How do we set the probability of introduction in a scenario tree model to demonstrate freedom from disease?

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As part of surveillance to demonstrate freedom from disease we may apply scenario tree models to estimate the probability that a population is free. Briefly a presentation of scenario tree models may be organized in five distinct categories: (1) definitions to present the objective (case definition (CD), population, design prevalence (DP), time period (TP)); (2) starting point; (3) inputs (probability of introduction (PrIntro), diagnostic test sensitivity); (4) data; and (5) outputs (system sensitivity, probability of freedom (PrFree)). With PrIntro we understand the probability that the disease is introduced to the population and it spreads among the units to the level of the DP in a TP. Therefore, PrIntro depends on the DP and TP. In addition, the TP should be defined to meet the underlying assumption of the model that the disease status of the units are independent from one time period to the next. Finally, the CD may affect how we determine the DP. We postulate that the impact of PrIntro and its relationships with DP, TP and CD may not be well understood. This is a problem in development of scenario tree models because a) the impact of PrIntro on the outcome PrFree may be substantial and b) PrIntro is very hard to determine emperically. A common way to determine PrIntro is to devide I by the number of TPs that the population has been free from the disease. We summarize how DP, TP and PrIntro were determined in published scenario tree models and then explore and describe the relationships in a simulation study.