Standards for reporting surveillance information in freedom from infection modeling by example of *T. spiralis* in Canadian swine

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Background

The Atlantic Veterinary College (AVC) at the University of Prince Edward Island, the Canadian Food Inspection Agency (CFIA), and the Canadian Swine Health Board (CSHB) are collaborating to confirm the absence of infection with *Trichinella spiralis* in Canadian commercial swine.

We use scenario tree models that combine historical and current *T. spiralis* surveillance data from different sources to estimate the probability of freedom from disease. Scenario tree modeling has become an established methodology and is well described in the literature [1,2]; however, standards for organizing and reporting the surveillance information incorporated into such models are less developed.

Organizing Surveillance Information

Based on our work on *T. spiralis*, we propose that information in surveillance models be organized in distinct categories, each with specific parameters and values that are thoroughly described and justified. The proposed categories are: 1) Definitions for Objectives, 2) Starting Point, 3) Inputs, 4) Data, and 5) Outputs.

The schematic of the processes involved with the well established scenario tree model (Fig. 1) shows the break down of the information needed to form the various model parameters and how they relate with each other to determine the model outcome. Each category will be presented with an example from our model to detect the presence of *Trichinella spiralis* in Canadian commercial swine (referred to as the *Trichinella* model).

1) Definitions for Objectives

To clearly state the objectives of the surveillance activities, four definitions must be provided: (1) the criteria which qualify a positive case (case definition), (2) reference population(s), (3) the duration of a time period (TP), and (4) the acceptable low level of disease (design prevalence(s), denoted as P*).

For the *Trichinella* model, a positive case was defined as having detected at least one *Trichinella* larva in a meat sample from a pig. The reference population included all domestic swine shipped to slaughter at federally inspected slaughter plants in Canada. This reference population was in fact split into two sub-populations, one for hogs and one for sows, since the OIE had different design prevalences for hogs (market pigs) and sows (breeders, including boars). For *T. spiralis*, the international standards for trade with animals and animal products are set by the OIE. In 2010, the acceptable threshold level (design prevalence) for sows was set at 0.0002 (1/5000 sows) and for hogs at 0.0001 (1/10,000 hogs) [3]. The TP was set to one year, the same as in the reported literature for similar *Trichinella spp.* surveillance models [4,5,6]. For simplicity, only the market hogs are included in this example.

2) Starting Point

The starting point includes the date of the last confirmed case (determined by the case definition) and we set the initial probability of freedom at 50%.

The *Trichinella* model starts in 1997 which also coincided with the routine digestion assay testing that began in 1998.

3) Inputs

All parameters with uncertainties are categorized as inputs for the model. These parameters are usually specific for the model, such as the diagnostic sensitivities for the tests used in the surveillance activity. The probability of introduction of the disease at the level of the design prevalence during the time period [Pr(Intro)] is also included as an input. The inputs for the *Trichinella* model for market hogs consist of: 1) the diagnostic sensitivity for the digestion assay, and 2) the annual probability that *Trichinella* is introduced at the level of the P*. Both inputs were assumed to follow a PERT distribution with parameters for the diagnostic sensitivity of the digestion assay at 0.40, 0.75, and the annual probability of introduction at 0.001, 0.03, and 0.07 for the lowest, most likely and highest possible values, respectively.

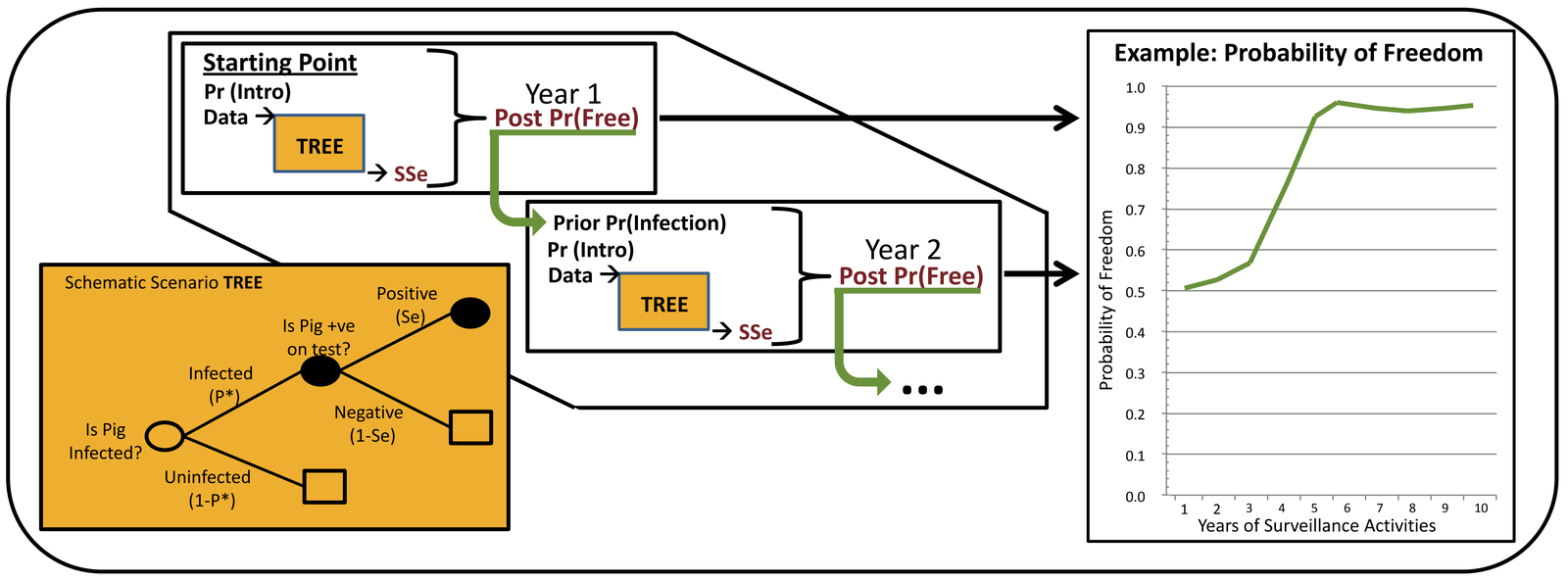

Figure 1. Schematic of the information required for the *Trichinella* model parameters.

4) Data

We consider all hard data that are collected during a surveillance activity as 'data'. This distinguishes data from inputs, with the latter containing uncertainties. Specifically, data refers to the number of animals tested in a TP, and the animals' associated information such as their risk characteristics (if risk nodes are included), their farm of origin (if disease is assumed to cluster within farms), and the test used on the sample(s) from the animal. Surveillance data collected for the duration of the year is entered into a scenario tree (Fig. 1) and a System Sensitivity (SSe) is estimated for each year. The *Trichinella* model surveillance data was provided by the CFIA, through the CanSwineSurv programme. A summary of the digestion assay testing, for market hogs from 1997 onward, is provided in Table 1.

5) Outputs

The SSe is the output from the scenario tree (Fig. 1), and it is the probability that the surveillance system found the pathogen in that time period (given the infection is present at P* or greater) with the number of animals tested. The most important output is the posterior probability that the population is free from infection [Post Pr(Free)] at the end of a TP, given that the pathogen was present in the population at least at the level of the design prevalence. The posterior probabilities of freedom for the *Trichinella* model are provided graphically in Fig. 2.

Table 1. Surveillance data for the *Trichinella* model.

Year	Hogs (n) Digestion Assay
1997	0
1998	28,000
1999	30,541
2000	26,268
2001	32,656
2002	29,044
2003	28,754
2004	29,941
2005	27,888
2006	29,001
2007	28,610
2008	28,458
2009	27,913
2010	28,376
2011	31,282

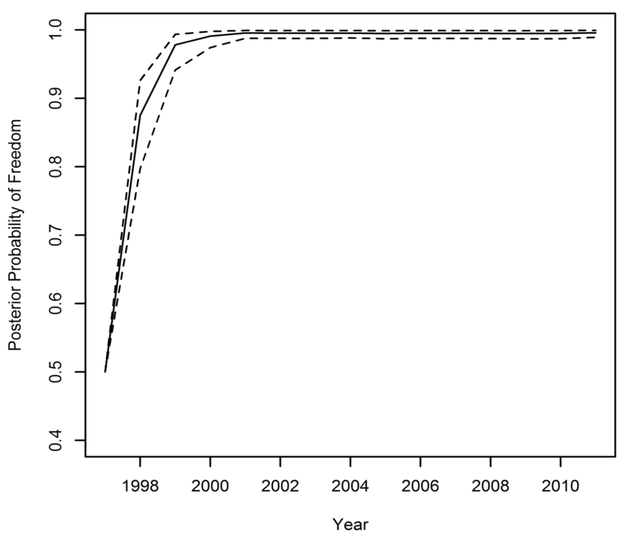

Figure 2. The annual mean posterior probabilities of freedom for market hogs with their associated 95% probability interval (dotted lines) derived from the stochastic simulation (10,000 iterations).

Conclusions

A standardized manner of reporting surveillance information in freedom from infection models, using scenario trees, will facilitate their validation and expedite their evaluation by experts in the field. The surveillance information for this Canadian *Trichinella* model was presented and reported in an organized and transparent framework.

The *Trichinella* model indicated that the ongoing surveillance activities for the market hogs were sufficient to maintain a high probability of freedom.

References : **1)** Martin, P.A. *et al*.: 2007, Prev Vet Med 79:71-97; **2)** Martin, P.A. *et al*.: 2007, Prev Vet Med 79:98-115; **3)** OIE: 2010, Terrestrial Animal Health Code, 19th Edition. Office International des Epizooties, Paris, France; **4)** Alban, L. *et al*.: 2008, Prev Vet Med 87:340-357; **5)** Schuppers, M.E. *et al*.: 2010, Epidemiol Infect 138:1242-1251; **6)** Alban, L. *et al*.: 2011, Prev Vet Med 99:148-160

Canadian Swine Health Board / Conseil canadien de la santé porcine

CFIA·ACIA Canadian Food Inspection Agency / Agence canadienne de l'inspection des aliments

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