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Prioritisation of wildlife pathogens to be targeted in European surveillance programmes: Expert-based risk analysis focus on ruminants

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ABSTRACT

This study attempted to develop a list of priority pathogens. It is part of a European Union (EU) project dedicated to the surveillance of emerging or re-emerging pathogens of wildlife. Partners of the consortium established an initial list of 138 pathogens of concern, which was reduced to a smaller list of 65 pathogens likely to affect ruminants (*i.e.*, the most costly animal group in the EU over the last 15 years). These 65 pathogens underwent a two-step, expert-based risk analysis: 92 experts graded them with respect to their global importance for animal welfare, species conservation, trade/economic impacts and public health. In step 2, the top 15 pathogens from step 1 were assessed by 69 experts considering seven weighted epidemiological criteria (pathogen variability, host specificity, potential for contagion, speed of spread, presence in Europe, difficulty of surveillance in wildlife and persistence in the environment) for which four options were possible. The responses concerned a wide geographic coverage. The resulting top-list pathogens were ranked as follows: 1. *Salmonella enterica*, 2. *Coxiella burnetii*, 3. foot-and-mouth disease virus, 4. *Mycobacterium bovis*, 5. bluetongue virus, and 6. European tick-borne encephalitis virus. The influence of the characteristics of the respondents, the importance of the levels of uncertainty/variability and the implication of the results are discussed. This work highlights the relevance of developing such lists for preparedness.

1. Introduction

Wildlife has increasingly been involved in the transmission of infectious agents to domestic animals (Gortázar et al., 2007; Martin et al., 2011). This phenomenon is particularly relevant for emerging diseases. According to the OIE (World Animal Health Organisation), an emerging infectious disease (EID) is "a new infection resulting from the evolution or change of an existing pathogenic agent, a known infection spreading to a new geographic

Abbreviations: EID, emerging infectious disease; EU, European Union; FMD, foot-and-mouth disease; PCA, principal component analysis; PPR, peste des petits ruminants; SD, standard deviation; TBE, tick-borne encephalitis; TSE, transmissible spongiform encephalopathy.

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area or population or a previously unrecognised pathogenic agent or disease diagnosed for the first time and which has a significant impact on animal or public health" (OIE, 2013). According to a recent review, most EIDs originate in wildlife (Jones et al., 2008). The WildTech European project (2009–2013) was developed to provide the European Union (EU) with molecular tools for the surveillance of wildlife pathogens (see European Commission, 2012 for an introduction to this programme). A key first step was the development of a list of priority pathogens. However, approximately 1300 wildlife vertebrate species occur in Europe, and more than 200 pathogens and associated diseases have been censused in European wildlife (Gavier-Widén et al., 2012a). Consequently, the surveillance of every host-pathogen combination would be prohibitively expensive, time-consuming and thus unrealistic. The EU explicitly encourages prioritisation of animal-related threats (European Commission, 2007). EU member states then must find the most relevant ways to target surveillance at the pathogens of greatest concern.

More often, information on wildlife pathogens (be it their molecular properties or their ecology, their incidence or prevalence, or their potential for transmission, Gavier-Widén et al., 2012a) is, at best, limited and sporadic. Because of the paucity of the available data, an approach that utilises experts' opinions is the most appropriate. Additionally, obtaining consensual outcomes from a panel of experts is recognised as the best way to obtain the stakeholders' endorsement. Moreover, such a collaborative approach is useful to tackle the great complexity associated with the introduction, establishment and spread of wildlife pathogens in complex biotic and abiotic environments (IUCN/SSC, 2014). Until now, expert-based prioritisation of animal pathogen risks has been based on well-established expertise, mainly in the fields of zoonoses, and the risks related to climate change (see *inter alia* Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail, 2012a,b for the incursion of exotic pathogens into a delimited territory; More et al., 2010 and Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail, 2013 for domestic animal diseases; Agence Française de Sécurité Sanitaire des Aliments, 2005 and Dufour et al., 2008 for risks related to global change; and Statens Veterinärmedicinska Anstalt, 2006 for risks originating in wildlife). Nevertheless, the approaches implemented in these prioritisation exercises are demanding in terms of time and/or expenses, mostly because they rely on experts meeting/reporting and providing feed-back (IUCN/SSC, 2014). Because some types of expert opinion surveys (*e.g.*, strict Delphi surveys) are time-consuming and may represent a dissuasive workload to the participants, a different approach using an e-mailing process was adopted here. The e-mail approach presents several advantages (Meho, 2006): more participants can be involved than would be possible in a workshop, the possible dominant influence of some individuals is avoided, anonymity is maintained, and more time is available for the participants to gather accurate information and perform the exercise. Moreover, an e-mail-based survey (World Health Organization, 2006) was preferred to a mail or an online survey. Better response rates and higher consistency are usually obtained with mail or combined (mail and web) methods (Jones and Pitt, 1999; Greenlaw and Brown-Welty, 2009; Lin and Van Ryzin, 2012). However, e-mail surveys are more direct and more personal and do not need the solicited expert to go on a separate website. It was thus considered as more likely to involve participants in the study. Enlisting a sufficient number of participants is important to ensure that a broad understanding of the problem is possible and to get reliable results (IUCN/SSC, 2014).

The purpose of the present work was to designate a shortlist of pathogens of concern to be targeted in further wildlife surveillance programmes in the EU. To this end, participants were requested to consider the risk presented by the occurrence (presence, emergence or re-emergence) of wildlife pathogens that can adversely affect the health of domestic animals and/or wildlife. Complex methods referring to experts' opinions have been using complex aggregation systems and numerous criteria-composed themes, criteria, and sub-criteria (ANSES, 2013; DEFRA, 2006; European Union, 2008; Ng and Sargeant, 2012). However, such a complexity would not be adapted to a short, e-mail based survey. The approach used here was a lighter methodology intended to involve a great number of experts representing a wide geographical coverage. The strengths and weaknesses of the method used are presented.

2. Materials and methods

2.1. Duration of the survey

The total duration of the survey was three months, from October 18, 2012, to January 18, 2013. This duration allowed a compromise between the rapidity of implementation and the number of experts who were able to participate in the study.

2.2. Population of interest and sampling frame

The population of interest was represented by the European population of specialists in European wildlife health, of veterinarians involved in European wildlife disease issues and of researchers in the field of microbiology, bacteriology, virology, parasitology, epidemiology, pathology and/or surveillance related to European wildlife. The names and e-mail addresses of solicited individuals were suggested by peers or collected from selected journal articles for which they were the corresponding authors, from lists of participants in international conferences on wildlife health, from websites of reference laboratories for animal diseases and from sources linked to relevant academic institutions (*e.g.*, European Board of Veterinary Specialisation and research unit websites).

Among these, we targeted a total of 523 people accordingly to an empirical, purposeful sampling frame (Patton, 1990). Our approach was not aimed at establishing a sample strictly representative of the population of interest, whose individual constitution would have been difficult to comprehend exhaustively (Tillé, 2001). Instead, we created a relevant panel in terms of fields of expertise and