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Reviewing model application to support animal health decision making

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ABSTRACT

Animal health is of societal importance as it affects human welfare, and anthropogenic interests shape decision making to assure animal health. Scientific advice to support decision making is manifold. Modelling, as one piece of the scientific toolbox, is appreciated for its ability to describe and structure data, to give insight in complex processes and to predict future outcome. In this paper we study the application of scientific modelling to support practical animal health decisions. We reviewed the 35 animal health related scientific opinions adopted by the Animal Health and Animal Welfare Panel of the European Food Safety Authority (EFSA). Thirteen of these documents were based on the application of models. The review took two viewpoints, the decision maker's need and the modeller's approach. In the reviewed material three types of modelling questions were addressed by four specific model types. The correspondence between tasks and models underpinned the importance of the modelling question in triggering the modelling approach. End point quantifications were the dominating request from decision makers, implying that prediction of risk is a major need. However, due to knowledge gaps corresponding modelling studies often shed away from providing exact numbers. Instead, comparative scenario analyses were performed, furthering the understanding of the decision problem and effects of alternative management options. In conclusion, the most adequate scientific support for decision making – including available modelling capacity – might be expected if the required advice is clearly stated.

1. Introduction

Models used in applied science have evolved with technical advances of computer power (Grimm and Railsback, 2005). Today's computer capabilities together with advances in modelling theory (Grimm et al., 2005) and model standardisation (Grimm et al., 2006; Grimm and Railsback, 2006; Schmolke et al., 2010) allow tackling of complex questions on disease control and specific veterinary management issues (Levin and Durrett, 1996; Eisenberg et al., 2002; Harvey et al., 2007).

Indeed, today's epidemiological models are routine scientific tools both in wildlife disease epidemiology (Smith and Harris, 1991; Tischendorf et al., 1998; Augustine, 1998; Gross and Miller, 2001; Shirley et al., 2003; Eisinger et al., 2005; Lloyd-Smith et al., 2005; Kramer-Schadt et al., 2009) and veterinary epidemiology (Noordegraaf et al., 2000; Mangen et al., 2001; Keeling et al., 2003; Murray, 2006; Kudahl et al., 2007; Backer et al., 2009; Szmaragd et al., 2010; Garner et al., 2010). Without a doubt modelling has also played a role in providing policy support and enhance decision making (Taylor, 2003).

We were interested in whether modern computer capabilities influenced the use of models in routine decision making. Which methodical solutions are applied? Do these reflect recent advances in modelling science? What

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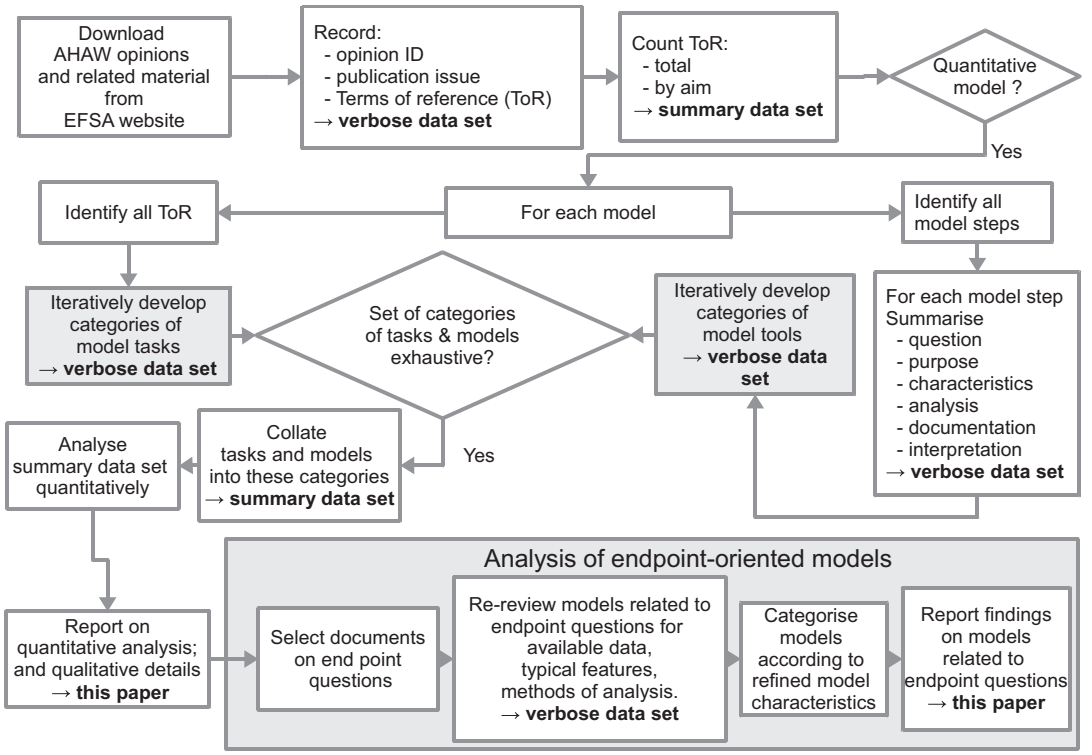

Fig. 1. Schematic work flow depicting the reviewing procedure on the documents published by EFSA's Animal Health and Animal Welfare Panel. Outcome related procedural steps are highlighted: bold letters – raw data assembled or fact sheet produced; grey shaded boxes – categories defined and refined to structure aggregated information. The annexed box comprises procedural steps related to the re-review of those documents that contained a model related to an end-point question. Review: First, documents applying quantitative tools were identified. Next, for each quantitative tool detailed data were recorded by tabulation (verbose data set) before further aggregation (summary data set). A classification framework was developed to structure the data on model tasks and model tools. The final assignment of existing models to the categories was summarized quantitatively and qualitative characteristics were described in text-form. Refined data on the largest category of model tasks (end point-oriented questions) was gathered through revisiting the associated documents (boxed procedure at the end).

kinds of constraints follow from the focus on decision making?

Documents containing information on the needs of the decision making bodies, the modelling approach used to provide support, and the provided outcome are seldom published in a standardised, open-access manner. Scientific literature focuses on the originality of the presented modelling, or certain innovative insight; but these papers less frequently link their motivation to the relevant practical decision problem. We recognised the scientific output by the European Food Safety Authority (EFSA) as useful source to investigate these issues due to its standardised structure and relevant focus. The EFSA scientific opinions are documents which, by intention, combine urgent needs from the decision making perspective with respective scientific expertise compiled by special advisory groups. Hence, EFSA scientific opinions jointly provide access to both perspectives, those of the requestor and the modeller. The availability of both viewpoints gives the chance for an integrated assessment of modelling as tool to support decision making.

The aim of this paper is to evaluate the application of modelling in animal health with specific emphasis on the decision making process. Output on animal health problems adopted by the EFSA's Panel of Animal Health and Animal Welfare (AHAW), representative of animal health issues, was subjected to a systematic review.

2. Materials and methods

Fig. 1 displays the work-flow of the review of scientific output published by EFSA's Panel of Animal Health and Animal Welfare (AHAW).

Initially, all documents were scanned for the application of quantitative tools (Fig. 1). The detailed reviewing was restricted to those documents, which were at least partly based on the application of quantitative tools. The review addressed stakeholder requests ('Terms of Reference' – ToR) and modelling, i.e. related sections of the documents were examined. Other parts, e.g. topical literature reviews, were neglected. Terms of Reference and models were analysed separately.

2.1. Material

All scientific opinions related to animal health issues adopted by the EFSA AHAW Panel from its initiation in 2004 until May 2010 were reviewed. There were 35 opinions that fit this criterion and they were downloaded from the EFSA web site together with accessible appendices.