J. Comp. Path. 2015, Vol. ■, 1–9

Available online at www.sciencedirect.com

ScienceDirect

ELSEVIER

www.elsevier.com/locate/jcpa

Prioritization of Companion Animal Transmissible Diseases for Policy Intervention in Europe

F. Cito[*], J. Rijks[†], A. T. Rantsios[‡], A. A. Cunningham[§], G. Baneth[¶], L. Guardabassi[‖], T. Kuiken[#] and A. Giovannini[*]

[*] Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise, Teramo, Italy, [†] Dutch Wildlife Health Centre, Faculty of Veterinary Medicine, Utrecht University, Yalelaan 1, Utrecht, The Netherlands, [‡] National School of Public Health, Athens, Greece, [§] Institute of Zoology, Zoological Society of London, Regent's Park, London, UK, [¶] The Koret School of Veterinary Medicine, Hebrew University, Rehovot, Israel, [‖] Department of Veterinary Disease Biology, Faculty of Health and Medical Sciences University of Copenhagen, Stigbøjle 4, Frederiksberg C, Denmark and [#] Erasmus University Medical Centre, Viroscience, Dr. Molewaterplein 50, Rotterdam, The Netherlands

Summary

A number of papers have been published on the prioritization of transmissible diseases in farm animals and wildlife, based either on semiquantitative or truly quantitative methods, but there is no published literature on the prioritization of transmissible diseases in companion animals. In this study, available epidemiological data for diseases transmissible from companion animals to man were analysed with the aim of developing a procedure suitable for their prioritization within a European framework.

A new method and its associated questionnaire and scoring system were designed based on methods described by the World Organisation for Animal Health (OIE). Modifications were applied to allow for the paucity of specific information on companion animal transmissible diseases. The OIE method was also adapted to the subject and to the regional scope of the interprofessional network addressing zoonotic diseases transmitted via companion animals in Europe: the Companion Animals multisectoriaL interprofessionaL Interdisciplinary Strategic Think tank On zoonoses (CALLISTO). Adaptations were made based on information collected from expert groups on viral, bacterial and parasitic diseases using a structured questionnaire, in which all questions were closed-ended. The expert groups were asked to select the most appropriate answer for each question taking into account the relevance and reliability of the data available in the scientific literature. Subsequently, the scoring of the answers obtained for each disease covered by the questionnaire was analysed to obtain two final overall scores, one for human health impact and one for agricultural economic impact. The adapted method was then applied to select the 15 most important pathogens (five for each pathogen group: viral, bacterial and parasitic) on the basis of their overall impact on public health and agriculture. The result of the prioritization exercise was a joint priority list (available at www.callistoproject.eu) of relevant pathogens according to these two criteria. As the scope of CALLISTO was comprehensive in terms of geographical area, animal species involved and impact of the diseases, the list of prioritized diseases had to accommodate the realities in different European countries and the differences in biology and animal–human relationships in a wide range of species including cats and dogs, pet pigs and sheep as well as captive reptiles. The methodology presented in this paper can be used to generate accurate priority lists according to narrower and more specific objectives.

Keywords: companion animal; prioritization; transmissible disease; zoonosis

Introduction

An increasing number and range of species of companion animals are kept in close interaction with human beings in industrialized societies. In European

Correspondence to: A. Giovannini (e-mail: a.giovannini@izs.it).

0021-9975/$ - see front matter
http://dx.doi.org/10.1016/j.jcpa.2015.01.007

countries, dog ownership involves 23% of households, ranging from 12% in Austria to 45% in Romania, while cat ownership involves 22% of households with a range from 12% in Slovakia to 45% in Romania (FEDIAF, 2012; Eurostat, 2014). The most frequently kept species of companion animals in the European Union (EU) are dogs (61 million) and cats (66 million), followed by pet birds (39 million), small mammals (21 million), ornamental fish (9 million aquaria) and reptiles (8 million) (FEDIAF, 2012). No data are available on the number of households with pets other than dogs and cats.

As companion animals share the same environment with people and can be carriers of microorganisms pathogenic for man, there is an urgent need to clarify the role of companion animals as sources of zoonotic infectious diseases. Companion animals are a potential source of infectious diseases for man, but also for food producing animals. Well known examples are the incursion of Newcastle disease into the poultry industry via trade in pet parrots and the role of dogs in the epidemiology of neosporosis, which can cause abortion in cattle. Nevertheless, the role of companion animals in the emergence and spread of infectious diseases in man and food animals remains a relatively underrepresented area of attention, both in research and in surveillance. Consequently, although various infectious disease risks have been associated with companion animals, crucial details are missing with regard to the magnitude of such risks from a societal perspective, including disease prevalence in the companion animal population, incidence of human disease attributable to companion animals and consequences on livestock production.

Clarification of the role played by pets in the occurrence of infectious diseases in man and farm animals cannot be made for all diseases potentially transmitted by pets. Therefore, a suitable approach to prioritize the most important diseases is needed.

Institutions working in the fields of public health and infectious diseases have different objectives and interests and, in a similar way, experts are increasingly specialized in understanding narrow groups of diseases. This makes it difficult to assess and prioritize a broad range of infectious diseases without being biased by institutional or individual professional focus and knowledge (Krause *et al.* 2008a). Therefore, the involvement of a range of experts is required to ensure that such an assessment is done as objectively as possible. Traditional priority setting procedures entail asking a number of experts to provide the required information and to reach consensus. While this method is relatively straightforward, it is not particularly transparent or repeatable (Havelaar *et al.*, 2010).

Currently, semiquantitative methods are frequently used in which criteria are divided into a limited number of classes or scored on arbitrary scales. Scores for all criteria are then aggregated using various formulae to produce an overall score (Havelaar *et al.*, 2010). Here, the transparency and repeatability are improved, but the classes are chosen rather arbitrarily. Furthermore, linear relations between the different classes of a criterion or between criteria are often assumed without support by available data (Havelaar *et al.*, 2010).

More recently, truly quantitative methods to rank diseases have been developed. These use clearly interpretable criteria, expressed on natural numerical scales. Furthermore, criteria may be weighted, according to a systematic procedure employed by a panel of judges independent from the authors or scientific experts who produce the final prioritized list (Havelaar *et al.*, 2010).

Sometimes, however, insufficient data are available to allow the adoption of truly quantitative methods. One of these cases is the process of prioritization of diseases for which only incomplete and heavily biased data exist. This is the case with many of the diseases affecting companion animals.

The present study was performed as part of an EU Framework 7 project (Companion Animals multisectoraL interprofessionaL and Interdisciplinary Strategic Think tank On zoonoses [CALLISTO]; Project number 289316), which aimed to develop a European interprofessional network to address zoonotic diseases transmitted via companion animals.

As the resources available for the project were insufficient to analyze all listed diseases, a prioritization strategy was designed. Several methods for disease prioritization in farmed animals are available (Krause *et al.* 2008a,b; DEFRA, 2009; Cardoen *et al.*, 2009; Havelaar *et al.*, 2010; Kurowicka *et al.*, 2010; Phylum, 2010; Humblet *et al.*, 2012) and a method for the prioritization of diseases in wildlife has been published (McKenzie *et al.*, 2007). None of these methods was developed to prioritize transmissible diseases in companion animals, so they are not directly usable for this purpose.

An analysis of the methods available in the literature and of the type of data available on the biological characteristics of the diseases and the options for their prevention and control in companion animals and man was performed, with the aim of developing a procedure suitable for companion animals in a European framework.

Materials and Methods

The Lists of Diseases

The preliminary activity, carried out during the first year of the project, was to draw up a list that was as exhaustive as possible of diseases transmissible from companion animals to man and to livestock, and to collect and analyze the available scientific literature on these diseases. Diseases were subdivided, according to the kingdom to which the aetiological agent belonged, into three groups: viral diseases, bacterial and fungal diseases and parasitic diseases. This activity was performed by three groups of experts, one for each group of diseases. The three lists of diseases are provided as supplementary documents to this manuscript. The three expert groups screened these lists to submit short lists for the prioritization process (Table 1).

Phases for the Definition of the Prioritization Process

The method for prioritization of diseases in companion animals, with associated questionnaire and scoring system, was designed in three stages: (1) review of the methods for prioritization of diseases described in the recent scientific literature, in order to identify the determinants for disease prioritization, (2) selection of the most appropriate method from those reviewed to use for the prioritization of diseases in companion animals, and (3) adaptation of the method chosen to meet the requirements for the project objectives and scope. The newly developed method was then applied to identify the 15 most important diseases (five each of viral, bacterial/fungal and parasitic diseases) on the basis of their overall impact on public health and agriculture.

Analysis of the Methods for Prioritization Described in the Scientific Literature

Eight recent studies on the prioritization of animal diseases were identified and used to develop a suitable questionnaire and scoring system for the purposes of the present study. These studies described methods for prioritizing wildlife diseases (McKenzie *et al.*, 2007), zoonotic diseases from livestock (DEFRA, 2009; Havelaar *et al.*, 2010; Kurowicka *et al.*, 2010; Phylum, 2010; Humblet *et al.*, 2012), human diseases only (Krause *et al.* 2008a,b) and foodborne zoonoses (Cardoen *et al.*, 2009). Four determinants of disease prioritization methods emerged from the analysis of these studies. The first determinant was the local epidemiological situation of the disease of interest (endemic versus exotic or emerging), which was dealt with differently according to the approach used in the study. For example, one study (Phylum, 2010) used different modules to tackle present versus absent diseases, while another (DEFRA, 2009) used different modules based on the possible objectives of the prioritization. This determinant set the suitability of methods for the evaluation of endemic and exotic diseases.

The second determinant was the impact of the disease in relation to public health, companion and food animal welfare, animal health and agricultural economics, international trade and wider society.

The third determinant was the possibility to respond to the disease with focus on either: (1) the disease(s) of interest, with (McKenzie *et al.*, 2007; Krause *et al.* 2008a,b; Phylum, 2010) or without

Table 1
Scoring of analysed diseases for human health impact and economic impact

Disease or pathogen	*Overall score human health impact*	*Overall score economic impact*
VIRUS		
Crimean-Congo haemorrhagic fever	**20.4**	**16.2**
West-Nile virus	**9**	**27.8**
Foot and mouth disease virus	**8.7**	**32.4**
Rabies virus	**8.3**	**23.1**
Bluetongue virus	**0**	**21.6**
African swine fever virus	0	16.9
Rabbit haemorrhagic disease virus	0	12.5
BACTERIA		
Campylobacter jejuni	**17.6**	**15.8**
***Leptospira interrogans* sensu lato**	**16.6**	**15.8**
Salmonella enterica	**12.5**	**17.6**
Bartonella henselae	**11.4**	**8.9**
ESBL-producing bacteria	**11**	**14.5**
Chlamydia psittaci	11	14.1
MRSA	10.9	14.8
Clostridium difficile	10.3	10.3
Coxiella burnetii	9.3	12.5
MRSP	8.9	9.5
Bite-related infection complex	8.6	7.1
Microsporum canis	7.6	10.3
PARASITES		
***Echinococcus granulosus* sensu lato**	**12.9**	**14.6**
Leishmania infantum	**12.6**	**11.3**
Toxoplasma gondii	**12.4**	**13.8**
Echinococcus multilocularis	**12.1**	**10.6**
Giardia species	**9.5**	**14.6**
Toxocara canis-cati	8.6	9.6
Ancylostoma caninum	6.5	8
Dirofilariosis	5	8
Neospora caninum	0	22.8
Uncinaria stenocephala	0	6.4

The five most important diseases in each group are indicated in bold font.

Please cite this article in press as: Cito F, et al., Prioritization of Companion Animal Transmissible Diseases for Policy Intervention in Europe, Journal of Comparative Pathology (2015), http://dx.doi.org/10.1016/j.jcpa.2015.01.007

(Cardoen *et al.*, 2009; Havelaar *et al.*, 2010; Kurowicka *et al.*, 2010) taking into consideration prevention, control, treatment measures and their costs and effectiveness, or (2) the reasons for intervention (RFI) and setting distinct priority lists in relation to the RFI (DEFRA, 2009). Examples of RFI are protection of public health, protection of the wider economy and society, securing of trade opportunities and protection of animal welfare.

The fourth determinant was the availability and quality of data. Approaches were either: (1) semiquantitative, with various degrees of contribution by expert opinion (Krause *et al.* 2008a,b; Cardoen *et al.*, 2009; DEFRA, 2009; Phylum, 2010), or (2) quantitative, with limited contribution by expert opinion (Havelaar *et al.*, 2010; Kurowicka *et al.*, 2010). The main advantages and disadvantages of the two approaches are:

- A more subjective classification of diseases using the semiquantitative approach. In this case, when scores for all criteria are aggregated to produce an overall score, linear relationships between the different classes of a criterion or between criteria are often assumed, but are not supported by data (Havelaar *et al.*, 2010). The main advantage of this approach is the ability to assess diseases for which data are lacking.
- The quantitative approach provides a more objective evaluation and prioritization process, but requires detailed data. In this approach, expert opinion is restricted only to very few aspects of the overall information collected. It is possible to perform a sensitivity analysis of the outcome to assess whether further data collection is required (Havelaar *et al.*, 2010) and the type of data needed.

Finally, the reviewed studies provided information on the scoring process. The outcome of the prioritization exercise may be a single list of pathogens/diseases, in which the various criteria considered (e.g. rates of transmission between animals, economic damage in the animal reservoir, animal—human transmission, inter-human transmission and impact on human health) are weighed before being listed according to a single score or according to other objectives of the prioritization process used. In any case, the weights used for the production of a single list are heavily influenced by political choices and social mediation, which may be different from country to country and which may change over time.

Selection of the Most Appropriate Method

The following two methods were deemed to be the most suitable for adaptation to the prioritization of diseases transmissible from companion animals to man and farm animals: (1) the World Organisation for Animal Health (OIE) method (Phylum, 2010); and (2) the Decision Support Tool developed by the UK Department for Environment, Food and Rural Affairs (DEFRA), (DEFRA, 2009).

Both methods are flexible, suitable for the evaluation of endemic and exotic diseases and take into account the possibility of responding to disease occurrence. Most importantly, both methods involve a scoring process that enables various aspects of each disease examined (e.g. public health, animal health/economics, welfare and wider social impact) to be taken into account.

The data available for the present study were mostly qualitative, with a limited amount of quantitative data. Therefore, a semiquantitative method was applied. The OIE method was used due to the limited availability of data and the more widespread experience with this method, which resulted from a 1-year process involving representatives from the OIE, the European Commission (EC), the Food and Agriculture Organisation (FAO), the Veterinary Services of Germany, Hungary, Italy, Sweden and the UK, and which has already undergone field use and evaluation. Data on diseases transmissible from companion animals to man or farm animals are limited, and although more comprehensive, the DEFRA method requires more detailed data than the OIE method.

The original OIE method is based on the following phases (Fig. 1):

1. Preliminary activities. These include identification of the country's political objectives, definition of the diseases to be included in the analysis, collection of available data and characterization of the country. Knowledge of the country's political objectives is needed to determine the appropriate weighting between the different types of indicators. In the case of companion animals, this could refer to the assessment of the role of zoonoses in public health policy or to the development of health policies aimed at specific sectors of the population (e.g. low socio-economic groups or children).
2. Profiling the biological characteristics of the disease without considering the possible effects of local conditions.
3. Defining a local approach for disease-related impacts.
4. Defining a local approach for control measures.
5. Iteration of the process during the first prioritization exercise, to reach consensus and to validate the results obtained.

Please cite this article in press as: Cito F, et al., Prioritization of Companion Animal Transmissible Diseases for Policy Intervention in Europe, Journal of Comparative Pathology (2015), http://dx.doi.org/10.1016/j.jcpa.2015.01.007

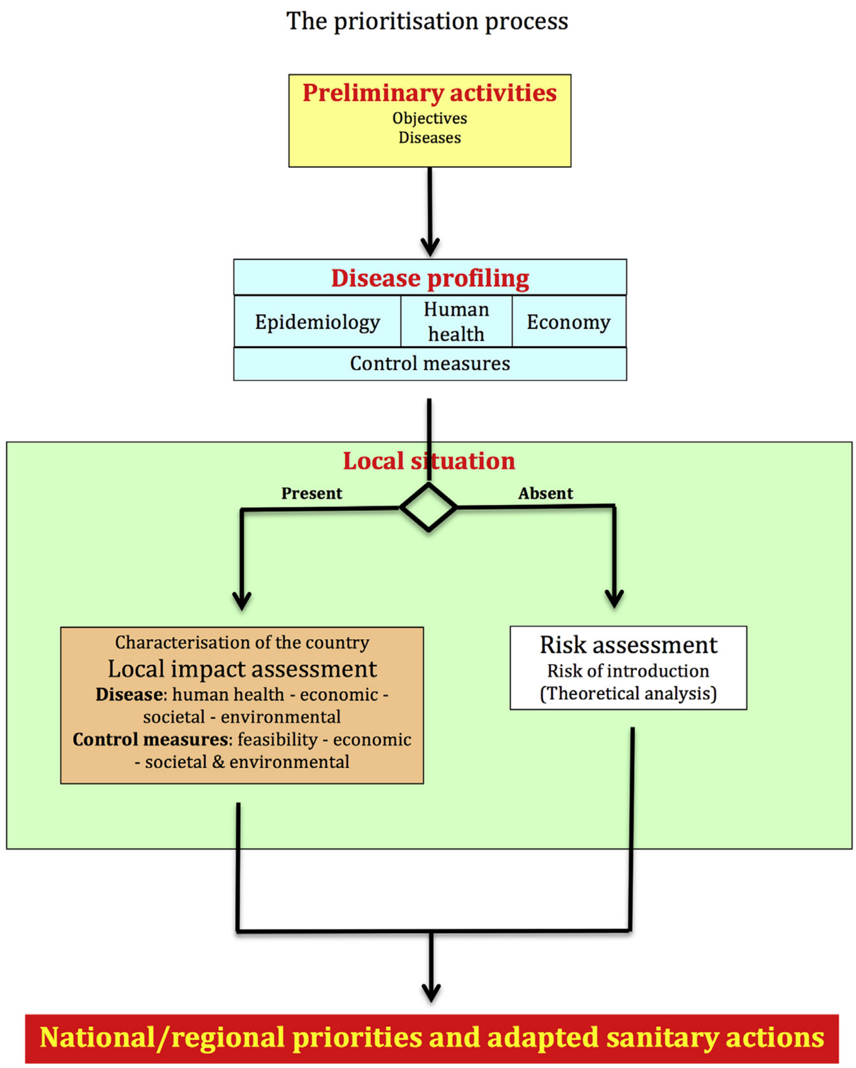

Fig. 1. Summary of the method used to prioritize diseases transmissible from companion animals to man and farm animals, based on the phases described in the OIE model.

6. Regular reiteration of the process to update the prioritization.

Adaptation of the OIE Method to the Project Objectives and Scope

The OIE method was adapted by designing a questionnaire specific for companion animal diseases that are known to be transmissible to man or to livestock and by incorporating a suitable scoring system for these diseases.

The adapted method was limited to the first two phases of the OIE method (i.e. preliminary activities and disease profiling). The choice of limiting the questionnaire to the first two phases and excluding the assessment of the local conditions (i.e. country level conditions) was motivated by the differences existing between EU countries. Otherwise, for each disease it would have been necessary to perform a separate assessment for each country involved in the project. This would have resulted in the production of different lists of priority diseases for each country, while the remit of the CALLISTO project was to produce one list for the entire EU.

The modifications applied were necessary to cope with the paucity of specific information on companion animal infectious diseases and to adapt the method to the regional scope of CALLISTO, as compared with the mainly country-based scope of the OIE method.

The OIE adapted method involved the collection of information from each of the three expert groups through a disease-specific questionnaire, scoring of the answers obtained for each question, assembly of the scores to obtain two final overall scores, one for the human health impact and one for the economic agricultural impact. The expert groups for viral, bacterial/fungal and parasitic diseases comprised of around eight individuals, mostly from Europe, but including participants from Israel and North America. All questions in the questionnaire were closed-ended and each expert was expected to select the most appropriate answer for each question individually. For each question, the relevance and reliability of the available data was assessed. If the quality was uncertain or if insufficient data were available, this was taken into account in the collective discussion and re-evaluation process. The reliability of the data available was described using a confidence score from 1 to 3 (where 1 means that the answer was based on experience or best guess and 3 means that the answer was based on validated evidence).

The questionnaire (see Supplementary material) had three sections organized as follows:

1. General information on the disease, including presence/absence and geographical distribution in the EU, a list of animal species that could be infected and whether or not the disease is a zoonosis. This information had no scoring attached, but was aimed at a very broad classification of the disease (questions 1–5).
2. Pathogen profile, covering the relevant epidemiological data for the pathogen (questions 6–10), its economic impact on agriculture (questions 11–14) and its public health impact (questions 15–19). The epidemiological data focused on the pathogen's routes of transmission and its means of persistence. The economic impact on agriculture considered both direct losses of livestock and indirect losses due to international trade restrictions. The public health impact dealt with the severity of human infection, the likelihood of inter-species transmission and of inter-human transmission, and those features of the biological cycle that facilitated human infection.
3. Control measures profile, aimed at assessing the availability and reliability of diagnostic tools, treatment and immunization in companion animals, in human beings and in susceptible livestock (questions 20–29).

Other relevant consequences of diseases transmissible by companion animals, such as societal or environmental impact were not assessed due to time constraints and the paucity of available data.

The pre-set answers to questions were grouped into three sets: answers relevant for public health (answers 7.2, 7.4, 10.5, 15, 16, 18, 19.3, 19.5, 20, 21 and 22), for the economic impact of the disease (answers 7.3, 7.6, 11, 12, 13, 14, 19.4, 26, 27, 28 and 29.2) and for both aspects (answers 6.3, 7.1, 7.5, 7.7, 8, 9, 10.1, 10.4, 10.7, 17, 19.1, 19.2, 19.6, 23, 24, 25 and 29.1).

In filling in the questionnaire, the expert groups were initially given freedom to choose the work methodology they preferred (e.g. collegial evaluation of each disease versus evaluation of each disease by one or few experts). Generally, experts in the group evaluated the disease(s) for which they had the most experience.

Then, the whole team of experts validated the profile of each disease. During the validation, the experts discussed any points needing clarification and identified points for which further bibliographical review was necessary. All experts collectively performed a re-evaluation of the answers to ensure consistency in the interpretation of the questions. It was essential for the experts to reach a consensus on the intrinsic characteristics of each disease. Through this process, all participants had the opportunity to calibrate their approach and become familiar with using the tool.

Due to the project's economic constraints, the process of validation was performed mainly through telecommunication, using teleconferences, e-mail and telephone calls.

The initial evaluation, the validation of the results obtained and the iteration of the process were a time-consuming process. Ideally, this process had to be repeated among expert groups in order to obtain a single list of the 15 most important pathogens, no matter whether they were classified as viruses, bacteria or parasites. This further phase would have consumed all the time allocated for the second cycle; therefore, it was decided to construct three separate lists of five pathogens each.

Scores and Scoring Process

Answers to the first five questions did not contribute to the scoring system and were used as tags for categorizing the diseases into different groups. Similarly, answers to some of the questions from 6 to 29 were not included in the scoring process and were used as tags for categorization. These questions, however, were redundant to other questions that provided further details on the epidemiology of the disease. For example, questions 8.1 and 10.6 were not used for scoring as they were further specified by questions 8.2 and 8.3. Similarly, question 10.2 was further detailed by question 7 and not used in the scoring process.

The number of different numerical scores was reduced as much as possible and a wide graduation of scores (0, 0.1, 0.5, 1 and 10) was used in order to weigh the different questions with respect to each other and to properly balance the combination of scores from different answers (Supplementary material).

The analysis generated two overall scores, which were obtained by assembling the individual question scores: a score for public health impact and a score for economic impact on agriculture.

Results

The possible impacts of a disease were separated into two categories: (1) impact on human health, and (2) economic impact (mainly given by the direct and indirect consequences of the transmission of the disease from companion animals to farm animals).

For ethical reasons, no attempt was made to combine public health with economic components. Moreover, determining the balance between public health and economic impacts is a political process conducted by the health and agriculture authorities.

Nonetheless, in order to generate a single list of diseases for each group of pathogens (i.e. viral, bacterial/fungal and parasitic), priority was given to the human health aspect and the five highest ranking zoonoses were selected from each group. When the total number of zoonoses analysed was less than five, the non-zoonotic diseases with the highest rank in the economic impact were added (Table 1).

Of the viral diseases prioritized, four were zoonotic and three of these (West Nile fever, foot-and-mouth disease and rabies) were the three highest ranking for economic impact. For bacterial infections, four of the five highest ranking zoonotic bacteria (*Campylobacter jejuni*, *Leptospira interrogans* sensu lato, *Salmonella enterica* and extended spectrum beta lactamase [ESBL] producers) were also in the top five bacterial pathogens for economic impact on agriculture. In the case of parasitic diseases, four of the five highest scoring zoonotic parasites (*Echinococcus granulosus* sensu lato, *Leishmania infantum*, *Toxoplasma gondii* and *Giardia* species) were also in the group of the five highest scoring pathogens with economic impact on agriculture (Table 1).

Discussion

The questionnaire produced for companion animal diseases was limited to the first part of the OIE questionnaire (i.e. the profiling of the disease). No consideration was given to the local situation (i.e. to the field data available about incidence and prevalence of the disease in the populations at risk [humans, companion animals or farm animals]) or to the available data on the current or past impact of these diseases on human health or on farm animals.

In the presence of endemic, emerging and exotic diseases, the potential impact of exotic diseases is not directly comparable with the actual impact of endemic diseases. Therefore, the scoring in a single list of diseases with different country epidemiological patterns requires the use of weighing parameters, which are the result of a political national choice. There was no indication as to the possible choices adopted by the EC or by the single national competent authorities.

The iteration of the process to calibrate the approach of the experts and to make them familiar with the tool had a crucial role in the prioritization. All the experts had to calibrate their assessment of aspects such as the severity of the diseases, how to classify the transmissibility of a disease (incidental or rare occurrence of transmission; transmission likely only within specific groups; moderate likelihood of transmission; high likelihood of transmission), or how to evaluate the role of companion animals when they were the main source of infection for human beings, but the reservoir of infection was in wildlife. Also, in some cases, the score given to each answer on the reliability of data used suggested performing an additional search for available literature. All groups of diseases required an internal validation and re-evaluation of the answers given by the experts.

Some considerations were needed concerning the lists of pathogens produced and the reasons for some inclusions or exclusions. The list of considered viral pathogens also included some agents that are usually not linked to companion animals (namely: foot-and-mouth disease, bluetongue and African swine fever). This inclusion was due to the definition of companion animal adopted by the CALLISTO project:

'Companion animals are any domesticated, domestic-bred or wild-caught animals, permanently living in a community and kept by people for company, amusement, work (e.g. support for blind or deaf people, police or military dogs) or psychological support – including dogs, cats, horses, rabbits, ferrets, guinea pigs, reptiles, birds, or ornamental fish' (www.callistoproject.eu). This definition, therefore, also includes keeping sheep, goats and pigs as pets or as a hobby.

Among the four viral zoonoses originally considered by the virology group, rabies had a low score in comparison with all the others. This is related to the presence of wildlife cycles of rabies in Europe, with the fox and the raccoon dog as the main reservoir species, while the role of dogs and other companion animals in rabies transmission is incidental in the EU.

Foot-and-mouth disease scored higher than rabies. This was not due to a higher score for zoonotic impact, but rather to a higher combined score for both human health and economic impact.

Given the criteria established to generate the list of priority pathogens (i.e. the five top scoring diseases for

Please cite this article in press as: Cito F, et al., Prioritization of Companion Animal Transmissible Diseases for Policy Intervention in Europe, Journal of Comparative Pathology (2015), http://dx.doi.org/10.1016/j.jcpa.2015.01.007

each group, which included the highest scoring diseases of economic impact when fewer than five zoonoses were recognized), in the case of viral diseases the final list included four viral zoonoses plus bluetongue.

Six bacterial zoonoses were initially prioritized because two (*Chlamydia psittaci* and ESBL-producing Enterobacteriaceae) achieved the same score. Of these, however, ESBL-producing bacteria were chosen for the top five list because these organisms were ranked higher in importance for animal health compared with *C. psittaci*.

The result of the prioritization exercise is a shared list of relevant pathogens (http://www.callistoproject.eu/joomla/attachments/callisto_II_extended_summary.pdf). The list differs from the results of similar exercises conducted for livestock or wildlife, but such differences are expected given the dissimilarities of the various studies (McKenzie et al., 2007; Krause *et al*., 2008b; Havelaar *et al*., 2010; Humblet *et al*., 2012).

A number of conclusions may be drawn from the present study. The first relates to the paucity of data available on companion animal diseases transmissible to man and farm animals and the effect of this scarcity in limiting quantitative approaches. The participants strived to achieve standardization and consensus between the experts within each group, but standardization between the different expert groups was not made. This was due to a limitation in the time and resources available. The consequence of this was that the three lists of diseases obtained cannot be merged, because the scoring was not based on a uniform scale across all groups.

The scope of CALLISTO was very wide in terms of geographical area, animal species involved and impact of the diseases. The objectives of the classification, therefore, had to be very broad and generic, to accommodate the different realities in European countries and the differences in biology and animal–human relationships of a wide range of species including cats and dogs, pet pigs and sheep and captive reptiles. A narrower scope could have allowed narrower and better defined objectives and, consequently, a more precise listing.

In our opinion, the method used gave a fairly valid classification of the examined diseases and seems very useful whenever the data available are mostly qualitative, with a limited amount of quantitative data. However, as more data become available, the DEFRA approach, with its separate modules based on the reasons for intervention (protection of human health is neither comparable nor can it be merged with economic considerations or opportunities for international trade) might be more suitable for future disease assessments. The DEFRA approach, indeed, may be used to drive the process of objective definition by decision makers for policy intervention in Europe and elsewhere. Before the use of any method beyond its original scope, it is necessary to adapt it to the new scope and to test it using real world data. Therefore, any possible future use of the DEFRA method for prioritization of diseases transmissible from companion animals to man and farm animals, requires an adaptation and validation process similar to that performed with the OIE method.

Acknowledgments

The authors acknowledge the contributions of A. Breed, S. Cleaveland, N. Forbes and J. Segers, as members of the Expert Advisory Group VI on Epidemiology and for participating in the project meetings. The activities of the EAG VI were funded by the FP7 European project CALLISTO (project number 289316).

Conflict of Interest Statement

The authors do not have any financial or personal relationships with other people or organizations that could inappropriately influence (bias) their work.

Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jcpa.2015.01.007.

References

Cardoen S, Van Huffel X, Berkvens D, Quoilin S, Ducoffre G *et al*. (2009) Evidence-based semiquantitative methodology for prioritization of foodborne zoonoses. *Foodborne Pathogens and Disease*, **6**, 1083–1096.

Department for Environment Food and Rural Affairs (DEFRA). (2009) ARCHIVE: Veterinary Surveillance: Prioritisation Project. Available at: http://archive.defra.gov.uk/foodfarm/farmanimal/diseases/vetsurveillance/strategy/programme/prioritisation.htm Accessed on July 24th, 2014.

European Pet Food Industry Federation (FEDIAF). (2012) *Facts and Figures 2012*. Available at: http://www.fediaf.org/fileadmin/user_upload/Secretariat/facts_and_figures_2012.pdf Accessed on July 24th, 2014.

Eurostat (2014) Data downloaded from: http://appsso.eurostat.ec.europa.eu/nui/show.do. Accessed on July 24th, 2014.

Havelaar AH, van Rosse F, Bucura C, Toetenel MA, Haagsma JA *et al*. (2010) Prioritizing emerging zoonoses in The Netherlands. *PLoS ONE*, **5**, e13965.

Humblet MF, Vandeputte S, Albert A, Gosset C, Kirschvink N *et al*. (2012) Multidisciplinary and evidence-based method for prioritizing diseases of food-producing animals and zoonoses. *Emerging Infectious Disease*, **18**. Online Report. Materials Available Online Only. Available at: http://wwwnc.cdc.gov/eid/article/18/4/11-1151_article.htm Accessed on 24th, July 2014.

Krause G, the Working Group on Prioritization at the Robert Koch Institute (2008a) Prioritization of infectious diseases in public health – call for comments. *Eurosurveillance*, **13**. October 2nd, 2008.

Krause G, the Working Group on Prioritization at the Robert Koch Institute (2008b) How can infectious diseases be prioritized in public health? *European Molecular Biology Organization (EMBO) Reports*, **9**, s22–s27.

Kurowicka D, Bucura C, Cooke R, Havelaar A (2010) Probabilistic inversion in priority setting of emerging zoonoses. *Risk Analysis*, **30**, 715–723.

McKenzie J, Simpson H, Langstaff I (2007) Development of methodology to prioritise wildlife pathogens for surveillance. *Preventive Veterinary Medicine*, **81**, 194–210.

Phylum (2010) *OIE study: Listing and Categorisation of Priority Animal Diseases, including those Transmissible to Humans – Methodological Manual*. Phylum SARL, Colomiers, France.

[*Received, December 29th, 2014*
Accepted, January 15th, 2015]