Designing a risk-based surveillance program for paratuberculosis in Norwegian dairy cattle

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INTRODUCTION

The prevalence of *Mycobacterium avium* subsp. *paratuberculosis* (MAP) in cattle in Norway is assumed to be low since MAP has only been diagnosed in 10 cattle herds since the surveillance program started in 1996 (Kampen et al., 2010). All these MAP cases have been attributed to one of two reasons; either through imported cattle (seven cattle herds) or through contact with MAP-infected goats (three cattle herds). The current surveillance program for MAP in cattle consists of both active and passive surveillance. The selection criteria used in the current surveillance program are shown in Table 1. The number of selected cattle herds are presented in Figure 1.

The aim of this study was to design a risk-based surveillance program for MAP in dairy herds. This was performed by defining risk indicators for MAP and use them in a multivariate statistical process control model to identify herds that are assumed to have a higher probability of having or achieving MAP infection.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Imported cattle after 1991	x	x														
Contact with imported cattle after 1991	x	x														
Imported cattle before 1991			x	x												
Older cattle			x	x		x										
Combined cattle and goat herds			x	x						x		x				
Areas with registered MAP in goats												x			x	x
Areas with earlier confirmed MAP in cattle			x	x												
Random sampling of dairy herds				x			x	x	x	x	x		x			
Random sampling of suckler beef cattle				x			x	x	x	x	x		x			
Continuing surveillance in serological positive herds				x	x	x	x	x	x							
Cattle with clinical symptoms of MAP					x	x	x	x	x	x	x	x	x	x	x	x
Cattle herds with MAP restrictions		x	x	x			x	x	x	x	x	x	x	x	x	x

Table 1. The selection criteria used in the Norwegian surveillance program for *Mycobacterium avium* subsp. *paratuberculosis* in cattle during 1996-2011

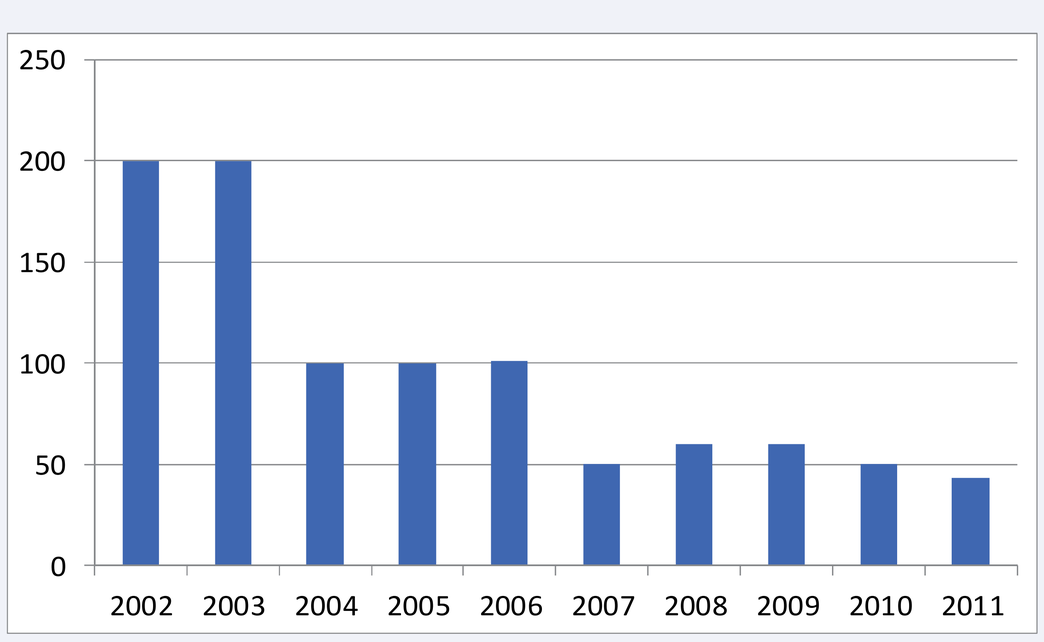

Figure 1. Number of selected cattle herds in the Norwegian surveillance program for *Mycobacterium avium* subsp. *paratuberculosis* in Norway 2002 – 2011

MATERIALS AND METHODS

- Data extracted from the Norwegian Dairy Herd Recording System:
  - Approximately 3 million cattle
  - 10 717 dairy herds
  - Study period from 1st of January 2002 to 31st of December 2011
- Other official registers were used to obtain information on geographical coordinates for farms and animal production type
- The included risk indicators were:
  - Risk factors:
    - Purchasing
    - Common housing cattle/goat
    - Geographical localization of the cattle herd with regards to caprine MAP-vaccinated counties
  - Production losses (weighted with cow-years) :
    - Culling of animals >3 years
    - Decreased milk production in 3rd, 4th and 5th lactation
    - Weight loss of carcasses >3 years
    - Diarrhoea/gastritis in animals >3 years
- Multivariate Statistical Process Control (MSPC) analysis was applied.
  - MSPC is the multivariate counterpart of statistical process control which was initially used to monitor different industrial processes (Shewhart, 1931)
  - The MSPC analysis combine the risk indicators and a quantitative risk measure for each herd by applying Hotelling's T^2 statistic (Hotelling, 1931)

RESULTS AND CONCLUSION

- Hotelling's T^2 values were calculated for each herd
- The herds were ranked according to the Hotelling's T^2 values
- Herds with the highest Hotelling's T^2 values were assumed to have a higher probability of having or achieving a MAP infection
- The 25 highest ranked herds were included in the surveillance program:
  - Geographical spread of the top 25 herds from the South- to Mid-Norway
  - Located both in counties with and without caprine MAP-vaccination
- The procedure may be adapted for early detection of infectious diseases, but it is important to be aware of underreporting of variables

REFERENCES

Hotelling, H., 1931. The generalization of student's ratio. Ann. Math. Stat. 2 (3), 360 – 378

Kampen, A., Djønne, B., Hopp, P., 2011. Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2010. Norwegian Veterinary Institute, Ch. The surveillance and control programme for paratuberculosis in Norway.

Shewhart, W. A., 1931. Economic control of quality of manufactured 236 product. New York: D. Van Nostrand Company, Inc, New York.