Finnish Food Safety Authority Evira

Genetic disease susceptibility and surveillance system sensitivity: classical scrapie

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Susceptibility of sheep to classical scrapie (CS) is modulated by the PrP gene and can be grouped into five NSP Types, NSP I being most resistant and NSP V most susceptible. Surveillance is targeted on fallen stock (FS), i.e. dead or culled over 18-month-old animals. Testing of animals slaughtered for human consumption (SHC) is limited. Our aim was to assess the effect of genetic susceptibility on the surveillance system sensitivity (SSe) in Finland in 2008-2014. The SSe is the probability that at least one infected animal is detected if the population is infected at or above the design prevalence (P*). We estimated the SSe by scenario tree modelling. To account for variability and uncertainty, we fitted distributions to key parameters and applied Monte Carlo simulation for the estimation of the results.

Scenario tree model

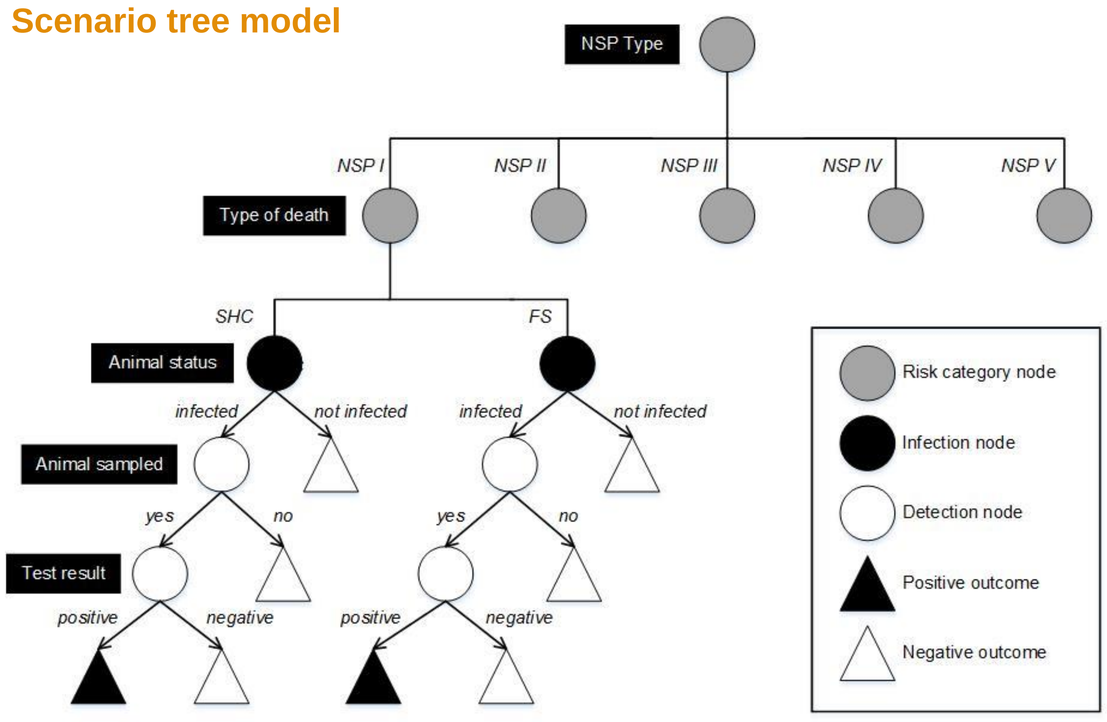


Figure 1. Scenario tree model. Only two branches of ten are presented; assume others to be structurally identical.

Scenario tree nodes and parameters

NSP Type: NSP Type distribution of sheep in Finland based on breed PrP genotypes and breed distribution of national flock (figure 2).

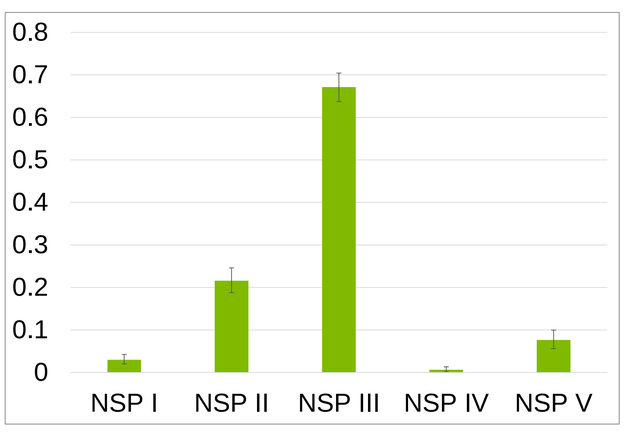


Figure 2. Population proportions of NSP Types in Finland (based on Hautaniemi et al. 2012 and the sheep and goat registry). Error bars represent the 95% confidence interval.

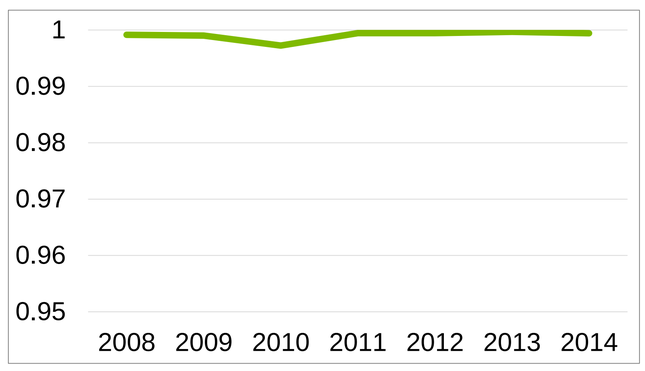
Type of death: True SHC and FS population proportions
Animal status: Effective probability of infection (EPI) = adjusted risk (AR) x (P*) where AR is based on the estimated risk ratio (RR) of different NSP Types against the average risk in SHC in Great Britain (GB) (Arnold and Ortiz-Pelaez 2014) and adjusted for the NSP Type distribution in Finland. The design prevalence P* = 0.1% based on the OIE Terrestrial Animal Health Code.
Animal sampled: Actual sampling numbers
Test result: Actual test results

Results

Risk calculations were based on data from GB (Arnold & Ortiz-Pelaez 2014) where cases were concentrated to FS giving high risk ratios in FS and susceptible NSP Types. When adjusted for Finland, the adjusted risk was highest for NSP V in FS.

The SSe for Finland showed very little fluctuation in 2008-2014 (figure 3). Even at its lowest point in 2010, the mean was 99.72%. The representative SSe for the same year, i.e. without considering NSP Types and the added sensitivity in focusing the surveillance on FS, was clearly an underestimation: 60.80%.

Figure 3. Mean surveillance system sensitivity SSe between 2008 and 2014. 10 000 iterations were performed.



Conclusions

- **The Finnish sheep population is relatively sensitive to CS.**
- **Consideration of NSP Types increases the accuracy of the SSe.**
- **Genetic susceptibility factors can be of great value when developing/assessing surveillance.**

References:

Arnold, M., Ortiz-Pelaez, A., 2014. The evolution of the prevalence of classical scrapie in sheep in Great Britain using surveillance data between 2005 and 2012. Prev. Vet. Med. 117, 242–250.

Hautaniemi, M., Tapiovaara, H., Korpenfelt, S-L., Liisa Sihvonen, L., 2012. Genotyping and surveillance for scrapie in Finnish sheep. BMC Veterinary Research 8, 122-128.

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