Cost-effectiveness of bulk-tank milk testing for surveys to demonstrate freedom from infectious bovine rhinotracheitis and bovine enzootic leucosis in Switzerland

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Summary

In Switzerland, annual surveys to substantiate freedom from infectious bovine rhinotracheitis (IBR) and enzootic bovine leucosis (EBL) are implemented by a random allocation of farms to the respective survey as well as blood sampling of individual animals at farm level. Contrary to many other European countries, bulk-tank milk (BTM) samples have not been used for active cattle disease surveillance for several years in Switzerland. The aim of this project was to provide a financial comparison between the current surveillance programme consisting of blood sampling only and a modified surveillance programme including BTM sampling. A financial spreadsheet model was used for cost comparison. Various surveillance scenarios were tested with different sample sizes and sampling frequencies for BTM samples. The costs could be halved without compromising the power to substantiate the freedom from IBR and EBL through the surveillance programme. Alternatively, the sensitivity could be markedly increased when keeping the costs at the actual level and doubling the sample size. The risk-based sample size of the actual programme results in a confidence of 94,18 % that the farm level prevalence is below 0,2 %. Which the doubled sample size, the confidence is 99,69 % respectively.

Keywords: bulk-tank milk, infectious bovine rhinotracheitis, enzootic bovine leucosis, financial comparison

Kosteneffizienz von Überwachungsprogrammen unter Nutzung von Tankmilchproben zum Nachweis der Freiheit von infektiöser boviner Rhinotracheitis und enzootischer boviner Leukose in der Schweiz

In der Schweiz wird der Nachweis der Freiheit von infektiöser boviner Rhinotracheitis (IBR) und enzootischer boviner Leukose (EBL) mittels *jährlicher* Untersuchung von Blutproben von Einzeltieren aus einer Zufallsstichprobe erbracht. Im Gegensatz zu verschiedenen europäischen *Ländern* wurden Tankmilchproben seit mehreren Jahren nicht mehr in der aktiven Überwachung von Tierseuchen genutzt. Das Ziel dieses Projektes war ein finanzieller Vergleich zwischen dem heutigen Überwachungsprogramm mittels Blutproben und einem modifizierten Überwachungsprogramm unter Einbezug von Tankmilchproben um die Kostenersparnisse einschätzen zu können. Ein finanzielles Spreadsheet-Model wurde für den Kostenvergleich benutzt. Szenarien mit verschiedenen Stichprobenumfängen und -frequenzen wurden entwickelt. Die Kosten könnten halbiert werden ohne eine Verschlechterung der Qualität des Überwachungsprogramms für den Freiheitsnachweis von IBR und EBL. Ebenso könnte die Sensitivität des Programms deutlich erhöht werden unter Beibehaltung der gegenwärtigen Kosten und einer Verdoppelung der Stichprobengrösse. Die risikobasiert berechnete Stichprobe des gegenwärtigen Programms erreicht ein Vertrauensniveau von 94,18 % bei einer Designprävalenz von 0,2 % infizierter Herden. Mit der doppelten Stichprobengrösse beträgt das Vertrauensniveau 99,69 %.

Schlüsselwörter: Tankmilch, infektiöse bovine Rhinotracheitis, enzootische bovine Leukose, finanzieller Vergleich

Introduction

Substantiating freedom from disease is the basis for international free trade of animals and animal products (OIE, Terrestrial animal health code, Vol.1, Section 1, Chapter 1.4, Article 1.4.6., 2010). In Switzerland, annual serological surveys are conducted in order to demonstrate freedom from infectious bovine rhinotracheitis (IBR), enzootic bovine leucosis (EBL), brucella melitensis, Aujeszky's disease and porcine reproductive and respiratory syndrome (PRRS). As Switzerland is free of these diseases, the low design prevalence at herd level assumed in sample size calculations necessitates the sampling of a large number of herds. The sampling procedure is a two-stage process. Firstly, the requested number of herds is randomly selected from the national flock and secondly, a predefined number of animals is tested within each selected herd. The tested animals can thus be seen as a representation of the whole herd. To reduce costs, two strategies can be followed: reducing the number of herds to be sampled, for example through risk-based approaches for sample size calculations (Hadorn et al., 2002; Stark et al., 2006; Schwermer et al., 2009) or reducing the cost of sampling by getting similar herd level sensitivity with fewer tests or less expensive sampling procedures. In the last few years, the main focus in Switzerland was reducing the number of herds that were tested. However, as the development of cost-effective tools for animal disease surveillance is of high importance to scientists and decision-makers in the field of veterinary public health, the second strategy is also highly valuable.

Bulk-tank milk (BTM) sampling represents a fast, easily available, inexpensive and non-invasive sampling method to investigate herds. In Northern European countries, BTM has been in use in epizootics eradication or surveillance programmes since the eighties and its implementation has since been expanded to many other European countries as well as Australia (Hutchison and Martin, 2005). The eradication or surveillance programmes already implemented for IBR and EBL in Austria, Sweden, Norway, Denmark, England, Holland and Finland were a strong motivation for this project (Van Wuijckhuise et al., 1998; Nylin et al., 2000; Paisley et al., 2001; Nuotio et al., 2003; Nuotio et al., 2007; Brun et al., 2007). In Switzerland, pooled individual milk samples were used in the control of IBR in the eighties (Ackermann et al., 1990)

In the milk-testing scheme in Switzerland, BTM samples are routinely collected from all dairy farms, and subsequently tested (somatic cell counts, bacterial counts and antibiotic-residue testing). All samples are tested in a single laboratory since the start of 2011. At least two BTM samples per month are collected from each Swiss dairy farm. The BTM samples are kept between 1–5 °C without using preservatives. These samples represent a readily available sample matrix for screening. The BTM sampling procedure is also non-invasive for the animal,

avoiding stress and negative effects that an invasive blood sampling can cause. Lower costs regarding farm visits, blood sampling procedures and materials render it a valuable and inexpensive sampling method.

This study aimed to compare the costs between the current surveillance programme for IBR and EBL with blood samples from individual animals, and a surveillance approach using BTM samples from dairy farms included in the milk-testing scheme in combination with the collection of blood samples from all other farms. Several surveillance scenarios were tested with two main goals: to either substantially reduce the costs or to increase the sensitivity of the surveillance programme maintaining the same costs. To reach these goals, a literature review of IBR and EBL BTM diagnostic tests was conducted and an overview of all available commercial tests was obtained to allow a better evaluation of the practicability of BTM testing. Data of the surveillance programme conducted in 2009 was used for the comparison. The results of this study should help to give guidance regarding the decision whether BTM testing should be used in the future for IBR and EBL surveillance in Switzerland.

Material and Methods

Bulk-tank milk sampling in Switzerland

BTM represents the entire milk production delivered by a dairy farm daily or every two days. The BTM samples are automatically collected on each farm by milk-collection tankers along the milk collecting routes. In Switzerland, a large number of farms are also sampled manually at milk collection locations, at dairies and at milk collecting or centrifugation plants. Specially-trained professionals take the samples in accordance with the international standards of the International Dairy Federation (IDF) and the Swiss law (Ordinance of 23 November 2005 on milk quality (MQV) and FVO, Technical directive for the execution of milk quality control of 30 Mai 2005: Version of 9 February 2009). BTM samples are refrigerated at 1–5 °C and sent to a single laboratory for the milk inspection analyses.

Swiss livestock population 2009

The number of cattle holdings in Switzerland in 2009 was 44'589 (Animal Movement Database, TVD, 2009). The number of dairy farms participating in the milk-testing scheme was 27'131 (61% of all cattle farms) with a total of 578'689 dairy cows. The mean number of cows in these dairy herds in 2009 was 21.3 animals (Federal Office of Agriculture, FOAG, 2009). The majority of cows (81,6%) are kept on the farms participating in the milk-testing scheme. The other farms represent the cattle holdings where only beef cattle are reared, farms where cattle are reared non-commercially or dairy farms from which

BTM samples are not collected because they do not sell their milk to a dairy. In 2009, this represented a total of 17'458 farms and a percentage of 39 % of all Swiss cattle farms. We obtained the number of farms from which BTM samples could not be collected and used by calculating the difference between the total number of Swiss cattle farms and the total number of farms participating in the milk-testing scheme. Currently, all these farms have to be surveyed with individual animal blood samples. There has been a strong decline in the number of Swiss milk producers in the last decade. The numbers of producers has fallen by 28,2 % with a simultaneous increase in the number of dairy cows per farm.

Framework of the financial model for the surveillance of IBR and EBL

The model framework was created in an Excel spreadsheet (Excel 2007, Microsoft, Seattle, WA). The spreadsheet model developed by Menéndez (2008) for a financial evaluation project of animal disease surveillance programmes in Switzerland was used as a basis. In the model, the different steps of the surveillance programme are described in detail and their costs are calculated. These steps include planning, implementation, sampling, laboratory testing, data management, controlling, data analysis and communication. Each step contains sub-steps with a description of the procedure and associated costs. For the costs calculation of the IBR and EBL surveillance using BTM samples the model required further refinements, so several sub-steps were added. In the planning procedure, we added the labour expenses for allocating farms to dairy or beef farms as labour. In the implementation procedure, we added the communication of the assignment of farms to the milk testing scheme laboratory as labour. In the sampling procedure, we added the triage, sorting and the delivery of the milk samples to the laboratories through the milk testing scheme laboratory as operations and expenses. In the laboratory testing procedure, we added the testing of BTM IBR Enzyme-linked Immunosorbent assay (ELISA) and EBL ELISA as operations and expenses. To ensure that dry cows or cows on medication (e.g. cows with mastitis, being treated with antibiotics) would be included, the model foresaw that all farms with BTM samples were sampled and tested twice in an interval of three months.

Surveillance costs: input data

Costs had to be estimated in order to calculate the cost-effectiveness of the surveillance programme. The cost estimations were collected from the FVO, the Institute of Virology and Immunoprophylaxis (IVI), the milk-testing laboratory (Suisselab AG) and the Swiss Post. The labour costs for the different collaborators at the Federal and Cantonal Veterinary Offices had to be quantified as wage rates. The time each collaborator spent on the surveillance

programme was also estimated. The labour costs were estimated at an hourly rate in Swiss Francs. The costs for a farm visit were estimated at 28 CHF and blood sampling per individual animal at 8.50 CHF. The material used for the blood sampling (e.g. tubes and needles) was estimated at 0.30 CHF per blood sample. The handling costs of BTM samples were estimated at 5 CHF per sample. The laboratory costs for blood serum ELISA and BTM ELISA were estimated in CHF per tested sample. The unit price per tested sample included labour, materials and general laboratory charges. The costs of a blood serum ELISA were estimated at 21.70 CHF and BTM ELISA at 25 CHF.

Annual Swiss IBR and EBL surveillance programme with individual animal blood samples

Currently, the sample size of this surveillance programme is calculated according to the risk-based approach first suggested by Hadorn et al., (2002), modified by Knopf et al., (2007) and Schwermer et al., (2009). A herd sensitivity of 99 % and a herd specificity of 100 % for IBR and EBL are used for the calculation of the sample size of the actual IBR and EBL surveillance programme. The sensitivity and specificity for the IBR blood serum ELISA are 99,3 % and 98,3 % (CHEKIT® Trachitest Serum, IDEXX Laboratories) and for the EBL blood serum ELISA 99,9 % and 99,8 % (CHEKIT® Leucose Serum, IDEXX Laboratories). These values were obtained from the Swiss reference laboratories for the named diseases. Blood samples of all cattle older than 24 months are collected on cattle farms. If there are fewer than 7 animals older than 24 months on a farm, younger cattle are also sampled to reach a number of 7 blood samples and thus ensure a sufficient level of herd sensitivity. For the calculation of the sample size, a herd sensitivity of 99 % and a herd specificity of 100 % are assumed. These parameters resulted in a sample size of 1'410 cattle farms for the survey in 2009.

Bulk-tank milk surveillance programme scenarios

The scenarios were built based on a sample size that allowed to declare with 99 % reliability that less than 0,2 % of herds are infected with IBR or EBL, as agreed in the bilateral treaty with the European Community (2002: Agreement between the European Community and the Swiss Confederation on trade in agricultural products. Official Journal of the European Communities L 114, 132–349). Five surveillance scenarios based on two objectives were compared with the current surveillance programme. The definition of scenarios followed the assumptions that either the performance of the current surveillance programme was sufficient for the regulators or that the costs were acceptable. Consequently, the first outline was a surveillance programme that should cost less, while achieving the same sensitivity as the current

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surveillance programme, e.g. use the same sample size as the actual programme. For the second outline, the target was to increase sensitivity while using not more than the current costs, e.g. the costs were fixed. To achieve this, either the sample size or the sampling frequency was increased. From these two baseline outlines, five scenarios for the BTM surveillance programme were evaluated, representing different sample sizes, different sampling recurrence and different fluctuating costs. The first scenario «Milk 1» was based on the same sample size as the sampling programme from 2009. In this scenario, a total of 1'410 cattle farms had to be sampled once a year, 550 through blood samples with a total of 10'815 examined blood serum samples and 860 dairy farms through BTM samples. In the second scenario «Milk 2», an estimation of the costs of 100 additionally sampled dairy farms was made in order to evaluate the mean costs and sensitivity of additional BTM sampling. Thus the cost-effectiveness of an increase in the sample size could be evaluated. This approach for the estimation of extra costs for sampling of additional farms offers higher accuracy compared to just stating the cost inputs for an additional farm, as the general costs for the programme are here split among all farms. General costs include all the costs for planning, implementation and administration of the surveillance programme. For the «fixed costs» outline we observed that this would correspond to doubling the sample size. As it is easier to communicate, we choose this approach rather than keeping the costs exactly the same as in the actual programme. The third scenario «Milk 3» was based on the doubled sample size compared with the survey from 2009. The fourth scenario «Milk 4» based again on the same sample size of the Swiss disease surveillance from 2009, but samples were taken twice a year. This scenario would thus be able to detect a disease event earlier than annual surveys. The fifth scenario «Milk 5» contained the sampling of all dairy farms included in the milk-testing scheme once a year and actual sampling of blood samples. 27'131 BTM samples and 550 beef farms with a total of 10'815 blood serum samples had to be tested.

Bulk-tank milk diagnostic tests IBR and EBL

Diagnostic use of ELISAs on BTM samples is common for IBR and EBL (Klintevall et al., 1991; Hartman et al., 1997; Sargeant et al., 1997; Nylin et al., 2000; Stahl et al., 2002; Ridge and Galvin, 2005). After an enquiry with 13 laboratories in Europe, commercially IBR and EBL BTM ELISAs were identified on the market (Tab. 1).

Additional costs: Follow-up testing for non-negative bulk-tank milk samples

In the case of non-negative BTM test results, it was assumed that blood samples of every single animal from the farms would have to be collected and tested. To assess the potential proportion of non-negative BTM results per

sampling round, the data from the BTM surveillance programme of 2008 for IBR, EBL and brucellosis from the Austrian Agency for Health and Food Safety (AGES) were used. In this programme, BTM from all Austrian dairy farms were tested once a year. As Switzerland, Austria is also free of IBR and EBL, and therefore, the epidemiological situation is similar. In the Austrian surveillance programme, 0,25 % of the BTM samples were not negative for IBR and 0,15 % for EBL. Therefore, if the scenario «Milk 1» was implemented in Switzerland, approximately 3 BTM samples could be not negative for IBR and approximately 2 BTM samples for EBL per sampling round. For the scenario «Milk 5», a total of approximately 68 BTM samples could be not negative for IBR and approximately 41 BTM samples for EBL. For the additional costs of the follow-up testing for non-negative BTM samples, the steps «sampling» and «laboratory testing» were taken into consideration because these represent fix costs for the re-testing in the model and do not depend on each Cantonal Veterinary Office. In the Swiss disease surveillance programme of 2009, the average of the tested blood samples per farm was 20.2. In the calculation, it was assumed that at least 20 animals per non-negative farm were retested individually.

Calculation of programme's sensitivity

To compare the detection power of the different scenarios, the probability to detect the farm-level design prevalence of 0,2 % was calculated using the freeware «freecalc» (AusVet Animal Health Services, Toowoomba, Australia). The sensitivity and specificity of testing an individual farm was set at 99 % and 100 % irrespectively whether the farm was tested using individual blood samples or BTM. The calculation was done with a population size of 41'100 cattle farms (Swiss Federal Statistical Office).

Results

Costs, the number of samples and the archived confidence of freedom for the current surveillance programme as well as for the different BTM scenarios are summarised in the Tables 2 and 3. The mean total surveillance costs for the current surveillance programme for IBR and EBL with blood samples is 1'662'468 CHF for the year 2009. The majority of the expenditures was for the laboratory testing procedures – some 73,9 % of the total costs. For the scenario «Milk 1», the total costs of this surveillance programme for IBR and EBL including BTM samples were 853'445 CHF. With this scenario the costs were reduced to approximately half of the current costs. For the scenario «Milk 2», the total costs were 864'445 CHF. Thus, for 100 additional BTM samples, the additional costs were only 11'000 CHF. Scenario «Milk 3» remained less expensive than the current risk-based programme, despite doubling the sample size. For the scenario «Milk 4» the extra costs in

Table 1: Commercially available BHV-1 and EBLV ELISAs in 2009 - (ND = no data available).

Producer	Disease	Testskits		Sensitivity	Specificity
Bio-X Diagnostics, Jemmel, Belgium	IBR	Bio K 238	Blood serum, milk and bulk milk	ND	ND
Hipra , Amer, Spain	IBR	CIVTEST BOV IBR	Blood serum, milk and bulk milk	ND	ND
Ingenesa, Madrid, Spain	EBL	Ingezim BLV	Blood serum and milk	ND	ND
Idexx, Maine, United States	IBR	BHV-1 Tank milk	Milk and bulk milk up to 50 animals	100; 98	100; 94
		Idexx Leukosis Milk Screening Ab	Milk and bulk milk	> 99	99
	EBL	Pourquier ELISA Leucose lait	Milk and bulk milk	ND	ND
		Pourquier ELISA IBR-IPV sérum et lait	Blood serum, milk and bulk milk	ND	ND
LSI, Laboratoire Service International, Lissieu, France	IBR	LSIVET MILK IBR Screening	Milk and bulk milk up to 50 animals	ND	ND
Svanova, Uppsala, Sweden	IBR	Svanovir IBR -ab	Blood serum, milk and bulk milk	97.4; Milk vs. Serum: 92.8	92.4; Milk vs. Serum:100
	EBL	Svanovir BLV-gp51-Ab	Blood serum, milk and bulk milk	*Ridge and Galvin, 2005: 50.4; Nuotio et al., 2003: 100 %	Ridge and Galvin, 2005: 99.9; Nuotio et al., 2003: 93.4 %
Synbiotics, Lyon, France	EBL	Lactelisa BLV Ab Mono Indirect	Milk and bulk milk up to 50 animals	ND	ND
		Lactelisa BLV Ab Bi Indirect	Milk and bulk milk up to 50 animals	ND	ND
		Lactelisa BLV Ab Tank 250 Bi indirect	Milk and bulk milk up to 250 animals	Ridge and Galvin, 2005: 100	Ridge and Galvin, 2005: 99.6

*In the study of Ridge and Galvin, 2005, comparing two BTM ELISAs, the sensitivity of one of the BTM test showed a very low sensitivity of 50.4 %. This obviously does not represent the true evaluation of the sensitivity. The tests used in absence of a gold standard could not estimate the true sensitivity and specificity of both EBL ELISAs, due to the fact that the two assays being compared were not independent.

comparison to the blood serum surveillance programme were 44'422 CHF. For the scenario «Milk 5», the total costs were 3'743'255 CHF. The laboratory costs for the BTM represented the major cost factor in this programme. The total costs of a re-sampling and re-testing were at least 3'300 CHF for the less expensive scenario «Milk 1». The total costs of re-sampling and re-testing were 27'300 CHF for the most comprehensive scenario «Milk 5».

In the scenarios «Milk 3» and «Milk 5» the achieved confidence levels were higher than required 99 %. In the actual programme and the scenarios «Milk 1» and «Milk 4» the sample size are equal in each sampling round and consequently the achieved confidence is the same. The testing of 100 more samples increased the confidence by 1 % in scenario «Milk 2».

Discussion

This financial comparison made it possible to assess the savings generated by including BTM samples in the surveillance programmes. Either the costs were reduced by 50 %, without any major impact on the quality of the surveillance programme. Or when the costs were maintained, the sample size or sample recurrence were increased, resulting in a higher sensitivity of the surveillance programme. For the sample size calculation, the herd sensitivity in the current blood sampling surveillance programme was estimated to be 99 %. Given the data on sensitivity of BTM tests there is no indication of a substantial decrease in the herd sensitivity as a result of the implementation of these tests (Tab. 1). The sample size is therefore not affected by this change, allowing us to use the same sample size calculation for the milk scenarios as for the actual blood sampling. The actual programme fulfils the required confidence level of 99 % through the utilization of a risk-based sample size calculation (Hadorn et al., 2002; Schwermer et al., 2009). In this approach the actual achieved confidence in an annual survey is combined with the results of prior surveys and can thus be lower than the required confidence level. In contrast, in scenario «Milk 3» the required confidence

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Table 2: Summary of scenario designs for IBR/EBL-surveillance with different sample sizes and combinations of dairy and non-dairy farms.

Scenario	No. of bulk milk samples	No. of blood samples	Description
«Blood»	-	22,732	Actual programme; blood samples from dairy and non-dairy farms
«Milk 1»	860	10,815	Same sample size as actual programme; blood samples are only from non-dairy farms
«Milk 2»	860 + 100	10,815	«Milk 1» and 100 additional BTMS; blood samples are only from non-dairy farms
«Milk 3»	1,720	21,630	Double sample size as «Milk 1» for dairy and non-dairy farms
«Milk 4»	2 x 860	2 x 10,815	«Milk 1» twice a year for dairy and non-dairy farms
«Milk 5»	27,131	10,815	BTMS from all available dairy farms and blood samples from non-dairy farms as in «Milk 1»

Table 3: Summary of the surveillance scenario's sensitivity and costs: Detection probability refers to the probability to detect a farm level design prevalence of 0.2 % in the Swiss cattle population; General costs are all costs for planning, implementation and administration of the surveillance programme. The costs are in CHF. Percentages refer to the total costs of the surveillance programme. The costs per average farm are calculated by dividing the total costs by the number of farms sampled. * This detection probability refers to a interval of 6 months in contrast ta an interval of 12 months for the other scenarios.

Scenario	Detection probability	Total costs	Bulk-tank milk sampling & testing costs (%)	Blood sampling costs (%)	Blood testing costs (%)	General costs (%)	Costs per average farm
«Blood»	94,18 %	1'662'468		295'021 (17,8)	1'229'036 (73,9)	183'411 (8,3)	1179
«Milk 1»	94,18 %	853'445	95'520 (11,2)	122'072 (14,3)	494'838 (58)	141'015 (16,5)	605
«Milk 2»	95,26 %	864'445	106'520 (12,3)	122'072 (14,1)	494'838 (57,3)	141'015 (16,3)	572
«Milk 3»	99,69 %	1'528'040	190'120 (12,5)	232'652 (15,2)	964'252 (63,1)	141'015 (9,2)	541
«Milk 4»	94,18 % *	1'706'890	191'040 (11,2)	244'144 (14,3)	989'676 (58)	282'030 (16,5)	1211
«Milk 5»	> 99,99 %	3'743'255	2'985'330 (79,7)	122'072 (3,3)	494'838 (13,2)	141'015 (3,8)	134

is achieved in each sampling round. The added value in scenario «Milk 4» is not a higher confidence per sampling round, but the shorter time interval between the sampling rounds. By this, the programme is better suited for early detection purposes. In the scenario «Milk 5», the confidence as close to 100 %, that it is out of the calculation power of the software used. In consequence, this scenario would provide the highest probability of freedom of all scenarios. However, as in this scenario a large part of the cattle farms are out of the sampling frame, the sample is not representative for the Swiss cattle population.

The factors representing the major costs in the scenarios were identified. These costs were related to herds not participating in the milk inspection scheme due to the costs of blood sampling of individual animals and testing of individual blood samples. Several possibilities are conceivable to reduce these costs, such as the pooling of blood samples, the sampling in slaughterhouses or the risk-based selection of farms for the sampling. Minor extra labour could be expected in the step «planning» of the surveillance programme for separating dairy farms, which can be tested through BTM samples, from beef farms, which still have to be tested through blood samples. In Switzerland, the TVD and the Information Database of the Swiss Veterinarian Authorities (ISVet) provide an excellent basis for conducting this classification more easily. In contrast, utilising additional BTM samples is rather inexpensive, as scenario «Milk 2» shows. Thus BTM samples also provide a quick and inexpensive means to modify the surveillance programme if requirements change, for example if testing of all dairy farms in a certain region in the case of a disease outbreak is required. By the sampling of all Swiss dairy farms – scenario «Milk 5» – the costs of the laboratory testing for the BTM samples represented the major cost factor of the surveillance programme. However, a reduction of the costs per BTM ELISA in the laboratories can be expected if the test is introduced on a routine basis.

The limitations of BTM samples also need to be considered. BTM samples only represent the cows delivering milk to the bulk-tank on the day of sampling, excluding dry cows, diseased cows, cows in the colostral period and other non-milking cattle. In each scenario, this problem was addressed by collecting and testing two BTM samples in a

minimal interval of three months. It was expected, that a second round of sampling would be sufficient to compensate this effect, as the dry period is on average 2 months and diseased cows should have recovered or have been culled in that time. The BTM diagnostic tools are sensitive to the number of pooled milk samples contained in the bulk-tank, the number of shedding cows and to the concentration of antibodies. The average acceptable maximal dilution for an ELISA for BTM seems to be < 50 animals in one bulk-tank sample, depending on the ELISA, as well as on the disease and the manufacturer. In an Australian study of a comparison of two ELISAs for detecting EBL, one of the ELISAs failed to detect EBL antibodies by a dilution of 1 in 40, whereas the comparable value for the other ELISA was 1 in 200 (Ridge and Galvin, 2005). By means of a dilution trial from a Danish study, a BTM BHV-1 blocking ELISA detected 75 % of the herds as BHV-1 seropositive with one out of ten cows being seropositive, but only up to 25 % of the herds with one cow being seropositive out of > 60 cows (Nylin et al., 2000). Switzerland has favourable conditions because of its small cattle herd size. The average number of cows in dairy farms in 2009 was 21.3. Additionally, only 2,9 % of dairy herds in Switzerland consist of more than 50, which means that 97,1 % of all Swiss dairy herds could be included in the BTM sampling surveillance programme and could be tested under optimal testing conditions. If the herd prevalence is low and the dilution is high, there will be a possible risk that a positive herd can remain undiscovered while the disease has already spread (Frankena et al., 1997; Nylin et al., 2000). A second round of sampling is also a valuable tool to detect this spread more quickly and also to detect false-negative herds with a recent infection history and which had tested negative in the first round of sampling (Houe et al., 2006). In Switzerland, a trend towards a decrease of dairy farm numbers with a simultaneous increase of respective herd size is currently observed. These general conditions therefore need to be monitored, and the surveillance programme should be adjusted when needed.

Conclusion

BTM sampling is a cost-effective method for cattle disease surveillance. The FVO is therefore organising a BTM pilot survey for the surveillance of IBR and EBL and foresees the implementation of BTM sampling in future surveillance programmes. The utilization of BTM samples also increases the flexibility of the surveillance programmes to changing needs, for example increased surveillance intensity in case of disease events or increase in the early detection capabilities of the survey design.

Acknowledgements

Efficacité économique des programmes de surveillance utilisant des échantillons de lait de citerne pour démontrer l'absence de rhino trachéite infectieuse bovine et de leucose enzootique bovine en Suisse

En Suisse, l'absence de rhinotrachéite bovine (IBR) et de leucose enzootique bovine (EBL) est démontrée par l'examen annuel d'échantillon sanguin d'animaux individuels choisi au hasard. Contrairement à plusieurs pays européens, les échantillons de lait de citerne ne sont plus utilisés depuis de nombreuses années dans la surveillance actives des épizooties. Le but de ce projet était une comparaison financière entre les programmes de surveillance actuels au moyen d'échantillons sanguins et un programme de surveillance modifié comprenant des échantillons de lait de citerne, ceci afin d'estimer les économies possibles. Un modèle de tableur financier a été utilisé pour comparer les coûts. On a développé des scénarios avec diverses

Ottimizzazione dei costi dei programmi di sorveglianza con l'uso di campioni di latte da cisterna per dimostrare l'assenza di rinotracheite infettiva bovina e leucosi bovina enzootica in Svizzera

In Svizzera, l'assenza di rinotracheite infettiva bovina (IBR) e di leucosi bovina enzootica (EBL) viene dimostrata tramite un esame annuale di campioni di sangue di singoli animali provenienti da un campione casualizzato. A differenza di molti paesi europei, l'uso di campioni di latte da cisterna non si utilizza più da diversi anni per la sorveglianza attiva delle malattie negli animali. L'obiettivo di questo progetto è di fare un confronto finanziario tra l'odierno programma di monitoraggio che utilizza campioni di sangue e un programma di monitoraggio modificato che include campioni di latte da cisterna al fine di stimare i risparmi sui costi. Un modello di calcolo finanziario è stato utilizzato per il confronto dei costi. Sono stati svilup-

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quantités et fréquences d'échantillonnages. Les coûts pourraient être diminués de moitié sans diminution de la qualité de programme de surveillance. De même, la sensibilité du programme pourrait être nettement augmentée en maintenant les cout actuels et en doublant le nombre d'échantillons. Les échantillons du programme actuels, basé sur le risque, atteignent un niveau de confiance de 94,18 % avec une prévalence désignée de 0,2 % de troupeaux affectés. En doublant le nombre d'échantillon ce niveau de confiance atteint 99,69 %.

pati scenari con differenti dimensioni e frequenze del campione. I costi potrebbero essere dimezzati senza deterioramento della qualità del programma di sorveglianza per dimostrare l'assenza IBR e EBL. Allo stesso modo, la sensibilità del programma potrebbe essere aumentata in modo evidente, pur mantenendo i costi attuali ma raddoppiando la dimensione del campione. Il campione, calcolato in base al rischio, del programma corrente ha raggiunto un livello di affidabilità del 94,18 % con una prevalenza dello 0,2 % degli allevamenti infettati. Raddoppiando la dimensione del campione, il livello di affidabilità è del 99,69 %.

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