

Towards sensible risk analysis and disease simulation models in animal health and food safety: a concept paper

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Purpose: Quantitative risk analysis and disease simulation models (QRADSMs) have become key tools to support animal health and food safety decisions. The design of robust QRADSMs requires significant quantitative skills, as both statistical inference (to estimate model parameters from data and expert opinion) and predictions (to assess intervention strategies) need to be considered simultaneously, while also providing results that are informative to decision makers. Modeling mistakes are easy to make, and can significantly affect the results relied upon by decision makers.

The objective of this talk is to present key indicators of decision-impacting modeling mistakes, and propose novel methods to prevent them.

Methods and results: Modeling mistake indicators reviewed will include abnormally broad or narrow confidence intervals, unrealistic results from individual model iterations, and normally distributed results from models with skewed inputs. Their common causes will be grouped in broad categories, such as the incorrect modeling of variability and uncertainty, the incorrect use of products to sum random variables, mistakes in fitting distributions to data, ignoring joint uncertainties, and the improper marginalization of nuisance parameters. Examples from real QRADSMs will be used to illustrate each mistake and solution. The methods to prevent them will include bayesian and frequentist options.

Conclusions and relevance: QRADSMs are increasingly used for epidemiological decision support. The common mistakes addressed during this talk can significantly affect model usability. This talk provides a structured summary of key indicators of these mistakes, and proposes methods to avoid them. This information should be relevant to model practitioners, reviewers, and decision makers.