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eufmd european commission for the control of foot-and-mouth disease
EuFMDiPLAST Foot-and-mouth disease And Similar Transboundary animal diseases

PRAGMATIST-TRIP: The Road to Implementation

An Optimization & Sensitivity Analysis, Summary Report

Introduction

The PRAGMATIST tool was previously developed to provide a semi-quantitative evidence base to inform the choice of FMDV vaccine selection for vaccine banks in FMDV free areas. The tool has three input variables: 1. estimates of the risk of incursion from specific areas (Source area Scores, SAS), 2. estimates of the relative prevalence of each FMD viral lineage (Prevalence scores) and 3. Estimates of the cross protection provided by each vaccine (Vaccine Antigen Coverage scores). This report provides a summary of work to incorporate the uncertainty in the three input variables into the tool, measure and display the effects of that uncertainty in the vaccine choices, and investigate relevance of the tool to FMDV endemic areas.

Methods

The effects of uncertainty in the three input data sources were modelled using probability distributions chosen based on available data and expert opinion. For the SAS, a series of normal distributions were used with varying standard deviations to reflect different levels of uncertainty. For both the Prevalence Score and the Vaccine Antigen Coverage scores, a distribution that emphasises the most likely value over the minimum and maximum estimates was used (beta-PERT distribution). Uncertainty was then incorporated by changing how far the upper/lower bound of the distribution are from the mean ('% 'noise'). Simulations were undertaken in R and results displayed in a prototype user-interface web application, including the single best vaccine choice and the rank order of vaccines if multiple vaccines were used. A workshop was undertaken in September 2019 to provide feedback and expert input into these analyses.

Results

A simplified measure of the effect of uncertainty on vaccine choice (vaccine 'diversity') was made by running multiple repeated simulations, resampling from the distributions, and summing how many vaccines are in each of the top five positions. The lowest value of this metric would be 5 (i.e. there are exactly 5 vaccines in the top five choices, and they are always in the same order). This metric thus captures both the number of vaccines that are selected, but also how much the selected vaccines swap in priority/order (Figure 1).

Uncertainty had an important effect on the combination of vaccines chosen to be part of a portfolio of five vaccines. This effect was greatest for the uncertainty in Source area Score and Vaccine Antigen Coverage, and was more pronounced for the lower ranking vaccines (those against rare or geographically distant lineages). Together these results highlight that the level of confidence in the input data (shape of the distribution used) has an important influence on vaccine choice and supports further work to establish the true variation in the input data, and the uncertainty in their measurement.

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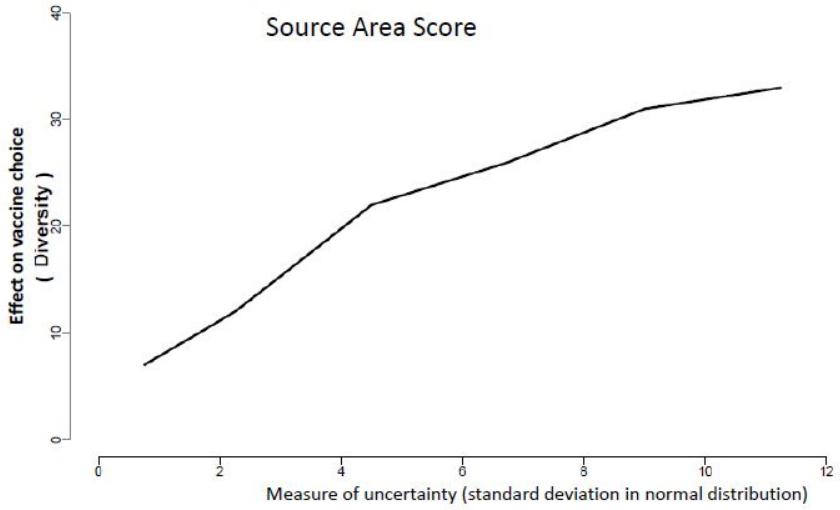

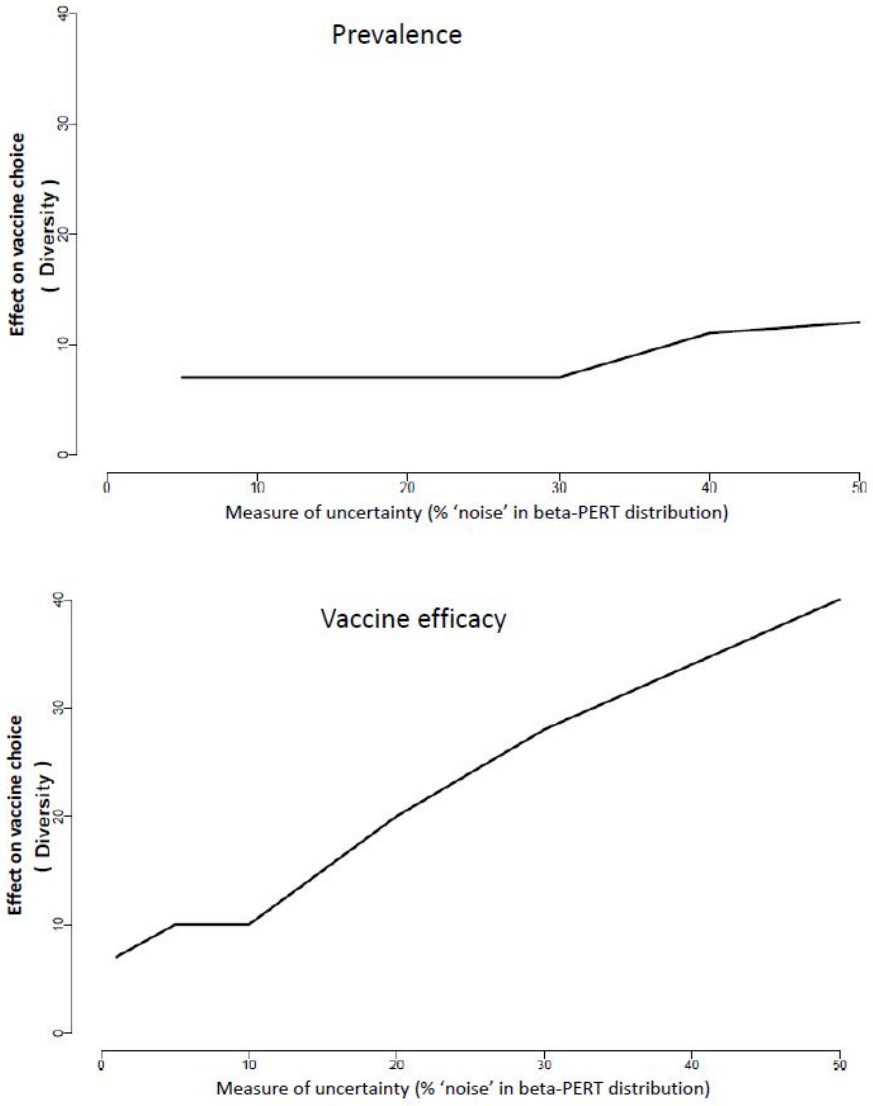

Figure 1. Shows effect on vaccine choice (diversity) measure for the different values of uncertainty in each of the three input variables.