METHODS FOR PRIORITIZATION:
CASE STUDY OF ZOONOSES IN SOUTH EAST ASIA

INTRODUCTION

Regarding the fact that financial and human resources are limited, there is nowadays a general agreement at national, regional and international level that policy for prevention, surveillance and control of infectious diseases must be cost-effective by focusing on the most relevant risks for both, animal and human population (OIE, 2008; WHO, 2008; Cardoen et al., 2009). Nevertheless, decision making in controlling infectious diseases is a complex, conflicting process, characterized by a mixture of epidemiological, economical and social-ethical value judgments, and priority setting becomes a multi-dimensional problem in which technical information is often intertwined with value judgments (Kurowicka et al., 2010). In this context, in order to succeed in setting rationally priority and to make the best use of limited human and financial resources for organizations in charge of diseases' surveillance and control and for research institutes, it urged to address prioritization in a comparative and transparent manner.

Prioritization, which is defined as the “process aiming to evaluate a group of items and to rank them in their order of importance or urgency” (Anonymous a) is a common approach, used in different fields, to focus on key issues that must be addressed in advance of others. The concept of priorities for diseases emerged first at the end of the 2nd world war when organizations concerned with international health have selected a number of diseases as priorities for control. At that time, prioritization was mainly supported by the rational selection, based on the burden of the diseases and the availability of cost-effective treatment, and the degree of attention that health leaders were paying on the diseases (Shiffman et al., 2002). In the last decades, arose the need to develop transparent and objective methods to support prioritization of diseases. While
new infectious diseases, with dreaded impact on both animal and public health, as well as on economy, emerge all the time (Johnes et al., 2008), human and financial resources for public and animal health activities, as surveillance, prevention, control and research, are limited. But it is difficult to compare the importance of diseases, which vary in terms of occurrence, impacts, etc. and so, in this context of scarce resources and multiple competing priorities, it is necessary to allocate rationally human and financial resources on relevant health priorities and decision makers need objective tool for resources allocation.

Up to now, many methods has been developed and used by various governmental organizations in charge of health issues at the national, regional or international level to set up control and surveillance programmes, and by technical institutions to define key research questions. And some research projects are still ongoing to develop efficient tools for prioritization. But, whatever the approach used to perform the prioritization exercise, some limitations to the current developed models persist.
OBJECTIVES

To investigate an innovative approach to identify criteria that ensure a good differentiation between the diseases and that can be used further on for a prioritization exercise, based on the analysis of zoonoses and their impact in South East Asia.
LITERATURE REVIEW

1. Review of zoonoses in South East Asia

Over 200 zoonoses have been described worldwide and South East Asia has recently been described as one of the main hotspots for the future emergence of zoonoses (Jones et al., 2008). Nevertheless, no recent review about zoonoses in South East Asia was currently available and collecting data about those diseases was a necessary prerequisite before going further into working on setting priority. A preliminary study was so undergone to identify the main zoonoses in South East Asia and to collect data that will support the further work on prioritization.

1.1 Case criteria

Using the WHO definition (Anonymous b), a zoonosis is any disease or infection that is naturally transmissible between vertebrate animals and humans. Over 200 zoonoses have been listed and they include diseases that have been well described over many years (as rabies, anthrax) and new or emerging diseases that have appeared within the past one to two decades.

Zoonoses are caused by all types of agents: bacteria (including Rickettsiae), parasites, protozoa, fungi, viruses and unconventional agents. They can be transmitted directly but indirect transmission through vector or food ingestion is most common. Regarding this definition and the expected large amount of zoonosis present in South East Asia, we focused our study on:

− zoonotic diseases for which animals still represent the main reservoir and source of the pathogens (e.g. exclusion of HIV, which became effectively and essentially transmissible from human to human after a single species jump), as Rabies or Brucellosis;
− zoonotic diseases for which other species than non-human primate species are commonly involved in disease transmission (e.g. exclusion of dengue and malaria), as Hepatitis E;
− food borne diseases for which transmission to human is due to primary contamination of raw animal products, as Salmonellosis or Campylobacteriosis.
− zoonosis that can be transmitted from animals to human, excluding those transmitted exclusively from human to animals (e.g. H1N1).

The study focused on the continental area of South East Asia, that encompasses: Cambodia, China (two provinces: Yunnan, Guangxi), Lao PDR, Myanmar, Thailand, Vietnam.

1.2 Information gathering

Necessary information to conduct this review was gathered from different techniques and sources.

Searches on peer reviewed literature were conducted using PubMed database since 1990. A first scanning involved searches on items such as “Zoonoses or zoonosis or zoonotic diseases South East Asia”, “emerging diseases South East Asia”, “bacteriosis South East Asia”, “virosis South East Asia”, “protozoosis South East Asia”, “mycosis zoonotic South East Asia”, “parasitosis South East Asia”, “unconventional agents South East Asia”, “food borne South East Asia”, “vector borne South East Asia”. Those searches led to a list of diseases, for which a new scanning was undergone using the name of each disease and the name of each countries (Cambodia, Lao/Laos, Myanmar/Burma, Thailand, Vietnam) or provinces (Yunnan, Guangxi) of interest.

Information was also gathered visiting official websites of international and national organizations involved in public and animal health: WHO, OIE, CDC. Other data came from the professional website GIDEON (Global Infectious Diseases and Epidemiology
1.3 Results

Following the information gathering in PubMed, 23 zoonoses that are commonly studied and described in South East Asia, were identified. These zoonoses have been categorized regarding the nature of the pathogen agents: virus, bacteria, protozoa or parasite. Any disease due to fungi has been hold as the mycoses are poorly described and are known to have a light economical and health impact. As well, any cases due to unconventional agents, as prion, has been reported in the area.

In order to get an overview of the data available about zoonoses in the area, information are displayed in two tables for each category of pathogens: epidemiology and ecology of the disease and impact on public and animal health health of the disease (see Appendices A, B, C, D).

2. Methods for prioritization of diseases

Methods for prioritization of infectious diseases have been performed to reach mainly two objectives, either ranking diseases which surveillance and control programmes should focus on in priority or ranking diseases which should be addressed first in specific research programme. Priority exercise can focus on diseases currently present in the region of the study or on the most relevant hazards for the future, regarding environmental, economical and sociological changes. Three different approaches, qualitative, semi-quantitative and quantitative, are used to support the different methods but whatever is the approach undergone, all the models follow the same step-by-step frame.

2.1 Prioritization, a step-by-step approach
The different steps that need to be rigorously followed to ensure an efficient prioritization exercise are the following:

- Step 1. Clear definition of the objective of the prioritization exercise
- Step 2. List of diseases that need to be ranked
- Step 3. List of criteria against which the prioritization is undergone (e.g. indicators that will be used to assess the importance of the disease regarding the objective of the prioritization exercise)
- Step 4. Allocating a score to each criterion: qualitative values, as low/medium/high for qualitative methods; quantitative scale (3 to 5 classes) for the semi-quantitative methods and true numerical values for quantitative methods.
- Step 5. Weighting system: allocate a weight to each criterion to take into account the relative importance of the criteria regarding each other and according the objective of the prioritization exercise.

2.2 The different approaches for prioritization

Three approaches support the different methods for prioritization

2.2.1 Qualitative approach

In this approach, criteria are assessed using qualitative value and data are then combined to obtain a total qualitative value per disease, regarding which the ranking is undergone.

Eger K. et al. (2009) use a qualitative approach for the prioritization of diseases and target groups for integrated care measures at the national level of Austria. A catalog of criteria is settled and assessed using literature review, grey literature and experts interviews. For each selected diseases, results are given in qualitative terms, as average, clear, low, high, rising, existing. An expert workshop is then
organized to value the criteria and the method, according to their experience and from the perspective of the national security. Final prioritization process results in the summarize of four weighted criteria for each of the selected disease. Diseases are then classified regarding three levels of priority.

Capek et al. (2006) use a qualitative method to prioritize non food borne zoonoses in order to allocate rationally resources for knowledge improvement, prevention and control, at the national scale of France. A preselected list of diseases is ranked regarding three criteria and using expert opinion. After discussion, a consensus is reached on categorization of diseases into three categories of different level of priority.

2.2.2 Semi-quantitative approach

Principle is quite similar than the one developed in quantitative approach but criteria are scored according to a scale: different classes are defined for each criterion and a numerical value is attributed to each class. Each criterion is classified into a class and so is allocated a numerical score. The sum of the scores leads to a total score per disease regarding which the diseases are ranked.

The semi-quantitative approach has been largely used by organizations to settle a list of diseases on which surveillance and research programmes should focus on (Anonymous c, 2009).

Context and characteristics of the main semi-quantitative methods previously developed are presented in Table 1.

2.2.3 Quantitative approach

In this approach, each criterion is associated with a true numerical
value and then all the values are aggregated to give a total value regarding which the diseases are ranked. Methods based on a purely quantitative approach are still few.

Kemmeren et al. (2006) developed a quantitative model to help Dutch decision makers to establish the priority of pathogenic micro-organisms that can be transmitted by food, as a basis for effective and efficient policy-making on control, prevention and surveillance. The hierarchic classification of diseases is based on the quantitative assessment of the burden of the disease and the cost of illness using outcome tree for each pathogen. The estimation the disease burden and the cost of illness is proceeded using an incidence approach, i.e. calculating the present expected sum of current and future costs accruing to all incident cases of disease in a specific time period, taking into account age-specific disease risk and related illness costs.

Fosse et al. (2008), propose a quantitative method to prioritize foodborne zoonoses due to consumption of pork and beef meat, to support decision-making in veterinary public health area. The method is based on the construction of a hazards typology and the calculation of a risk score for each selected hazards (combination of the incidence of human cases due to pork consumption and of the severity of the cases).

Havelaar et al. (2010) work on a general method to prioritize pathogens in order to support the development of early warning and surveillance systems of emerging zoonoses in the Netherlands. The quantitative method is based on a multi-criteria method that allows to combine objective information on the epidemiology and societal impact of zoonotic pathogens with subjective information on the relative weights of different criteria. The risk score is based on seven epidemiological and societal criteria that cover the complete pathway from introduction to societal impact of the diseases. Authors decided to restrict the number of criteria to avoid the challenge to develop complex validated databases.
2.3 Analysis of the advantages and disadvantages of each approach

*Qualitative approach* is a quick and simple tool, easy to communicate to decision makers. However, all the methods described previously are very subjective and show a lack of repeatability and transparency, and so can lead to important bias in the ranking of the disease.

*Semi-quantitative approach* increases transparency and repeatability comparing to the qualitative approach, but developed methods remain subjective and arbitrary (Krause et al., 2008, Kurowicka et al., 2010). There is no objective basis to combine highly divergent criteria on the same scale and then simply add up or multiply all scores (Kemmeren et al., 2006) and linear relation between the different scales of a criterion or between criteria are often assumed but not supported by data (Havelaar et al., 2010). Some methods attempted to improve the differentiation between the diseases by increasing the number of scale in the scoring system. However, the difficulty to generate clear definitions for each scale increases with the number of scale and there might not be sufficient detailed information available for many diseases and criteria to allow such a differentiated approach (Krause et al., 2008). Furthermore, all the criteria do not have the same importance when undergoing a prioritization exercise and so, a relative weight needs to be applied to them (Krause et al., 2008a). For the approaches in which a weighting system is applied, it commonly persists a lack of transparency and objectivity in the way the weight are attributed to criteria. Finally, most of the methods require inputs from expert group for the scoring of the criteria. There is thus a high risk that the answers of the experts are biased by their individual professional focus and so that there is an important part of subjectivity in the final result of diseases ranking (Krause et al., 2008b).

*Quantitative approach* is less arbitrary that semi-quantitative approach as the criteria are scored using natural values or associated numerical scale. Also, all criteria
are weighed in proportion to their true values, instead of on arbitrary numbers and so the final ranking result is expected to be more accurate and realistic (Kurowicka et al., 2010). A disadvantage is that the process is very resource intensive, requiring careful consideration of a large volume of data while many data gaps may exist. Such data gaps result in uncertainties about the final results, but the quantitative approach also helps to prioritize among data needs and to identify key research questions. To avoid the complexity to gather a large amount of data, methods use a restricted number of criteria. Even if the authors tried to reach a high level of integration in the choice of the criteria to cover the wider range of features, they may miss some components of the diseases that are useful to be assessed to fully achieve the objective of their study. Nevertheless, according to Cox et al. (2005), simple quantitative models will often be more accurate and useful than qualitative risk rating, while requiring no more information than would be needed to assess, justify, and interpret qualitative rating.

Therefore, regarding the previous literature study, three main approaches have been initiated to prioritize diseases but with some limitations: qualitative approach which is subjective and unreliable to support accurate models; semi-quantitative approach which leads to reproducible but still arbitrary models; quantitative approach which is more transparent and objective but need a high amount of data. A summary of principles, advantages and disadvantages of the three different approaches is presented in Table 2.

2.4 Key points for a successful prioritization exercise

The study of the current developed and applied methods underlines some key points that need to be taken into account and/or improve to ensure an efficient prioritization exercise.

First of all, the objective has to be clearly labeled as it will support the further choice of the diseases to be ranked and of the criteria to be scored. Furthermore, it
is a main point that the objective of the prioritization exercise matches with the expectations of the country or the region where it is carried out and considers the socio-cultural context of the area of interest. Up to now, available tools for prioritization have been developed mainly for developed countries and application of such methods in developing countries require some adjustments. For instance, while developing countries are currently focusing mainly on exotic or emerging diseases, it may be more relevant for developing countries to concentrate their efforts on the surveillance and control programmes of infectious diseases that impact the well being of poor communities and smallholders farmers (WHO, 2008).

The list of diseases that will be ranked through the prioritization exercise need to be exhaustive in order to miss any threatened diseases in the final priority list. There are several means to collect the list of diseases, as bibliographic study, health authorities reports, expert opinion, etc.

The choice of the criteria is a cornerstone in the prioritization process as they will support the assessment of the diseases regarding each others. Firstly, it is crucial for criteria to be accurate and clearly labeled to be sure that they are understood the same way by all the users and that potential discrepancies between expert answers are due to different experts' point of views and not to different levels of understanding of the criterion. The same comment is applicable when defining the different level of the scale in semi-quantitative methods. Secondly, the choice of the criteria needs to be relevant regarding the context in which the prioritization exercise is performed and the objective which is aimed to be reached. But it is very challenging to be exhaustive in the list of criteria to be sure to assess all the accurate components of the disease, without being redundant (Krause et al, 2008a) to avoid introduction of major biases in the final result of the ranking. Furthermore, criteria have to be relevant regarding the socio-economic context of the country. For instance, in regions where it may exist some ethical or religious barriers to set up some control measures (as culling stray dogs for rabies control
program), it is important to include a criterion that allows to assess the feasibility to implement some specific control measures. In quantitative methods, where the main issue is the availability of true numerical value to assess the criteria, authors usually chose a very restricted list of criteria that may not be enough to cover all the relevant components of the diseases to be assessed.

The scoring step, especially for qualitative and semi-quantitative methods, requires the inputs from experts which are asked to assess a wide range of diseases regarding various criteria in the field of health, economy, epidemiology and society (see Table 1). Expert opinion elicitation is a precious tool when there is a critical lack of data about diseases but experts get increasingly specialized, making difficult to find institutions and individuals who would be able to prioritize a broad range of infectious diseases without being biases by individual professional focus on one hand or lack of specific pathogen related knowledge on the other hand (Krause et al., 2008b). And so, using expert elicitation to score the disease is one of the main source of uncertainty in the final result of the prioritization exercise. But in developing countries, because of financial and technical gaps for proper control and surveillance networks, data, and even more quantitative data, are scarce or difficult to access and it seems difficult not to rely on expert inputs to score the diseases.
MATERIALS AND METHODS

1. Data collection through an electronic-based questionnaire

Despite the fact that there is no objective of prioritization announced in first instance, the questionnaire was designed within the framework of a prioritization exercise, in order to be able to use the data in a prioritization model later on. Data collection was performed using a multiple-choice questionnaire. For each statement (criterion), the respondent had to choose the most appropriate options (class) for the disease he/her was answering about, among five or six proposed.

Annex B: Questionnaire about zoonoses in South East Asia.

1.1 Selection of the diseases

A list of 23 diseases was established based on the results on the previous bibliographic study. Two more diseases were added following advises provided by people who pre-tested the questionnaire (Plague, Schistosomnis). The refine list of selected diseases is presented in Table 3.

1.2 Selection of the criteria

The list of the criteria that are used as indicators to assess the different characteristics of the disease, as well as their different classes, were obtained through the study of a wide range of available prioritization methods (see Table 1). In the context of prioritization of zoonoses in South East Asia, two major characteristics need to be taken into account when choosing the criteria. Firstly, when talking about zoonoses, the frame of the study is located at the interface between human, animal and environment. So, the choice of criteria should allow to assess diseases against a wide range of components: epidemiological features, animal and public health impact, socio-economical impact of
the disease. Secondly, when addressing the problem of disease prioritization in developing countries, the objective of the prioritization exercise may be different from the one of the methods developed until now for developing countries, and thus the choice of the criteria, as well as the scale against which they are scored, need to be adapted regarding the cultural and economic issues of the region to ensure their relevancy. The accuracy and relevance of criteria selected following the bibliographic study were then assessed by 6 experts involved with zoonoses in South East Asia and working in different institutions, as universities, research institutes and international organizations. Finally, 45 criteria were selected, classified into five categories: epidemiological trends (8 criteria), impact on animal health (9 criteria), impact on public health (11 criteria), economical impact (7 criteria) and social impact (10 criteria). The refined list of criteria is presented in Table 4. The different classes defined for each of them can be accessed in version of the questionnaire in Annex B.

1.3 - Design of the websurvey

The questionnaire was an electronic-based survey, developed using the website SurveyMonkey©. Respondents entered it using an URL link. The questionnaire encompassed six sections. In the first section, the respondents were asked to provide details about their personal background and professional situation (position, organization, disciplines, country of experience, specific expertise about zoonoses). The five following sections were corresponding to the five categories of criteria. For each criterion, respondents had to choose the most appropriate class among the five or six available and mentioned the level of confidence they had in their answer on a scale, ranging from 1 (low confidence in the answer) to 5 (very high confidence in their answer).

It was emphasized to the recipients that questionnaires were anonymously and that the validity of the survey depended on the correctness of the answers and the level of confidence. To incentive for participation, all respondents were informed that
they would receive results of the survey.

The questionnaire was pre-tested on 6 experts regarding the quality of the explanation provided to recipients and the format of the questionnaire.

1.4 Diffusion of the questionnaire and collection of the data

To define the population of recipients for the purpose of this study, a snowball sample was used. The initial group of recipients was defined gathering different networks and sources, involving people working in the field of zoonoses in South East Asia: database of CIRAD, mailing list of FAO laboratories network, mailing list of the SEACFMD campaign (OIE-SRR), list of attendees at regional meetings in the field of public and animal health, corresponding authors of the articles gathered during the review of zoonoses in South East Asia, universities lecturers. This first sample was asked to forward the questionnaire to people they might know with an expertise on zoonoses and working in South East Asia.

The estimate population who received the questionnaire was 300 people. The access to the questionnaire was opened during 1 month after the first mail to the initial group was sent. A reminder was sent to the initial group 15 days before the closure of the questionnaire.

2. Data processing

Once the questionnaire closed, all the surveys were downloaded from the website of SurveyMonkey© and the answers were displayed in an Excel© factsheet. Only the completed questionnaires were taken into account for the study. After checking for incoherent data in the section about the personal details, all the answers were coded. The section about the professional position of the respondent was coded using a binomial
code: 0, the respondent did not select the class; 1, the respondent select the class. For the field of experience, 1 was assigned to individuals that mentioned a specific experience about the disease they answered on and 0 to individuals without any experience about the diseases they answered on. For the country of experience, all the respondents working in South East Asia (at national or regional level), based in or outside the region, were assigned the code 1. Finally the classes taken by the different criteria according to the respondents were recoded into ordinal data by applying a numerical scale which was designed considering the level of complexity of the epidemiology of the disease and the level of impact on health, economy and society. 1 was assigned to the class of the criterion with the lowest impact or level of complexity and 5 to the class with the highest impact or level of complexity (see Figure 1 for example). A data matrix was so obtained in which the respondents were identified with their IPP address and all the criteria were considered as qualitative ordinal variables, ranging from 1 to 5. All the values were associated with a level of confidence provided by each respondent (ranging from 1 to 5). An extract of the data matrix is presented in the Appendix C.

3. Evaluation of the quality of data collection method

In order to assess the quality of the data collection method, a study of the accuracy of respondents answers was undergone.

3.1 Correlation between the self-assessed level of confidence and the experience

To assess if the process of the self-selection by respondent of the disease of interest may improve his/her confidence in classifying diseases, difference in level of confidence between experimented and non experimented respondents was evaluated performing a one-sided Mann & Whitney test, which can be used for qualitative variables measured in two independent small samples (<30). A contingency table was built in which respondents were grouped in “experimented” and “non experimented” population.
The value of the level of confidence that was used for the comparison was the mode, e.g. the class that the respondents used the most all along the questionnaire to assess their level of confidence.

The test was performed for HPAI (21 questionnaires) and Rabies (11 questionnaires), using the excel fact sheet developed by Anastats (2009). Significance was taken as p<0.05.

3.2 Evaluation of the data collection using external data sources

To assess if the answers of the respondents are consistent with the data available in scientific papers and organizations' reports, an inter-rater reliability analysis using the Kappa statistic test was performed: categorisation of the variables obtained from each respondent was compared to classification obtained when filling the websurvey using data collected through the review of zoonoses. The test was applied for diseases for which at least 3 completed questionnaires were obtained: Anthrax (3), HPAI (21), Leptospirosis (4), Rabies (11), Salmonellosis (3).

Cohen's kappa is a measure of association (correlation or reliability) between two measurements of the same individual (disease) when the measurements (criteria) are categorical. Kappa is often used to study the agreement of two raters such as judges or doctors. Each rater classifies each individual into one of k categories. The statistically significant kappa test indicate that the null hypothesis (ratings are independent, i.e. kappa = 0) should be rejected and the alternative hypothesis (agreement is better than one would expect by chance) should be accepted. Nevertheless, statistical significance for kappa is rarely reported because even relatively low values of kappa can nonetheless be significantly different from 0 but not of sufficient magnitude. To conclude on a kappa test, only the magnitude is taken into account to reflect the agreement between raters and the most common guideline used to interpret the magnitude of K is the one of
Landis and Koch which considers values of Kappa from 0 to 0.20 as slight, 0.21 to 0.4 as fair, 0.41 to 0.60 as moderate, 0.61 to 0.80 as substantial, and 0.81 to 1 as almost perfect agreement (Landis and Koch, 1977). But most statisticians prefer for Kappa values to be at least 0.6 and most often higher than 0.7 before claiming a good level of agreement. The data (see Appendix D Table 1) were reported in a two-way contingency table where rows represented the classification of the respondent regarding the classification from the bibliographic study and columns represented the classification of the bibliographic study regarding the classification given by the respondent. As classes of the criteria were ordinal, a Kappa test with linear weighting was applied, to take into account the relative concordances between the different categories. The imputed relative distances between successive classes were set as 1.

Kappa test was conducted with the online calculator provided by the website Vassarstats and developed by Richard Lowry (2011).

To assess if there is a difference in the reliability of respondents regarding their expertise, a comparison of the observed Kappa valued between the experimented respondents and the non experimented respondents was undergone, using a Mann and Whitney test using the excel fact sheet developed by Anastats (2009). Significance was taken as p<0.05.

4. Data analysis

4.1 Multivariate analysis : Multiple correspondence analysis

Because of the large number of criteria (45), multivariate analyses were the most appropriate tools to describe the relationships between the diseases and to underline which criteria support their differentiation.
Thanks to their ability to examine the relationships existing between various variables, MA have been widely used in epidemiological studies to extract key information from large datasets and to understand correlation between variables (Costard et al., 2009; Ribbens et al., 2008). Multivariate analyzes encompass several methods among which the multiple component analysis (MCA) is specifically dedicated to investigate categorical variables. The main objective of MCA is to summarize the associations among a set of categorical variables in a small number of dimensions, and to give a low-dimensional graphical representation of these associations. So, by assigning numerical values to the individuals, and the different categories of the variables, this technique is able to find quantification for different dimensions that optimize the differentiation of categories from each others (Ribbens et al., 2008). As MCA deals only with categorical variables, it avoids any assumptions about the distribution (Dohoo et al., 1997).

MCA is conducted on a contingency table which is an individuals x variables matrix, where the rows represent individuals and the columns the values of the variables. The distance matrix is computed based on the distances between the rows of the data matrix, using the Euclidean method. Then a factor analysis is performed by defining projections (or factors) representing an optimized quantitative summary of the relationships between variables. Construction and selection of the factors is performed so to keep in the projection as much of the variability as possible of the complete data set. A factor is therefore a linear combination of the variables and is characterized by its eigenvalue, which indicates the variability (or inertia) of the data it represents. The first factor is the projection which represents the highest amount of variance, and each other factor is defined so that it captures the variance not explained by the previous factor (Costard et al., 2009). The correlation ratio, calculated for each variables, measures the participation ('loading') of the variable in the inertia of each factor and allows to interpret the information summarized in each factor (Dohoo et al., 1997). Finally, variables which were used to build the factorial axes and individuals are plotted on a joint
display to show the relationships between variables and individuals.

In order to investigate the ability of the criteria to differentiate the diseases between them, two different types of MCA were applied. First, a between MCA was conducted to underline variables differentiating diseases. The principle of the between MCA is to calculate factors in order to maximize the inter-group variance and minimize the intra-group variance. Thus, the factors are constructed in order to well represent the inter-group variance of the data set. As the correlation ratio measures the degree of representation of the variable by the factor, if the variable is highly correlated to the factor (high correlation ratio), that means that its distribution is characterized by a high inter-group variance (e.g. high variance of the respondents answers between the diseases). Then, a within MCA was applied on the data set. Contrary to the between MCA, factors are constructed in order to maximize the intra-group variance and minimize the inter-group variance. So, when a variable is highly correlated to the factors, that means that its distribution is characterized by a high variance within the values given for the same diseases (same group).

MCA were performed on all the variables and then on the five different categories of variables: epidemiological features, impact on human health, impact on animal health, impact on economy, impact on society.

The average of the correlation ratios for all the variables regarding the different factors of the MCA were calculated for the between MCA and the within MCA. Multivariate analyzes were conducted with the statistical software R 2.11.1 (R development Core Team, 2010), using the package ade4 (Dray et al., 2007).

4.2 Weighting the respondents' answers to take into account the uncertainty in the answer
In a classical MCA, all the individuals and variables have the same weight in the calculation. To take into account the level of expertise and the level of confidence of the respondents in the computation of the data for the same group of diseases, a weighting system was applied to the values of the variables (Birol et al., 2010). The aggregation was performed in order to allocate a more important weight to the answers given by respondents who mentioned a specific expertise for the disease selected and to answers for which the level of confidence of the respondents was high. To do so, a weighted average was computed based on the level of confidence (ranging from 1 to 5) and the experience (1, respondent without experience and 2, respondent with experience) for the disease.

In case, respondents forgot to self-assess the confidence in their answer, the class with the highest frequency for the other answers of the questionnaire was assigned to missing data.

4.3 Classification of diseases

Hierarchical cluster analysis was used to differentiate groups of diseases with similar profiles (epidemiological complexity and impacts on health and socio-economy). HCA used a set of dissimilarities for the 59 individuals being clustered. Initially, each individual is assigned to its own cluster and then the algorithm proceeds iteratively, at each stage joining the two most similar clusters, continuing until there is just a single cluster (Anonymous g). HCA was conducted on the factorial coordinates of the individuals provided by the previous between MCA, using the Ward's minimum variance method which principle of aggregation is to minimize intra-cluster variance and to maximize inter-cluster variance (Costard et al., 2009). The distance matrix was computed using the first 14 factors (representing 90% of the variance) from the previous MCA.
Classifications were conducted with the statistical software R 2.11.1 (R development Core Team, 2010), using the package ade4 (Dray et al., 2007).

4.4 Profile of diseases

The way the classes of the variables were encoded using a numerical scale that reflects the complexity and the burden of the disease, allows to sum the scores provided by the respondents to obtain a total score per disease or per category of variable, in order to quantify the impact of the disease in terms of five aspects:

- epidemiology: the epidemiological profiling aims at determining the expected level of complexity of a disease;
- impact on public health: this steps aims at determining the nuisance potential of the disease in terms of human health, taking into account 2 complementary notions, the strictly disease-related threat to human health and the possibility of controlling the disease in human; this will give an highest impact to diseases with a strong nuisance potential in humans and few possible means of control.
- impact on animal health: idem but at the animal scale
- impact on economy: the economic profiling of a disease aims at determining its nuisance potential for the economy, and takes into account direct and indirect impact of the diseases at the animal and human scale;
- impact on society: the impact of the disease on society indicators allows to assess the perception of the disease by public based on its impact on economy, environment, health, control means...:

To do so, the sum of the overall scores and the score for each category of criteria, divided by the number of criteria taken into account, was computed. In case several respondents answered for the same disease, the weighted median of their scores
RESULTS

1. Descriptive results

In total, 111 respondents entered the questionnaire in the website during the period of time of 45 days it was open. 59 persons completed the questionnaire (53%). The majority of respondents were veterinarians (57%) and/or epidemiologists (32%), working mainly for international and governmental organizations (respectively 32% and 35%) and for research institutes (26%) (see Figure 2). The field of expertise of the respondents was animal health for 48%, epidemiology for 48%, veterinary public health for 32% and public health for 18% (see Figure 3).

Respondents had to choose among a list of 25 zoonotic diseases or had the choice to propose one of their own choice. On the 25 diseases, completed questionnaires were obtained only for 17 of them. One more questionnaire was completed for swine influenza, which was not among the proposed diseases. For some diseases, several completed questionnaires were filled, as for HPAI (21), Rabies (11), Anthrax (3), Leptospirosis (4), Salmonellosis (3), Scrub typhus (2), Bovine tuberculosis (2), Filariasis (2), Streptococcus suis (2).

The percentage of respondents who quit the questionnaire without filling it entirely increased as they went along the questionnaire: 44% at the end of the first section about the impact on animal health down to 6% at the end of the last section about the impact on society.

Among respondents who completed the questionnaire, people mainly mentioned a specific expertise in zoonoses (71.2%) and usually filled the questionnaire choosing the
disease they had experience for (59.3%). On the contrary, people without any experience on zoonoses were more numerous (61.5%) among respondents who dropped the questionnaire before the end.

For the completed questionnaires, 66.1% of the respondents were working at the national level in one of the southeastern Asian countries (including continental and insular, as well as people working in China) and 22.0% at the regional level. 11.9% of the respondents were based outside the region (Sri Lanka, India, Australia) and did not mention any professional activities in South East Asia.

The respondents were required to self assess the level of confidence for each answer provided, on a range from 1 (low confidence in the answer) to 5 (high confidence in the answer). Three categories of confidence were done: low level of confidence (class 1 and 2), medium (class 3) and high (classes 4 and 5). Computing the mode for the level of confidence of each respondent (eg the class of confidence the most mentioned by each respondent all along the questionnaire), it was observed that 62.7% of the respondents answered the questionnaire with a high level of confidence, 35.6% with a medium level of confidence and 1.7% with a low level of confidence. The distribution of the level of confidence for all the variables was the following: low for 10.4% of the answers, medium for 29.1% and high for 58.1%. 2.4% of data about level of confidence are missing. Considering the frequencies of respondents answers within each confidence categories for each category of criteria, the field with which the respondents were the most confident with their answers is epidemiology (73.1%), followed by animal health (61.4%), public health (59.1%), economy (54.5%), society (50.9%) (see Table 5). The criterion in each category for which the frequency of answers with a low level of confidence was the highest was: the variability of the pathogen (8.8%), the prevalence of the diseases in animal (29.8%) and human (30.5%), impact on international trade (17.5%), impact on environment and biodiversity (19.3%). The criterion in each category for which the frequency of answers with a high level of confidence was the highest was:
the zoonotic potential of the agent (82.8%), the availability of diagnostic tools for animal in SEA (75.9%), the disease knowledge in human (69.0%), direct economic impact of animal diseases (68.4%), level of priority of the disease for stakeholders (60.3%).

2. Evaluation of data collection

2.1 Correlation between the self-assessed level of confidence and the experience

The level of confidence was significantly higher for experimented respondents (mode 4) than for non-experimented respondents (mode 3) concerning HPAI (with a risk of error of 5%). But no significant difference was observed for respondents answering about Rabies (with a risk of error of 5%).

2.2 Evaluation of the survey using external data sources

The observed Kappa values (associated with the confidence interval), that measures the inter-rater reliability between each respondent and external data (collected from the bibliographic review) are displayed in Appendix D Table 2.

The agreement between respondents and bibliographic study, as explored by the Kappa inter-rater agreement test, appears to be moderate (median 0.43, [0.08,0.65]), regarding the guideline of Landis and Koch. As explored by the Mann and Whitney test, there is no difference in the degree of agreement between respondents answers and bibliographic data for respondents with experience (median: 0.44) than with those without (median: 0.43), with a risk of error of 5%. Nevertheless, it exists one extreme value (0.08) which impacts a lot on this result. Indeed, when canceling it from the contingency table, there is a significant difference (with a risk of error of 5%)
3. Evaluation of the criteria

The correlation ratio (CR) intra and inter-group, for each criterion, was computed and compared.

Results of the CR for all the variables regarding all the factorial axis are given in the Appendix E. The 12 first criteria that influenced the most the inter-group variance (e.g. the variability of the respondents answers between the different groups of diseases) mainly belonged to the category about the impact on animal health (n=4) and the economic impact (n=4), following by those belonging to the category about the impact on society (n=3). Only one criteria was belonging to the category about the impact on public health an any to the one about the epidemiological features. The 12 first criteria that influenced the most the intra-group variance (e.g. the variability in the answers of respondents for the same disease) were distributed homogeneously between the different categories of criteria: epidemiological trends (n=2), animal health (n=2), human health (n=3), economy (n=3), society (n=2) (see Tables 6 and 7).

Looking deeper into each category of criteria, the computation of the ratio between the intra CR and the inter CR for each criterion allowed to distinguish criteria which minimized the intra-variability and optimized the inter-variability. The values of the inter/intra CR for all the criteria are presented in Table 8. In the epidemiological category, criteria with such a ratio greater than two (n=3) were: speed of spread of the disease within animal population (3.35), zoonotic potential of the pathogen (2.48) and the variability of the pathogen (2.2). For criteria relative to animal health (n=4): effectiveness of existing surveillance measures (2.7), success of control in other countries (2.35), impact at herd scale (2.34) and prevalence of the disease (2.06). For criteria relative to human health (n=3): effectiveness of existing surveillance measures (3.98), impact at individual scale (3.69), effectiveness of existing prevention measures (2.7). For criteria
relative to economy (n=4): impact on international trade (3.95), direct economic impact of animal disease (3.22), indirect economic impact of animal diseases (2.59), poverty impact of the disease (2.04). For criteria relative to society (n=5): level of priority for stakeholders (3.54), economic cost of the disease (2.91), potential impact on media (2.87), impact on animal welfare (2.82), threat to species with a social value (2.39).

The results of the intra-group variance and the inter-group variance provided by the MCA were: 0.615 and 0.385 for all the variables, 0.600 and 0.400 for criteria relative to epidemiology, 0.611 and 0.389 for criteria relative to animal health, 0.644 and 0.356 for criteria relative to public health, 0.589 and 0.411 for criteria relative to economy, 0.616 and 0.384 for criteria relative to society.

4. Profile of diseases

For 7 diseases (44%), the epidemiological profile was quoted the highest: Bartonellosis, Japanese encephalitis, Leptospirosis, Rabies, Salmonellosis, Scrub typhus, Swine influenza and Trematodosis.

For the other diseases, the economic impact was quoted the highest for five (28%) of them (Anthrax, HPAI, Bovine tuberculosis, Brucellosis, Filariasis, Leishmaniasis) and the public health impact for four (22%) of them (Giardiosis, Nipah, Streptococcus suis and Taeniasis). For one disease (6%), the social impact was quoted the highest (Anthrax). For any of the diseases, the impact on animal health was assessed as the main burden of the disease.

According to the respondents, the disease with the greatest epidemiological complexity is Bartonellosis (4.38), while Trematodosis (4.33) is the one with the greatest impact on animal health and human health (4.18) and HPAI on economy (3.14) as well as on society (3.9).
The score of each disease regarding the different category of criteria and the criteria altogether are displayed in Table 9.

5. Classification of the diseases

The hierarchical cluster analysis performed on the results of the between MCA provided the dendograms of the clusters of diseases regarding their profile. Simultaneously, the total score computed for each disease was displayed within the classification.

For the dendograms representing the individuals (see Figure 4), aggregated by the MCA, regarding all the variables, 4 clusters were clearly identified: one gathering Leishmaniasis and Nipah, one gathering 7 diseases (Salmonellosis, Anthrax, HPAI and Rabies grouped together; Leptospirosis and Scrub typhus grouped altogether; Filariasis; Leptospirosis), one gathering Bovine tuberculosis, Swine influenza, Brucellosis, Streptococcus suis, and a last one gathering Bartonellosis, Giardiosis and Trematodosis.
DISCUSSION

1. Data collection

The findings of this study highlight that data collection through a web-survey may be an interesting alternative to expert opinion elicitation when collecting data about diseases.

Expert opinion is widely used in epidemiological survey to collect data about diseases when data are scarce or too costly to collect through classical epidemiological studies (Mitchell et al, 2009; More et al, 2010; Gale et al, 2009; Birol et al., 2010). But it is challenging to select and involve experts with an enough good knowledge to give inputs about a broad range of zoonoses. In this study, data collection method was designed in order to avoid biases related to a lack of knowledge of experts for a broad range of zoonoses. Instead to ask a narrow list of participants to score various zoonotic diseases against a list of criteria, it was decided to ask to numerous people involved with zoonotic diseases in South East Asia to fill the questionnaire about a self-selected disease, expecting that they will pick the one they are the most familiar with. Even with the self-selection of the disease, varying levels of knowledge among respondents were also addressed by using a self-weighting assessment approach to allow respondents to weight their answers regarding their confidence.

The snowball sampling approach used to maximize the number of recipients did not allow to select respondents on specific criteria of expertise and location, but the length of the questionnaire and the high level of knowledge required by the questions, likely played a role in the selection of respondents who completed it. Indeed, among respondents who completed the questionnaire, most of them mentioned a specific experience for a zoonotic diseases (71.0%) and were specifically working in countries of South East Asia (88.1%). As a result, the self assessed level of confidence of respondents
in their answers was high as most of them (98.3%) answered with an overall level of confidence medium or high. Furthermore, even if most of the respondents were veterinarians or epidemiologists (likely because of their predominance in the starting mailing list), the level of confidence was acceptable in the field of public health, economy and society for which the percentage of respondents who were highly confident in their answers was respectively 59.1%, 54.5% and 50.9%. Nevertheless, this sampling approach may have led to an over-representation of some professional categories (veterinarians) and a discrimination against countries where there is a weak internet connection. Indeed, in case the connection failed, the questionnaire quit without saving the questions answered priory.

The findings of the study did not support that the level of confidence was strongly correlated to the specific experience: the level of confidence was found significantly higher for experimented respondents answering for HPAI but not for Rabies. This result can be explained by the difference in the complexity of these two diseases and in the basic level of knowledge of health professionals. Indeed, HPAI is an emergent disease with complex epidemiological patterns and new findings regularly published in the scientific literature, although the aetiology and epidemiology of rabies is already well understood and few gaps remains in the knowledge of this disease. As a result, even participant with no specific expertise in Rabies, have an enough good knowledge to answer questions about this disease with confidence.

2. Difference and accuracy of respondents' answers

The agreement between respondents and bibliographic study (median 0.43), as explored by the Kappa inter-rater agreement test, appeared to be moderate, regarding the guideline of Landis and Koch. Furthermore, the high level of variability intragroup (0.615) computed by the MCA emphasized that the variability of the respondents answers for a same disease was important.
These findings can be explained by response biases due to a lack of clarity of the questionnaire at different levels. Despite the fact that the questionnaire was pre-tested prior to the mailing, some ambiguities remained in the definition of some criteria and classes associated. For instance, when respondents were asked to assess the range of animal species commonly involved in the disease transmission, some respondents had obviously grouped all the species belonging to the same Order or Family while others did not. Thus, in the case of Scrub typhus, some participants answered “1 species” (for rodents) while others answered “4 species and over” to take into account all the species of the Order Rodentia involved. Then, for some specific criteria, it was difficult for respondents to answer at the regional level as the situation in the different countries of South East Asia might vary a lot in terms of epidemiology but also in terms of geopolitical, socioeconomic and sociocultural contexts that triggers some inequities in the implementation of public and animal health activities. As a result, respondents answered focusing on the specific context of his/her country of experience. Furthermore, the two sections about impact of the disease on public health and impact of the disease on animal health were encompassing the same questions and it might occur that from time to time, some respondents were confused and did not answer for the appropriate section. It was also noticed that, despite the particular attention paid to their definition, the classes proposed to the respondents to choose were not appropriate for some diseases. For example, for the criteria 'Effectiveness of existing control measures at a global level', the level of availability of vaccination and treatment was declined to define the different classes but there is no option proposed in which vaccination is not available but a treatment might be effective. However, this option is the most appropriate for some diseases, such as infection to *Streptococcus suis* for which no vaccination is available for human but antibiotics might be effective to treat the infection. Finally, it was not clearly defined if the questions were dealing with declared disease or infection and thus for some diseases as Nipah virus, for which there are no cases in South East Asia, although the infection is widespread and endemic in wildlife, some questions were difficult to answer
and might lead to variability in respondents answers.

Nevertheless, bibliographic data can not be considered as a “gold standard” and even if personal focus is nonexistent when filling the questionnaire using bibliographic data, it always remains a part of subjectivity. Thus, the moderate correlation between answers of respondents and bibliographic data can not be only attributed to a lack of accuracy of the data collected through the websurvey.

3. Assessment of the criteria

The correlation ratio calculated for each criteria regarding the different factorial axis of the multiple correspondence analysis allowed to compare criteria on their ability to discriminate diseases.

The results obtained from the MCA performed on all the variables indicated that the economic impact is the category that triggers the most important variability between the diseases. Criteria that support the variability intra-group are equally allocated to the different categories. Regarding the inter/intra ratio of the criteria within each category, both for animal and public health, indicators relative to the efficiency of prevention and surveillance measures appeared to be the more pertinent to discriminate diseases. For the economic category, the results indicated that the economic impact of the animal disease ensured a greater differentiation than the economic impact of the human diseases. Five criteria relative to the societal impact among the 10 evaluated presented a high value of the inter/intra ratio, underlining that the impact on society is an important aspect to take into account to differentiate diseases.

The ratio between the intra CR and the inter CR, obtained by performing MCA, as well as the level of confidence of the respondents, obtained through the questionnaire, are two measures that can be combined to help in selecting accurate and relevant criteria for
prioritization. For instance, in this study, in the category of epidemiology, a particular attention should be paid to the criteria 'speed of spread of the disease in animal population', 'zoonotic potential of the agent' as well as 'variability of the pathogen', which combined a high inter/intra correlation ratio (respectively 3.35, 2.48 and 2.2) and a large proportion of respondents which answered with a high level of confidence (respectively 77.6%, 82.8%, 63.2%). On the contrary, criteria with the lowest inter/intra CR do not ensure a good discrimination between diseases because of the high variability of the answers of respondents for a same disease and a low variability of the answers between diseases. Nevertheless, looking at the level of confidence self-assessed by the respondents and associated to these criteria may give some interesting insights about the source of this variability. A high intra CR associated with a high level of confidence of the respondents may suggest that the source of the variability is mainly due to a difference of understanding between the respondents or an inappropriate definition of the classes which did not allow an efficient differentiation between the diseases, while a high intra CR associated with a low level of confidence may be due to a lack of knowledge of the respondents to answer this specific point. So in the first case, it emphasizes the need to refine the definition of the criteria and their classes, to improve their understanding and their ability to differentiate diseases and in the second case, it identifies some gaps in the knowledge of the disease that could support further key research questions. For example, in this study, when looking at the epidemiological category, criterion 'distribution of the diseases in South East Asia' showed a low inter/intra ratio as well as a large proportion of respondents with a low level of confidence in their answers (6.8%). This result suggests that the high variability in the respondents answers is mainly due to a lack of knowledge on this particular point. On contrary, the criterion “presence of the disease in South East Asia” which combined a low inter/intra ratio (0.83) and an important proportion of respondents with a high confidence in their answers (72.9%), should have been understood differently by the different respondents.

These findings must be interpreted in light of biases in the methodology at
different levels. The size of the different group of diseases was different, ranging from 21 for HAPI to one for Bartonellosis, Brucellosis, Giardiosis, Japanese encephalitis, Leishmaniosis, Nipah, Swine influenza, Taeniasis, Trematodosis. For diseases for which several answers were obtained, the aggregation of the different answers within the MCA allowed to take into account the level of uncertainty (level of confidence and specific expertise for the disease). For the disease for which a single respondent answered, data were point values. Furthermore, calculations performed by the MCA take into account the different values of the variables but also the size of the different group of individuals. When computing the average for a same group, the principle of the MCA is to calculate it for each class of the variables, weighting each class with the total number of answers obtained per class and then, each individual (disease) is also weighted according to the number of individuals belonging to the same group. So the number of individuals in each group is taken into account twice in the calculations of the MCA. In this study, where there was a wide range for size of each group, the final outputs of the MCA may be biased and the values of the correlation ratio should be interpreted carefully.

4. Profile diseases and classification

Displaying the classification of disease simultaneously with the scores provided by the respondents provides a good overview of how the disease clustered regarding their profile and how important their impact were in term of epidemiology, health, economy and society.

But the results must be interpreted in light of the biases triggered by the data collection as explained previously (variable effective of respondents for the different diseases, high variability in respondents' answers underlining a misunderstanding of the questions) but also by the potential redundancy of some criteria. For instance, criteria relative to animal health and economy are strongly dependent as any disease with a great impact on animal health at the population scale (criterion belonging to animal health
category) fatally triggers proportionate economic impact in terms of production losses and cost of control measure (criterion belonging to the economic category). Furthermore, for Giardiosis, the average level of confidence of the solely respondent was very low (1.22) and this finding brings into question the reliability of the data collected from this participant. Moreover, it is important to keep in mind that the economic impact is assessed regarding both the direct production losses due to the symptoms and the cost of the control measures. So, for a disease as HPAI for which surveillance and control programmes have been carried out worldwide by international and national organizations, the cost of the prevention and control measures is very high and so a greater economic impact (score 4.43) is given to this disease comparing to other important economic diseases as Brucellosis (score 3.29) or Salmonellosis (3.57) for which no costly programme are applied.

5. Towards prioritization

Prioritization may be an efficient tool for policy-makers in charge of setting surveillance system and control programme, to target efficiently diseases that need to be addressed in advance to others. In developing countries, the importance to prioritize disease in a subjective way is even more significant. In South East Asia, the occurrence of zoonoses and their spreading are facilitated by the lack of public and animal health capacity on one hand and the exceptionally high population growth rate, the agricultural expansion and intensification, the human encroachment of game reserves, the globalization of commerce and trade, and more frequent contacts between humans, domestic animals, and wildlife on the other hand (Caceres and Otte, 2009). Furthermore, the region is considered as an “hot spot” for future emergence and spread of zoonoses because of suitable environmental conditions (Jones et al., 2008): warm and humid climate, vast array of biodiversity, high frequency of natural disasters (as flooding), etc. Finally, most of the zoonoses defined as “neglected tropical diseases” by the WHO are endemic in the area, as anthrax, rabies, filariasis, brucellosis, bovine tuberculosis or
cysticercosis. Neglected tropical diseases are infectious diseases that principally impact the world's poorest people. They are so-called because of the general disregard for diseases impacting the developing world and because of the intensity of focus on the “big-three”, HIV-Malaria-Tuberculosis, to the detriment of other diseases. Nevertheless, most of them are of particular importance in term of their frequency amongst poor communities and their clinical, social and economical impact and have excellent prospects for successful control with existing technologies (Feasey et al., 2010).

So there is a strong need to address prioritization of zoonoses with subjective tools, adapted to the context of South East Asia.

The findings of the study open new lines of work to improve prioritization models or to develop new tools for prioritization, adapted to the context of zoonoses in South East Asia but that can be extend to other prioritization contexts.

Firstly, MCA can be a very useful tool to refine the list of criteria prior to performing the prioritization exercise. The choice of the criteria against which the prioritization is performed remains a weak point in most of the studies although it is determinant for the performance of the method (Krause et al., 2008a). On one hand, their choice should be made from the point of view to get a well-balanced representation of the components of the disease to comply with the aim of the study – in the case study of zoonoses, public and animal health criteria, socio-economic aspects in relation to public and animal health, environment impact and the perception by population. But on the other hand, to deal with the scarce availability of some data (Kemmeren et al., 2006; Fosse et al., 2008) and to ensure a clear differentiation between diseases (Cardoen et al., 2009), the list of criteria may be restricted as much as possible. The findings of this study indicates how MCA, combining with the analysis of the level of confidence of respondents in their answers, can help in identifying key criteria that ensure a good differentiation between diseases based on data collected through a web-survey. According to the objective of the prioritization exercise, an extended list of relevant criteria can be
first set and followed by a preliminary analysis of the correlation ratio and the level of confidence, to determine those for which a reliable differentiation between diseases is obtained, those for which the definition needs to be improved and those which should be left. With a particular care to ensure that all the components of the diseases are taken into account to comply with the aim of the prioritization, this approach allows to refine the list of criteria, in order to base the further scoring exercise on clear, relevant and accurate criteria. The clarity of the criteria and classes is a key point when using a websurvey as participants answer on their own without any external help (like a facilitator in a workshop) and there is no way to check for the correct understanding of the questions.

Secondly, the web-based questionnaire can be an interesting alternative to the scoring step by experts, commonly used in semi-quantitative models (Discontools, 2005). Despite the fact that there is no objective of prioritization announced in first instance, the questionnaire was built following the frame of ones used for scoring diseases in semi-quantitative prioritization methods. Once the objective of the prioritization process is clearly defined, classification given by respondents can be recoded into ordinal data in order to obtain a score for each criterion, which can be then aggregated to lead to an overall score per disease, base of the ranking. Contrary to the approach developed in previous methods, it is not a restricted panel of experts who is asked to rank a broad range of disease but a large population of stakeholders who is asked to give inputs about one disease that they have self-selected. So, this methodology circumvents the problem of the lack of knowledge and the subjectivity due to professional focus, encountered with expert opinion elicitation. In some methods, to manage the lack of ready knowledge of the experts for a wide range of diseases and to improve the objectivity and the accuracy of their responses, information data based on literature study are given to the experts to help them in scoring the criteria (Cardoen et al., 2009; WHO, 2006). This approach presents different constraints and disadvantages. First, it is not always possible to gather from the literature some data about diseases, especially in developing countries and it may be very resources intensive - that's why expert opinion elicitation is usually carried
out to avoid this two constraints of data collection. Secondly, if this help aims to decrease the subjectivity of experts by making their scores evidence-based, their own judgment are fatally biased by the external information and the scoring is not based anymore on a purely expert opinion but on a mix of expert inputs and bibliographic data, in which the weight of each party can not be assessed.

Comparing to expert opinion, the main advantages of such a questionnaire are that it is inexpensive, fast and makes a survey in a large population manageable. But possible disadvantages are related with the clarity of the questions, the validity of the responses and low response percentage (Ribbens et al., 2008). In this study, despite the pre-testing step of the questionnaire, the high intra-group variability of the variables as well as the moderate correlation between respondents answers and bibliographical data emphasized the fact that the criteria and the definition of the different classes associated, were not clear enough to ensure that they were understood the same way by all the respondents.

So, electronic-based questionnaire appears to be a reliable alternative to expert opinion if the questionnaire is carefully designed in order to ensure that the discrepancies among respondents answers are due to a difference of opinion and not to a difference of understanding. The validity of data needs to be carefully analyzed to be sure that all raters apply data collection method in a consistent manner. Different methods are currently available to evaluate the quality of collection method. Some are based on the inter-rater reliability assessment (probability), as the Kappa or the Fleiss's test (Li Gwet, 2008) as some others calculate the sensitivity and specificity of data regarding a gold-standard method (Garabed et al., 2009) or geographic information system (Richardson et al., 2009).

Furthermore, as previously mentioned, to improve the accuracy of the approach proposed in this study, the analysis of data should be performed on the same size of individuals per diseases. The consultation of high number of experts results in the dilution of the effect of individual subjectivity and misinterpretation, and will allow to work with distribution of score instead of single point values. As a result, the final ranking of diseases will take into account the uncertainty and the variability of the system and will be more accurate. (Cardoen et al., 2009; Havelaar et al., 2010). Some others lines of work should be also
interesting to explore, in order to improve the accuracy and the relevancy of the data collection through a websurvey. To improve the representativeness of the respondents and to take into account the perception of the diseases by all the stakeholders involved with zoonoses, the questionnaire may be declined in different versions adapted to the different professions (veterinarians, medical doctors, economists, farmers, etc.). Furthermore to deal with the part of subjectivity which remains with respondents' answers, the definition of the criteria may focus on the identification of 'proxy criteria'. Those criteria do not present a great interest in themselves, except the fact that they are not submitted to professional focus of respondents and that they allow to assess other variables with which they are closely related to.

Finally, classification of disease based on the results of the MCA provides clusters of diseases with similar profiles, which can be used as a start for prioritization exercise. Instead of ranking the diseases regarding each other, they are first clustered together depending on their characteristics and then one in each cluster is selected as a priority. By focusing efficiently efforts on this disease to improve the surveillance and control systems, it can be expected that the future improvement obtained for this disease will spread to the other diseases of the same cluster. This approach presupposes that the criteria are carefully selected to be sure that the clusters of diseases are accurate and relevant. An important advantage of this approach is to avoid the risk of vertical programmes which is always present when addressing the prioritization task pathogen-by-pathogen (Krause et al., 2008b). Indeed, when following a strict pathogen-focused approach, the original purpose of any health activity would be severely constrained and it would result in the competition of vertical programmes if decision makers do not keep in mind the operational commonalities among the high-priority diseases. To avoid this undesirable consequence of prioritization, some groups have therefore performed prioritization exercises focused on general health issues rather than on individual pathogens (Eger et al., 2009) but the way diseases are grouped do not necessary lead to homogeneous clusters of diseases which require the same individual methodological
approach. Performing a classification supported by criteria (variables) carefully selected regarding the aim of the prioritization should lead to the formation of clusters of diseases with a similar profile and so, it can be expected that any efficient work done for this disease would trigger some beside benefits on the other belonging to the same cluster, by reinforcing the whole surveillance and control system (WHO, 2008). For example, if a prioritization work is undergone to set a list of priority diseases on which a programme of strengthening capacities of diagnostic laboratories should focus on, a preliminary classification of diseases can be carried out to clusters diseases regarding the availability of diagnostic infrastructure, the complexity of the diagnostic techniques, the level of biosecurity required for analysis, the existence of a surveillance programme, etc. Once the classification is obtained, one or two diseases can be selected among the clusters to focus the activities of the programme on. The selection of diseases can be obtained by crossing with the national priority list of the country in which the programme is settled in order to improve the commitment of all the stakeholders involved in diseases surveillance at the country level.
CONCLUSION


