ELICITATION OF EXPERT KNOWLEDGE ON RISK FACTORS FOR CLASSICAL SWINE FEVER TRANSMISSION IN SWITZERLAND

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Dans les cas où les données sont rares ou peu fiables, l'avis et le consensus des experts peut être une alternative permettant la conception d'un système d'expert et d'un modèle de simulation. L'analyse conjointe adaptée (ACA) est une technique relativement nouvelle dans le domaine vétérinaire. Cette dernière a été utilisée pour les facteurs de risque de la peste porcine classique (PPC) en Suisse. Les experts de la PPC, dans le domaine de la recherche, dans les Services de santé animale et l'administration vétérinaires, ont été sollicités pour participer à deux groupes de travail. Chaque participant est pourvu d'un ordinateur en vue de compléter un questionnaire qui lui a été adressé. Il a été demandé aux participants d'estimer l'importance relative des facteurs de risque de la contamination par la PPC en Suisse entre les fermes. Un ensemble de 10 facteurs de risque potentiels a été évalué. D'autre part, on a demandé aux intervenants d'évaluer la technique de l'ACA à partir d'un entretien. Le facteur de risque le plus important selon l'avis des experts, était la commercialisation des animaux avec 26.6% d'importance relative, suivi par une alimentation impropre et les échanges de cheptels. D'une façon générale, la technique ACA a été bien acceptée par les participants, et pourra être utilisée dans le futur. Les résultats de cette étude ont été comparés à ceux trouvés par une étude allemande. Une bonne concordance a été observée entre les résultats trouvés par l'étude épidémiologique allemande et par la technique d'estimation en Suisse vis-à-vis de l'importance des facteurs de risque. La possibilité et les répercussions de l'utilisation des systèmes experts dans l'aide à la décision dans le futur sont discutées.

INTRODUCTION

During an exotic disease epidemic, large amounts of data are collected and have to be processed efficiently in order to allow appropriate decision making. Computer programs can facilitate this task to a large extent by the use of powerful data management tools and epidemiological simulation models (Morris et al., 1993). Such models are based on the characteristics of the disease. However, in many countries exotic disease outbreaks are rare, and if they occurred in the past, they were seldom documented in detail. Therefore, necessary inputs for outbreak simulations such as the relative importance of alternative disease transmission pathways are often lacking. In a situation of incomplete information, the consultation of experts is a possibility to complete the available data.

Different interview techniques for the elicitation of expert opinions have been used in the field of exotic animal diseases. Recently, Horst et al. (1996) introduced computer-based questionnaires using conjoint analysis and adaptive conjoint analysis (ACA) to estimate risk factors for disease introduction in a country. One advantage of these methods is that each expert expresses his/her opinion independently. This prevents psychological and sociological processes that influence a person's opinion in a group situation.

This paper describes the use of ACA in Switzerland for the quantification of risk factors responsible for between farm spread of classical swine fever (CSF).

MATERIAL AND METHODS

Swiss experts with different backgrounds were invited to participate in either of two identical workshops. Experts were either researchers in veterinary virology (research group), federal veterinary office staff (administration group) or district veterinarians (field group). The directors of the research and administrational institutions involved selected expert candidates from among their staff after having been explained the objective of the experiment. The district veterinarians were invited to participate in the exercise during one of their regular training seminars.

Each workshop started with a short introduction to the subject and some technical explanations. The questionnaire used in the experiment was fully computer-supported. Each participant was provided with a personal computer to work independently from the others. Technical questions were answered individually. The questionnaire was designed using ACA software (Sawtooth Software, Evanston, IL).

The exercise consisted of two parts: 1) ACA task, and 2) evaluation of the ACA technique from the experts' point of view. In the ACA part, the participants were asked to estimate the relative importance of risk factors for the farm-to-farm transmission of CSF in Switzerland. ACA is based on the principles of conjoint analysis, which was originally used in marketing research for the elicitation of consumer preferences (Green and Srinivasan, 1990). The basic assumptions in conjoint analysis in the context of animal diseases are: 1) a risky situation (profile) can be described by the levels of a set of risk factors (attributes), and 2) a person's judgement over a situation is based on the levels of the risk factors (Horst et al., 1996). Risk factors can have two levels: present or absent.

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The risk factors considered in the experiment were: animal trade between farms, animal trade to slaughter, visitors with pig contact, visitors without pig contact, livestock transport vehicles, swill feeding, airborne transmission, rodents or birds, wild boars.
First, the candidates were asked to rank the levels of each risk factor to assess the preferred level. Then, pairs of profiles each consisting of 2 or 3 risk factors with differences in one or several risk factor levels were compared and the preference of the candidate recorded. The program adapted the selected pairs according to earlier answers given by a candidate in order to maximise information gain while still limiting the number of combinations to be evaluated. All additional scores given by the candidate were used to update the original risk estimate for a risk factor using an iterative algorithm. In the end, the program designed a series of customised profiles for each candidate. These were progressing in preference from highly undesirable to highly desirable based on earlier answers of the candidate. The internal consistency of a candidate could thus be assessed. The relative importance of the different factors (utilities) were then calculated from the program output and re-scaled to add up to 100. For more technical details see Johnson (1993).
In the second part of the workshop, participants were asked to evaluate the ACA session, in which they had just participated, with respect to different criteria, such as technical feasibility of the technique or realism of profiles. A total of 7 questions were asked. Answers were given as scores ranging from 1 to 7.
The results from the ACA workshop were compared with field data from a recent CSF outbreak in Germany. The data included 121 farms infected with CSF during 1993-1995. The source of virus introduction was assessed at CSF notification. The source of virus for each farm was classified in one of 5 categories. The category 'neighbourhood spread' was used when no specific source of infection could be identified and the farm was at a close distance of another infected farm. This category is a conglomerate of risk factors (for example rodents, airborne spread) acting over a short distance.

RESULTS

A total of 33 experts participated in the exercise, 8 in the research group, 5 in the administration group and 20 in the field group. The results of one participant contained missing values and had to be excluded. Three participants had correlation coefficients for internal consistency <0.1 and were thus excluded from the analysis. The mean correlation coefficient of the remaining participants was 0.69 (SE=0.06). The results of the ACA are presented in Table I. Animal trade between farms is perceived to be the most important risk factor for CSF transmission between farms by Swiss experts. Swill feeding is also assigned a high risk ranking, while wildlife is considered to be of very low importance. There was no significant difference between the different participant groups (Friedman 2-way ANOVA).

Table I
Relative importance of risk factors for the transmission of CSF within Switzerland as estimated by experts (n=29)*

Risk factor	Estimated relative importance	95% Confidence interval
Animal trade between farms	28.2	24.8-31.3
Swill feeding	17.6	11.4-19.1
Livestock transport vehicles	13.5	10.3-15.0
Visitors with animal contact	12.4	7.1-14.0
Animal trade for slaughter	6.6	2.7-9.8
Slurry vehicles	5.3	2.1-8.4
Wild boars	4.9	3.8-7.9
Visitors without animal contact	4.2	1.3-8.0
Rodents, birds	3.8	0.1-6.3
Airborne transmission	3.5	1.0-6.5
	100.00	

* 4 persons excluded due to inconsistent answers (correlation coefficient < 0.1)

The results from the ACA experiment were compared with the virus source of 121 farms infected with CSF during 1993-1995 in Germany (Table II). The risk factors for transmission used in the ACA experiment were not identical to the source categories used in the field. This added difficulty to the comparison. The experts considered animal trade to be the main source for virus introduction, which was consistent with observations in the field. If categories related to visitors and risk factors acting over short distances in the expert experiment are summarised (23.9%), they rank second like visitor and neighbourhood infections in the field situation. However, swill feeding was ranked considerably higher by the experts while wild boar infection was perceived to be relatively less important. The risk of livestock transport vehicles was judged similarly.
All experts were capable to finish the computer-supported questionnaire, even though some of the participants had hardly any computer skills. The results of the evaluation of the ACA technique by experts are summarised in Table III. Most participants found the workshop technically easy to complete, interesting and even entertaining. However, some had concerns with respect to the realism of the profiles created by the program. It seems to be important to keep the sessions short in order to keep the participants focused and motivated.

Table II
Source of introduction of CSF virus to 121 farms during the 1993-1995 outbreak in Germany

Risk factor	Number of farms	%
Animal movement	36	29.8
Visitors & Neighbourhood	35	28.9
Wild boar	22	18.2
Livestock transport vehicles	19	15.7
Swill feeding	9	7.4
	121*	100.0

*for 47 additional farms, the source of virus introduction was unknown

Table III
Evaluation of adaptive conjoint analysis workshop by participants (n=33)

Question asked:	Score categories (%)			
The computer-supported session was ... (Score)	1-2	3-5	6-7	Median
Interesting (1) – not interesting (7)	43.8	43.7	12.5	3.0
Realistic (1) - unrealistic (7)	25.0	50.0	25.0	4.0
Intellectually demanding (1) – not demanding (7)	9.4	59.4	31.2	5.0
Technically complicated (1) - simple (7)	9.4	40.6	50.0	5.5
Boring (1) - entertaining(7)	9.4	56.2	34.4	5.0
Too long (1) – not too long (7)	21.9	43.7	34.4	4.0

DISCUSSION

The question of how exactly an expert in a specific field can be identified is difficult to answer. In this experiment, the objective was to include people who were dealing with CSF in their everyday working situation and who would have to make decisions in the case of a CSF outbreak in Switzerland.

The results of the workshops showed that the ACA technique seems to be a time-efficient and technically appealing technique for the elicitation of expert opinions in the field of exotic animal diseases. It was generally well received by the participants, although some experts questioned the realism of the profiles created by the ACA software. This issue should be addressed in the design of future questionnaires. Inconsistent answers of participants may be due to a lack of understanding of the program principles or due to a lack of motivation. By keeping the sessions short and by providing incentives to the participants, the impact of this problem should be reduced.

The use of expert opinion is very common in the development of expert systems. In the course of knowledge acquisition, usually some sort of structured interview is used. However, it can be difficult to obtain reliable quantitative information. Some interview techniques such as ACA allow the quantification of expert opinion using regression principles. Inconsistent experts can be identified and excluded from the final analysis. However, the outcome of the exercise will still be the assessment of an (subjective) expert opinion, which by definition is neither true nor false and therefore - strictly speaking - cannot be validated. Nevertheless, we compared the results of the workshop with field data in order to further investigate our results. The field data used came from a region in Germany that did not have exactly the same production structure as the pig industry in Switzerland. Therefore, some risk factors such as visitors or feeding practices may be different. Also, the definition of the virus source categories was not congruent. When discussing expert opinion also a potential bias by recent experience or general policy has to be considered. However, the ranking of the risk factors according to expert opinion in this experiment was relatively similar to the field results except that the third and the fifth ranks were swapped. Yet, a relatively large proportion of field outbreaks (28%) was not classified with respect to the virus source. Whether these farms would have been evenly distributed over all categories – as currently assumed – is unknown.

In conclusion, the use of quantitative techniques such as ACA for the elicitation of expert opinion is a possible alternative to field data in a situation where the latter is not available. Technical concerns in terms of the validity of estimates are inherent to the subjective nature of expert opinions and will have to be addressed on a case-by-case basis. The results of the CSF risk factor experiment are considered for use in a decision support system for the management of CSF outbreaks (EpiMAN-SF; Stärk et al., 1996).

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