Comparing algorithms performance for monitoring endemic disease: a simulation study based on the Danish PRRSV monitoring program

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Dynamics of porcine reproductive and respiratory syndrome virus assessed by an oral fluid commercial PRRSV antibody enzyme-linked immunosorbent assay

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Introduction: Porcine reproductive and respiratory syndrome virus (PRRSV) is a major threat to the swine industry due to its financial cost. Pen-based oral fluid (OF) sampling provides an efficient monitoring method of the dynamics of PRRSV in swine populations, thus allowing the development of effective control, and/or elimination strategies.
Materials and Methods: A 10,000 PRRSV naïve-vaccinated sow farm located in Mexico, was infected with a wild type strain of PRRS in November of 2013. Infection with PRRSV was confirmed by clinical signs, PRRSV real-time quantitative reverse transcription polymerase chain reaction (qRT-PCR), and sequencing, yielding a 1-26-2 RFLP cut pattern. A herd stabilization plan was established, i.e. sow herd mass vaccination (2X) with a modified live vaccine (MLV), nursery depopulation, and vaccination of all gilts present in the gilt development units (GDU). When herd stabilization was confirmed, as measure by the absence of clinical signs and weaning of PRRSV PCR negative gilts, a surveillance program was established using oral fluids. The IDEXX PRRS OF Ab test (IDEXX Laboratories, Inc., Westport, ME.), and qRT-PCR PRRS were used, since gilts were vaccinated at weaning. As PRRSV negative gilts populated the nursery, the same two pens per group were sampled every week from 4 weeks of age to one week before farrowing. A longer farm closure period was achieved by inseminating and gestating gilts in GDU2.
Results: During the first 40 weeks, samples tested by qRT-PCR were positive to vaccine virus (2-5-2 RFLP pattern) in gilts from 4 to 10, and 20 to 22 (re-vaccination) weeks of age. Thereafter, samples became and remained negative to PRRSV. ELISA results expressed as sample/positive (S/P) ratios were positive in gilts from 4 to 40 weeks of age, ranging from 0.6 to 3.5, with the youngest animals showing the highest S/P ratios and decreasing after 10 weeks of age. On week 40, two weeks before the new gilts farrowed, S/P ratios in OF samples increased, ranging from 2.5 to 7.3 in gilts of 22-28 weeks of age. The presence of the original PRRSV wild type virus, 1-26-2 RFLP pattern with 99% homology, was confirmed by qRT-PCR of the same OF samples.
Conclusion: Oral fluids antibody monitoring offers a stress-free and cost effective PRRSV surveillance tool, allowing immediate detection of PRRS excretion in a subpopulation(s) within a farm. Therefore, control actions can promptly be established to decrease production and economic losses. Possible reasons for this event include a non-detected PRRSV persistently infected subpopulation in conjunction with depleted immunity against the PRRSV wild type strain, and/or a biosecurity break and/or aerosol lateral contamination.

Disclosure of Interest: None Declared

Keywords: PRRS, diagnostic, oral fluid, serum, ELISA

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Comparing algorithms performance for monitoring endemic disease: a simulation study based on the Danish PRRSV monitoring program

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Introduction: Surveillance systems are critical for accurate and timely monitoring and effective disease control. The use of statistical quality control methods for monitoring endemic diseases which are part of compulsory surveillance programs has not been previously explored. It is important to monitor changes of for instance disease prevalence, which might indicate disease spread. Thus allowing control efforts to be triggered immediately.
Materials and Methods: In this study, we investigated the performance of three univariate process monitoring control algorithms with the aim of building a monitoring system that can detect changes in the proportion of positive herds for endemic diseases in an accurate and timely way. Additionally, the effect of the sample size (or magnitude of the surveillance system) in the algorithm performance was also assessed. The Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) monitoring program in Danish breeding herds was used as model to design this study.
Three algorithms commonly used for biosurveillance were compared: Shewart P chart (PSHEW), cumulative sum (CUSUM) and exponentially weighted moving average (EWMA). In order to simulate a baseline scenario, the weekly number of positive herds was obtained from a binomial distribution with a probability (p) of 0.1 and a sample size equal to the actual number of Danish breeding herds tested for PRRSV each week from 2007 to 2014. Increases of the number of positive herds were simulated for changes in the prevalence from p=0.1 to p= 0.15 and p= 0.20 during 4, 8, 24, 52 and 104 weeks. Thereafter, the performance of the algorithms was compared by examining their detection capability under the different scenarios.
Results: The results showed that EWMA and PSHEW had higher cumulative sensitivity (CumSe) when compared with the CUSUM. Changes from 0.10 to 0.20 in sero-prevalence were easier detected (higher CumSe) when compared with changes from 0.10 to 0.15 for all three algorithms. EWMA and PSHEW detected changed showed similar results based on the median time to detection. CUSUM detected changes in the sero-prevalence later compared to EWMA and PSHEW for the different scenarios. Increasing the sample size 10 times resulted in half time to guarantee detection (CumSe=1), whereas 100 times sampled sized reduced the time to CumSe=1 by a factor of 6.
Conclusion: In summary, we showed that small changes in diseases sero-prevalence can be detected by using these algorithms. Increasing the sample size provides a faster detection for PRRS. However, the associated costs of increasing the number of herds tested and the disease should to be taken into account when making a decision.

Disclosure of Interest: None Declared

Keywords: Disease monitoring, Endemic, Univariate process monitoring control algorithms