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Surveillance system sensitivities and probability of freedom from *Mycobacterium avium* subsp. *paratuberculosis* infection in Swedish cattle

Jenny Frössling[a,b,*], Helene Wahlström[a], Estelle Carina Constance Ågren[a], Angus Cameron[c], Ann Lindberg[a], Susanna Sternberg Lewerin[a,d]

[a] *Department of Disease Control and Epidemiology, National Veterinary Institute, SE-751 89 Uppsala, Sweden*
[b] *Department of Animal Environment and Health, Swedish University of Agricultural Sciences, P.O. Box 234, SE-532 23 Skara, Sweden*
[c] *AusVet Animal Health Services, 140 Falls Road, Wentworth Falls, NSW 2782, Australia*
[d] *Department of Biomedical Sciences and Veterinary Public Health, Swedish University of Agricultural Sciences, P.O. Box 7028, SE-750 07 Uppsala, Sweden*

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ABSTRACT

Previous investigations suggest that the prevalence of *Mycobacterium avium* subsp. *paratuberculosis* (MAP) in Swedish cattle is low and all recent cases have been linked to imported animals. The aim of this study was to evaluate the surveillance system for MAP infection in Swedish cattle and to estimate the probability that the Swedish cattle population is free from this infection. Calculations of surveillance sensitivities and probability of freedom were made using stochastic scenario-tree modelling, which allows inclusion of information from several different sources, of complex surveillance data including results from non-representative sampling, as well as of documentations of differences in risk of being infected. The surveillance components included in the model were: (1) clinical surveillance, (2) fallen stock investigations, (3) the national surveillance programme (mainly beef herds), (4) a survey involving dairy herds and (5) a risk-based survey targeting herds with imported cattle. Previous or current presence of imported animals and participation in the on-going control programme was specified for each tested herd, in order to adjust for differences in risk. Calculations were made for each year from the start of 2005 to the end of 2008, and this formed the basis for a final estimate covering the whole study period and predictions of future probabilities of freedom from MAP. Results show that when applying a design prevalence of one animal in 0.1% of the herds, the probability of freedom at the end of 2008 was 0.63. At the design prevalence of one animal in 0.5% of herds, the estimated probability is >95% and it is demonstrated that the prevalence of MAP in Swedish cattle is below this level or absent. In order to increase the annual surveillance sensitivity in the future and thereby improve the probability of freedom, new surveillance activities or an intensification of current ones are needed.

1. Introduction

Paratuberculosis, or Johne's Disease, is an infectious and chronic disease which has been demonstrated in cattle and in a few other species of animals, mainly ruminants (Collins, 2003; Nielsen and Toft, 2009). It is present worldwide and is caused by *Mycobacterium avium*

* Corresponding author at: Department of Disease Control and Epidemiology, National Veterinary Institute, SVA, SE-751 89 Uppsala, Sweden. Tel.: +46 18 674359; fax: +46 18 674445.
E-mail address: jenny.frossling@sva.se (J. Frössling).

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subsp. *paratuberculosis* (MAP). The infection has substantial impact on animal health and is estimated to cause significant economic losses in animal production (Dufour et al., 2004; Groenendaal and Galligan, 2003; Kudahl and Nielsen, 2009; Pillars et al., 2009; Tiwari et al., 2008). Due to the slow progress of this disease and limited diagnostic sensitivity, particularly in subclinical cases where shedding is limited or intermittent, MAP infection is considered difficult to monitor and control (Behr and Collins, 2010).

In Sweden, MAP infection has been included in the Swedish Epizootic Act (SFS 1999:657) since 1952. According to this legislation, notification and investigation of clinical suspicions are mandatory in all species and eradication measures (including whole-herd depopulation) are taken upon detection. Paratuberculosis was not detected in Sweden for several decades until 1993 when MAP was confirmed in an imported beef cow. Trace back and trace forward investigations identified 53 infected herds; all were beef herds and most had imported individuals or had a connection to herds with imported individuals (Viske et al., 1996; Sternberg Lewerin et al., 2007). All of these herds were depopulated and since then, several additional activities have been undertaken for the surveillance and control of MAP infections in Sweden (Engvall et al., 1994; Viske et al., 1996; Sternberg and Viske, 2003; Sternberg Lewerin et al., 2007). The purpose has been to eradicate MAP from the cattle population. The results indicate that implemented strategies have been successful. The last case of MAP in Sweden was in 2004 when an imported bull was sampled and detected through surveillance by necropsy of fallen stock. In order to evaluate the current probability of freedom, and to estimate the contribution of the different surveillance components, a complete investigation of the whole surveillance system regarding MAP infection in cattle is needed. For paratuberculosis, which is a slowly progressing disease, it is also important that this type of evaluation takes into account surveillance data from previous years.

The aim of the present study was to evaluate the surveillance system regarding MAP in Swedish cattle, to quantify the contribution from different surveillance components and to estimate the probability that Swedish cattle are free from MAP infection. The aim was further to compare different surveillance strategies and to identify potential improvements in the ability of the system to detect infected animals.

2. Material and methods

This study is based on information from surveillance activities as regards MAP in Swedish cattle ≥2 years of age, during the time period 1st of January 2005 (i.e. the first year after the most recent case of MAP was sampled) to 31st of December 2008 (data retrieval for this study was performed in 2009). Calculations of surveillance sensitivities and probability of freedom from MAP infection were performed on data from each year separately and the probability of freedom at the end of the whole study period was

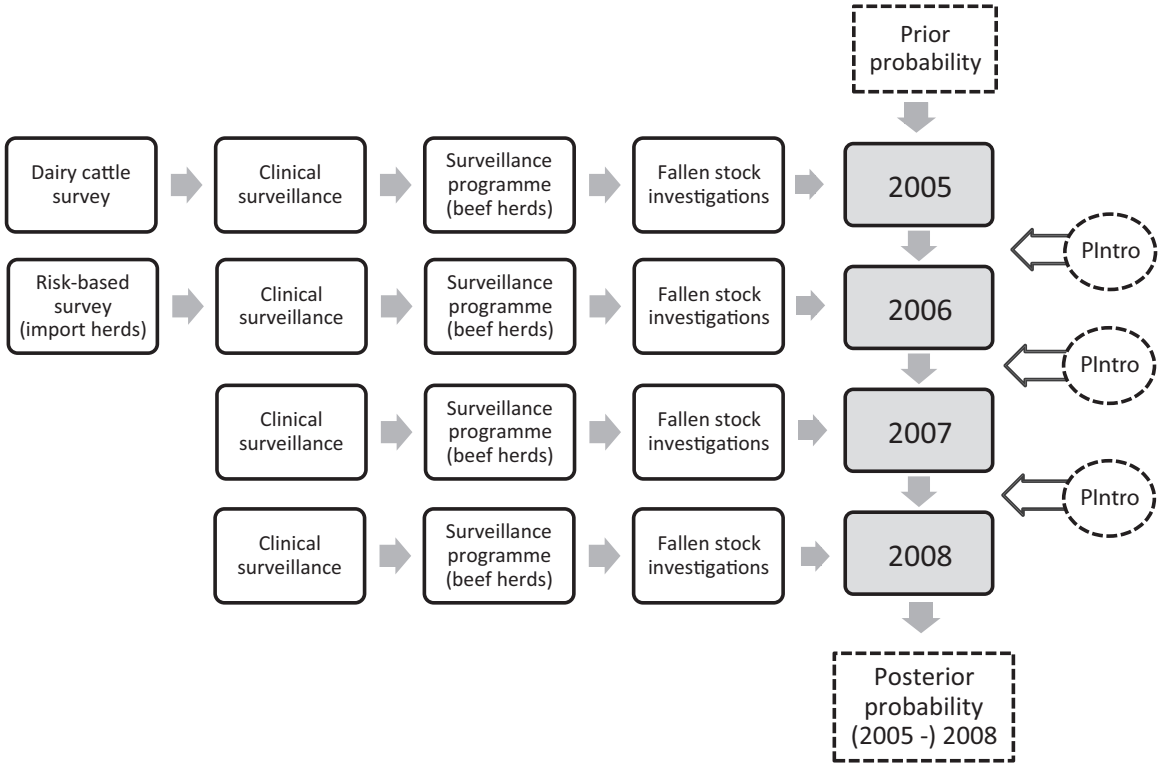

Fig. 1. Schematic layout of a scenario-tree model used to evaluate the surveillance system for *Mycobacterium avium* subsp. *paratuberculosis* infection in Swedish cattle. Three or four components were identified to contribute to the total surveillance sensitivity of each year 2005–2008. Probability of freedom was estimated considering surveillance activities also from previous years and the annual probability of introduction (*PIntro*).