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A model (BSurvE) for evaluating national surveillance programs for bovine spongiform encephalopathy

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Abstract

Our BSurvE spreadsheet model estimates the BSE prevalence in a national cattle population, and can be used to evaluate and compare alternative strategies for a national surveillance program. Each individual surveillance test has a point value (based on demographic and epidemiological information) that reflects the likelihood of detecting BSE in an animal of a given age leaving the population via the stated surveillance stream. A target sum point value for the country is calculated according to a user-defined design prevalence and confidence level, the number of cases detected in animals born after the selected starting date and the national adult-herd size. Surveillance tests carried out on different sub-populations of animals are ranked according to the number of points gained per unit cost, and the results can be used in designing alternative surveillance programs.

Keywords: BSE; Bovine spongiform encephalopathy; Cattle; Epidemiology; Point system; Prevalence estimation; Resource allocation; Surveillance

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1. Introduction

The intensity and pattern of BSE surveillance testing varies greatly between countries and until recently there has been no standard method of evaluating such surveillance programs. The World Organisation for Animal Health (OIE) provides guidelines for BSE surveillance, which were initially based on the results of passive clinical surveillance for BSE in Great Britain (World Organisation for Animal Health, 2004). Standards were revised to take into account the findings of the initial active surveillance of fallen stock in Switzerland, which revealed a greater prevalence of BSE than that estimated from clinical surveillance (Doherr et al., 1999). Between May 1999 and April 2000, a targeted screening program in Switzerland showed the odds of detecting a case of BSE in fallen stock was 49-times higher compared to detection via mandatory reporting of clinical suspects (passive surveillance); in emergency-slaughter stock the odds were 58-times higher (Doherr et al., 2001).

The 2004 OIE guidelines required testing a minimum number of cattle showing clinical signs consistent with BSE, with the number adjusted according to the size of the cattle population >30 months of age. Article 3.8.4.2 of the Animal Health Code 2004 (OIE) stated that the minimum numbers of animals to test were a 'subjective interpretation' rather than statistically derived, due to the non-randomness of sampling animals exhibiting clinical signs. Cattle can be considered to leave the national herd via one of four 'surveillance streams': clinical suspects (animals reported as showing neurological signs that might have been due to BSE), fallen stock (animals which died on farm), casualty slaughter (animals that are injured or abnormal but eligible for slaughter under special restrictions), or healthy slaughter (healthy cattle slaughtered for human consumption). If insufficient numbers of clinically affected animals were available, cattle showing clinical signs that were not necessarily those of BSE should be tested. This sub-population included fallen stock and casualty slaughter cattle. Healthy-slaughter animals were used to make up any shortfall in a country with insufficient numbers in the above two categories. A surveillance program based exclusively on random sampling from healthy-slaughter animals was not recommended but permitted if sufficient numbers are tested to detect infection at a prevalence of less than one case in 1 million animals. Even if the assumption was made that each infected animal would test positive, this would require sampling of >2.2 million animals to achieve 95% confidence of detecting one of five infected animals in a population of 5 million adult cattle. These requirements addressed a range of situations in different countries, but did not provide a way to demonstrate the prevalence of infection or allow uncomplicated comparison between countries.

The development of rapid screening tests for BSE and the evaluation of the first three tests by the European Commission (Moynagh and Schimmel, 1999) led to the widespread use of these screening tests in the European Union (EU) countries in 1999 and in other countries at the end of 2000. Within the EU, compulsory large-scale surveillance for BSE in all Member States began in July 2001 (Regulation (EC) No. 999/2001 of the European Parliament). According to current EU regulations most member countries are required to test all animals showing clinical signs, all healthy-slaughter stock >30 months of age and all fallen stock and casualty slaughter animals >24 months old at the time of death. As a result, ~11 million cattle per year are tested within the EU (European Commission, 2004).