDV infection is rare in cattle.

The dam of this heifer was also tested and it was negative for antigen, so it stayed in the farm.
All autumn first calvers and youngstock were tested between April and November 2015, but there were no positive results.

The bulk milk test in July that followed the elimination of the PI primiparous showed no antigen in the milking herd (Annexes

Annex 1).

Figure 3: Report from Animal and Plant Health Agency (APHA) with listed nine negative individual results and one positive result for BVD ELISA Antigen, following a positive blood pool for BVDV PCR.

Follow-up and Prevention

Fertility and production

There were no obvious changes on the fertility and production parameters advent of the introduction of the PI in the milking herd. However, a close monitorisation on the production, fertility and nutrition parameters is paramount to identify early potential problems in the herd, as the consequences on fertility might only be visible in the following months. Important clinical signs to look for are poor reproductive performance with low conception rates and repeat breeders, depressed milk production, diarrhoea in some cases, and mucosal disease if mutation of the virus from a non-cytopathic for to a cytopathic form.
The milk production was not seemed to be affected possibly because the mature herd had been previously exposed to the virus and maintained some immunity, and the virus was promptly detected and removed from the herd.

Biosecurity

The biosecurity risks were highlighted and the areas to improve were discussed with the client. However, the farm practices regarding biosecurity remained unchanged, regardless of the advice given, claiming limited resources under the justification of the current economic situation in the dairy global market.

Further intervention

Due to the biosecurity risks identified in both premises, a thorough vaccination protocol was put in place on the bulling heifers. This will prevent formation of new PIs during the period of high risk on this farm. All newborn calves must carry on being tested for 12 months following the removal of the last PI from the farm.

Implications / Conclusions

Although the biosecurity risks existed on the farm, the re-introduction of BVDV in the milking herd was in my opinion more likely to have happened due to an incomplete eradication programme. The programme followed the Scandinavian principles of BVD eradication (2), such as identification of infected herds using serological tests to determine if the herd has been exposed to the BVDV, and virus clearance in infected herds aiming to remove PI in a cost- and time-efficient manner; however the second step was potentially not achieved in this farm and a PI never got tested and survived through rearing and calving.

The cost-benefit analysis had some limitations; it did not consider discounting for future costs and benefits, nor all variables involved in the process, e.g. yield, disposal of dead animals, treatments and farm-specific costs. Nevertheless, it was a useful exercise, adding value to the discussion between veterinarian and farmer on the new intervention. The economic losses of BVD outbreaks have been described to cost from a few thousand pounds, up to over £70,000 in large dairies (3). In this case-study, the medium-term impact of the disease revealed very high losses that justify a committed eradication programme. In a block calving herd, age at first calving is a crucial fertility parameter, which depends largely on a successful calf rearing programme. BVD is a disease likely to impair calf growth, as it predisposes animals to health problems, such as neonatal diarrhoea syndrome and bovine respiratory disease, amongst other diseases, with subsequent impact on herd health (4).

The tests used are an efficient tool in the eradication process, as they provide high sensitivity, identifying infected animals, and high specificity, which help in differentiating PIs from transient viraemic animals (5). The costs related to testing might be high, but do not exceed the benefits advent from the no-disease status.

Cull of PIs should be immediate to reduce the risk of circulation of the virus on the farm and the opportunity to originate new PIs. In this case, because the herd had been exposed to BVDV in the past, it was not fully susceptible and the infection spread did not take off, due to the capacity of the infection to spread (R_0) being lower than in a fully susceptible population. Nevertheless, heifers are naïve and the antibody protection in older animals is not life-lasting, so vaccination will help to prevent the production of new PIs, especially in farms that don’t eliminate immediately these high risk animals.

Others factors could have impacted the changes on the conception rates, namely lameness or nutrition. This was not reported in the current paper, however, body condition scoring and locomotion scoring are carried out routinely in this farm by agricultural students and no significant differences in their findings and in the farm management have occurred in the last years.

In conclusion, farmers must be encouraged to start and finish a committed BVD eradication programme to prevent high economical losses associated with the disease on a dairy farm. The Veterinarian should carry out risk management analyses and engage in business analyses to demonstrate and discuss the benefits and the costs involved in disease interventions in each specific farm, including vaccination programmes.

Bibliography

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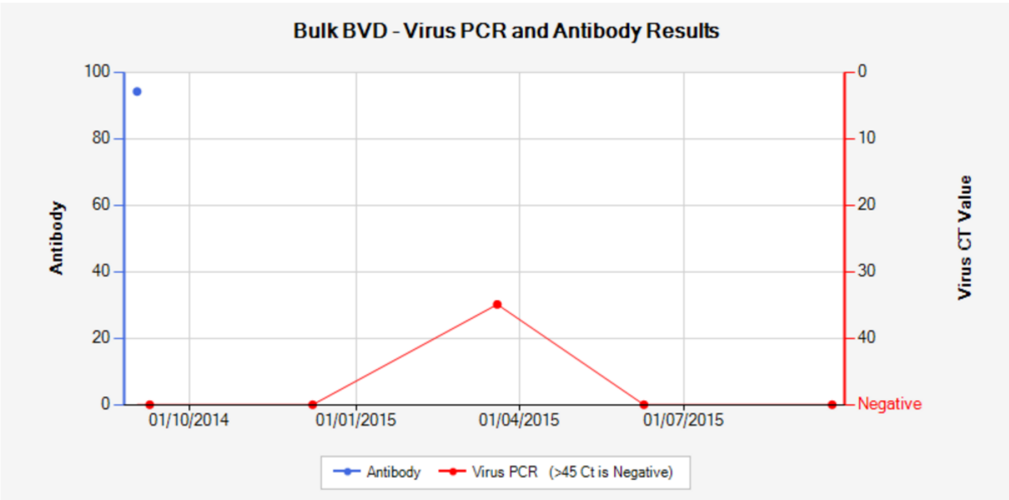
Annexes

Annex 1: Variation of the BVD test results for antigen (red dots) and antibody (blue dot) in time, from October 2014 till July 2015 (source: NMR).

BVD Bulk Test Results – Test Summary Graph



BVD test results - Summary

Batch Number	Sample Date	Bulk or Individual	Sample Count	% Pos or Result	Sample Type	Test Type	Report
80026405	21/09/2015	Bulk	1	Negative	Milk	BVDv	
80025285MORE	09/06/2015	Bulk	1	Negative	Milk	BVDv	
80023865MORE	20/03/2015	Bulk	1	Positive	Milk	BVDv	
80022535MORE	08/12/2014	Bulk	1	Negative	Milk	BVDv	
80021553MORE	09/09/2014	Bulk	1	Negative	Milk	BVDv	
02091436MORE	02/09/2014	Bulk	1	High Positive	Milk	BVD	