20th International Pig Veterinary Society Congress

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Durban
South Africa

We are delighted that the International Pig Veterinary Society Congress 2004, decided to select South Africa as the host country for the 20th IPVS Congress. The Pig Veterinarians of South Africa will ensure that this congress lives up to the best traditions of previous congresses; incorporating an interesting and topical scientific programme, fascinating accompanying persons tours and an excellent social programme, allowing delegates the opportunity to network with their overseas colleagues.

This, the first IPVS congress on the African continent, will undoubtedly be of enormous benefit in generating solutions to the emerging pig veterinary challenges, especially those related to exotic and changing viral diseases, decreased use of antimicrobials and nutritional advances. The congress is important to further pig veterinary science in South Africa, to encourage younger veterinarians to join the pig industry, as a vehicle to generate funds for research and to improve the pig industry in Southern Africa.

South Africa is a magnificent and beautiful country, and offers tourists value for money. Thus, pre and post congress tours will be a major attraction for delegates to come to South Africa. Durban, in KwaZulu Natal, is a vibrant multi-cultured city with magnificent beaches, easily accessible game parks, theme villages and a moderate winter climate making it an ideal tourist destination. We urge our colleagues throughout the world to use this opportunity to get a glimpse of the continent’s rich and fascinating wonders and to enjoy the hospitality of their African friends.

Dr Peter Evans
Chairman: Local Organising Committee: IPVS 2008
DECISIONS BASED ON PORCINE HEALTH DATA – DO THEY PAY OFF?

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Introduction
Decision making is conducted in the porcine industry by numerous persons and at different levels. Each pig farmer needs to take business decisions at regular intervals, decisions that can have short-term, mid-term or long-term consequences. There are both strategic and operational decisions. And decisions may be related to a large number of issues such as housing decisions, management decisions or animal health decisions. In an organised industry, certain decisions will not be taken by the individual farmer, but by industry representatives who promote the interests of all pig farmers. Such decisions may be related to marketing, breeding strategies or political lobbying. Additionally, some decisions are taken at governmental level. These are primarily decisions related to subsidies, disease control programmes and welfare policy as well as international trade. All these decisions have one thing in common: They are somehow related to economics. Good decisions will result in a favourable development of economics, not so good decisions may result in economical losses. The losses are likely to be distributed between farmers, industry and government. Some decisions may also affect the economy of the entire society, including consumers and tax payers.

We take decision every day and most of us do not use a structured approach to decision making. However, the processes related to decision making have been the subject of research in the field of decision analysis for many decades and general patterns of decision making have been described (42). Tools to support decisions have also been developed in many areas including farming. Such tools are called expert systems or decision support systems (43). In structured decision making, information is collected and analysed and used to reach the decision outcome. Alternative decisions can be compared and the probability of the desired outcome estimated. However, examples of such structured analyses of decision processes in the pig industry are rare.

The topic of this article is the use of data – specifically porcine health data – to make decisions. The objective is to evaluate whether decisions based on such data result in more favourable economic outcomes than decisions taken otherwise. Because of the large number of decision levels and decision types outlined above, I will focus on decisions taken at industry or government level only.

Economic consequences of porcine diseases
Economic consequences of porcine diseases both exotic and endemic are undisputed. Depending on the type of disease, there are economic consequences both at the individual farm level (27) as well as at the national level. The extent of the losses due to a specific disease for an individual farmer depend on the frequency of occurrence of the disease, the effect of the disease on production and the costs of treatment and/or prevention. Examples of endemic diseases for which the economic importance was assessed are shown in Table 1 (list does not claim to be exhaustive).

<table>
<thead>
<tr>
<th>Disease</th>
<th>Country</th>
<th>Year</th>
<th>Annual losses</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Actinobacillus pleuropneumoniae</em></td>
<td>USA</td>
<td>1995</td>
<td>21 Mio $</td>
<td>21</td>
</tr>
<tr>
<td>PRRS</td>
<td>USA</td>
<td>2003</td>
<td>560 Mio $</td>
<td>35</td>
</tr>
<tr>
<td>Pre-weaning mortality</td>
<td>USA</td>
<td>1990</td>
<td>1,374 $*</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>USA</td>
<td>1995</td>
<td>180 Mio $</td>
<td>22</td>
</tr>
<tr>
<td>Swine influenza</td>
<td>Great Britain</td>
<td>1996</td>
<td>17 Mio £</td>
<td>4, 5</td>
</tr>
<tr>
<td>Enteric diseases</td>
<td>Great Britain</td>
<td>1996</td>
<td>9 Mio £</td>
<td>4, 5</td>
</tr>
<tr>
<td>Atrophic rhinitis</td>
<td>Great Britain</td>
<td>1996</td>
<td>6 Mio £</td>
<td>4, 5</td>
</tr>
</tbody>
</table>

*increased profit in a 150-sow herd due to 10% reduction in pre-weaning mortality

At the industry level, the extent of disease costs are influenced by the consequences of disease status on international trade as well as on consumer safety. Among the most costly porcine disease in the latter category, we can therefore find highly contagious diseases that are limiting international trade and zoonotic diseases. Major outbreaks of contagious diseases such as foot-and-mouth disease (FMD) have been shown to have a huge impact on the welfare of both farmers and related industries as well as entire national economies. For the UK, it was estimated that the FMD outbreak of 2001 created losses of £ 3.1 billion for agriculture and the food chain (45). A similar additional amount was lost in non-agricultural businesses, primarily tourism. For the USA, it was estimated that an outbreak comparable to the one of
2001 in the UK would result in losses of $14 billion in farm income (37). The swine sector was found to be drastically affected with a gross revenue reduced by 34% which was the highest of all industries. A similar analysis was conducted for a range of exotic diseases with respect to the economic consequences for the pig industry in Australia (14). It was found that losses in the range of AUS$ 10-30 million were to be expected. In the case where an exotic disease became established in Australia, annual losses of 5-11% of the national income generated by the pig industry were calculated. The latter would result in far-reaching structural changes in the national pig industry with additional social and economic consequences.

The economic consequences of zoonotic porcine infections resulting in food-borne disease of humans are documented (41). Buzby and Roberts (8) estimated annual losses due to human illness with respect to the most prevalent pathogens in the USA of $9.3-12.9 billion. Miller et al. (30) estimated the annual social costs of salmonellosis associated with pork in the USA to be 82 million.

Porcine health data

In order to support decisions at macro-economical levels, different types of porcine health data can be used from various sources (10). A selection of data sources is provided and discussed in Table 2.

Table 2 Sources of data related to porcine health

<table>
<thead>
<tr>
<th>Source</th>
<th>Data type</th>
<th>Objectives of data collection</th>
<th>Data owner</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat-inspection data</td>
<td>Prevalence data of lesions leading to reduced price or condemnation of carcass</td>
<td>Food safety</td>
<td>Meat inspection authority, farmer</td>
<td>Data not always recorded, limited accessibility for industry-wide analyses</td>
</tr>
<tr>
<td>Production data</td>
<td>Standard performance data such as litter size, growth rate</td>
<td>Business decisions</td>
<td>Farmer, consultant</td>
<td>Different types of data recording software, data protection, privacy issues.</td>
</tr>
<tr>
<td>Health</td>
<td>Mortality</td>
<td>Business decisions</td>
<td>Farmer, consultant</td>
<td></td>
</tr>
<tr>
<td>Surveillance data</td>
<td>Cases of notifiable diseases, incidence data</td>
<td>Disease control decisions</td>
<td>Veterinary Services, Health Services</td>
<td>List of notifiable diseases variable, case reporting data may be biased (under-reporting)</td>
</tr>
<tr>
<td>Targeted surveys</td>
<td>Prevalence of antibodies or agent</td>
<td>Disease control decisions</td>
<td>Veterinary Services, Health Services</td>
<td>Expensive, data may be biased due to non-representative sampling.</td>
</tr>
<tr>
<td>Outbreak data</td>
<td>Incidence data, number of affected animals and farms</td>
<td>Disease control decisions</td>
<td>Veterinary Services</td>
<td></td>
</tr>
<tr>
<td>Veterinary data</td>
<td>Case histories, diagnoses, treatments</td>
<td>Treatment decisions</td>
<td>Veterinarian, farmer</td>
<td>No standardised recording, privacy issues, not accessible for analyses.</td>
</tr>
<tr>
<td>Laboratory data</td>
<td>Test results</td>
<td>Treatment decisions</td>
<td>Laboratory, Veterinarian, farmer</td>
<td>No standardised recording, privacy issues, data may be biased due to selective submission of samples.</td>
</tr>
<tr>
<td>Research data</td>
<td>Depending on research question</td>
<td>Research</td>
<td>University, farmer</td>
<td>Expensive, may be biased due to non-representative sampling.</td>
</tr>
</tbody>
</table>

In general, most data sources are subject to bias either because of underreporting or because of non-representative selection of samples or farms. Additionally, many data collections are not accessible for an industry-wide analysis because no electronic databases are maintained, because of non-standardised recording or because of privacy issues. Therefore, porcine health data are generally scarce. At the individual farm level, performance data are often available. Most of the common performance indicators are, however, only indirectly reflecting the health status of the animals. The link between disease occurrence and performance effects needs to be specifically established for each disease. At a national level, more information is often available for exotic diseases or diseases as part of a control programme, because these are notifiable to the veterinary authorities or health services. The same is true for data related to major outbreaks. For the remaining areas, data need to be specifically collected as part of project and research activities. This
requires funding and is therefore often limited to diseases that receive high priority from funding agencies. The latter are currently most often interested in emerging diseases, exotic diseases or zoonotic diseases.

**Types of decisions**

Industry and government can use porcine health data to support a range of decisions. Examples of these decision types will be described in the following paragraphs. They are illustrated with examples where economic analyses were conducted.

**Surveillance decisions:** Surveillance programmes are conducted in order to collect information on the health status of animals. This may be important to achieve goals related to food safety, animal health and international trade. Surveillance programmes often involve sampling of animals or carcasses and subsequent laboratory testing. Each sample that is collected and analysed provides a certain amount of information at a given cost. The goal of surveillance programmes is to optimise the cost-information ratio. This can be achieved by the so-called risk-based surveillance (44). In risk-based surveillance, elements of risk assessment are applied to target high-risk products, regions or animals. This concept has been applied in surveillance programmes of salmonella infection in pigs in Denmark. Eneæ et al. (12) showed that the number of meat juice samples collected from farms with a zero or low prevalence of reactors could be reduced dramatically without increasing the number of pigs originating from herds being classified as high-risk. This targeting of the sampling resulted in a decreased cost of over 290,000 $ per year for Denmark.

A risk-based approach was also used in Switzerland in the design of the annual serological survey for Aujeszky’s disease virus. The required sample size was made dependent of the probability of introduction of the virus since the previous survey and the probability of residual infection (method published for its application to bovine herpes virus surveillance, 20). In comparison with the required sample size for conventional random sampling, the sample size was reduced considerably (Table 2). The costs were reduced accordingly.

**Table 2** Number of farms required for annual serological surveillance for Aujeszky’s disease virus in Switzerland using simple random sampling and risk-based sampling (Knopf, personal communication)

<table>
<thead>
<tr>
<th>Year</th>
<th>Population size [number of farms]</th>
<th>Sample size [number of farms]</th>
<th>Conventional</th>
<th>Risk-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>6904</td>
<td>1954</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>6334</td>
<td>1907</td>
<td>1242</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>5836</td>
<td>1878</td>
<td>1033</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>5443</td>
<td>1882</td>
<td>1074</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>5443</td>
<td>1882</td>
<td>1250</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>5443</td>
<td>1882</td>
<td>1250</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>11291*</td>
<td>2717</td>
<td>1328</td>
<td></td>
</tr>
</tbody>
</table>

*Target population increased from sows to finishing pigs

Surveillance is also conducted for early detection of exotic diseases. The speed and reliability of case detection (number of infected farms until detection) is then compared with the cost of the surveillance activities. Such an assessment has been conducted for CSF surveillance in The Netherlands (19). The results demonstrated that although the surveillance activities then applied did achieve a high level of detection quality (<20 infected farms at the moment of first detection) a comparable level of reliability could be achieved when leaving out the most expensive part of the surveillance i.e. periodic clinical inspection of herds. This would result in financial savings of € 12.5 Mio. per year.

**Disease control decisions:** Before a disease programme is initiated at a regional or national level, the economic return on the investment required needs to be discussed. Surprisingly few reports are, however, available in this field. In Sweden, a control programme against Aujeszky’s disease virus (ADV) was considered in the 1990s. A cost-benefit analysis was conducted in order to assess the economical value of the programme (2). It was shown that the results were dependent on the level of regulation applied in the agricultural market. In the scenario where Sweden would become an EU Member State (as it currently is) the programme was only profitable if the consequences of disease (loss in weight gain, increase in outbreak frequencies) was considerable.

In the case of a disease outbreak, often a series of control strategies can be applied either alone or in combination. The choice of the control programme may affect the spread of the eradication success as well as the costs. Various models have been developed to assist decision makers in this fields (15). The most economically detrimental porcine diseases in this category are foot-and-mouth disease (FMD) and classical swine fever (CSF). For both diseases, models have been developed that include both the epidemiological effect of control measures as well as the economic consequences.
For FMD, disease control strategies and alternatives were recently assessed in detail based on data collected during the FMD outbreak in the UK in 2001. During the outbreak, the epidemiological impact of control strategies was modelled and suggested a potential benefit of vaccination (13, 32). More detailed analysis demonstrated that a combination of vaccination and culling strategy could be beneficial (18). However, targeting of farms or regions to be vaccinated with priority would be essential. In the Netherlands, emergency vaccination of all cloven-hoofed animals including swine was applied in combination with stamping out during the FMD incursion from the UK in 2001 (6). In total, over 2000 farms were vaccinated within 2 weeks including 104,000 pigs. Subsequently, a decision tree was developed for different regions of the Netherlands and for different outbreak scenarios (47). It was shown that the economically optimal strategy was not identical for all areas nor for all scenarios. In densely populated livestock areas, ring vaccination was economically optimal because it reduces the limiting effect of culling capacity while ring culling was economically preferential in sparsely populated livestock areas. The value of control strategies alternative to culling was supported by analyses conducted on the basis of data collected during the UK outbreak of 2001 where it was shown that there was insufficient evidence to demonstrate that ring culling was efficient (46).

For CFS, a similar model was used and applied to the CSF outbreak in the Netherlands of 1997-1998 (28). In this outbreak, stamping-out procedures, movement standstill, and pre-emptive slaughter were applied. The analysis showed that the total costs (direct and indirect) of the outbreak were US$ 2.3 billion. It was also shown that less than 50% of the total losses were covered by the government, the rest by the farmers and by related industries. As an alternative to the culling strategy, vaccination strategies were considered for CSF but in an application to 1997-1998-outbreak data did not prove to be superior to stamping out (36). In a further expansion of the model, it was shown that emergency vaccination could have a positive affect on both duration of a CSF outbreak as well as on the number of infected farms when applied in combination with stamping out (24). In contrast, emergency vaccination using marker vaccines were hardly more efficient than stamping out unless trade of meat from vaccinated animals within the European market was allowed (25, 26). Effects of re-structuring of the pig industry as a possible additional preventive measure were also investigated (11). It was shown that integration of pig production into chains might have a beneficial effect.

**Risk management decisions:** In the case of endemic diseases, the focus of decision making is on the level of control that should be applied in order to optimise the risk-benefit ratio. Risk assessment methods including risk modelling are used more and more often in this area. The same is true with respect to the control of zoonotic pathogens where the risk of consumers is balanced against the cost of control measures along the food chain.

In the case of salmonella infection of pigs, van der Gaag et al. (49) showed that a contamination prevalence of <2% required an investment of 5.5 € per pig or approximately 4% of the total production costs per pig in the Netherlands. Also, the intervention strategies considered may have indirect benefits with respect to pathogens other than salmonella. Along the pork production chain, interventions targeted at salmonella reduction, a combination of strategies was shown to be most effective with the prevalence in primary production being highly influential (49, 1). Hurd et al. (17) used the outcome of pork-attributable human cases to model the effectiveness of interventions along the food chain. He showed that interventions on farm alone would not result in a further decrease of salmonella prevalence in pork in Denmark. On the other hand, it was demonstrated that a decontamination step would result in a significant decrease of human cases caused by salmonella in pork. It was confirmed by Miller et al. (30) that intervention steps during processing had a better benefit:cost ratio than interventions targeted at pre-harvest levels. In Finland, the efficiency of the national salmonella control programme covering meat and egg production was assessed (23). Finland used defined food safety objectives for salmonella and a surveillance programme designed to document the achievement of the objective. The economic analysis of the programme demonstrated its viability.

Bacteria resistant to certain antimicrobial substances are also considered to be a potential consumer health risk. Therefore, the cautious use of antimicrobials in swine production is being promoted. In Denmark, the use of antibiotics for growth promotion was discontinued in 1998. The economic impact of this intervention on the swine industry was assessed. It was suggested that only a small reduction in production of 1-1.7% per year occurred and an increase in production cost of 1.04 € or 1% (3). It was concluded that the losses were offset by increased consumer confidence and human health benefits. The results are not in accordance with estimates made for the US pork industry where it was calculated that the use of antimicrobials for growth promotion result in a gain of $0.59 per pig or 9% of net profits (29, 31).

**International trade decisions:** Before starting a disease control programme, economic assessment of the benefits become more and more essential in the light of limited financial resources. When considering the benefits of a control programme, aspects of international trade need to be considered. In the case of Aujeszky’s disease (AD), vaccination strategies have been used in several European countries over the last decade. In the case of the Netherlands, it was shown that if export to Germany was no longer possible because of the AD control conducted there, this would in turn make an AD vaccination programme in the Netherlands economically attractive (7). Without considering the export ban, the programme would not have been justifiable.
Conclusions: Does it payoff?

Before starting the analysis regarding pay off, we need to ask ourselves: Pay off to whom and in what way? A payoff can be understood strictly economically speaking. But it could also be interpreted in a broader way to include non-monetary benefits such as increased public health, improved consumer confidence or a better image. For example, the choice of a disease control strategy does not only affect the economic consequences of an outbreak, but may also have an impact on the general welfare of farmers. It was shown in the case of FMD that culling strategies increase levels of stress and depression in farmers (50). Disease control measures for FMD were delayed during an outbreak of FMD in the Netherlands because of protest of farmers (6). In the wake of the FMD outbreak in the UK in 2001, a wide discussion on ethical aspect of disease control measures was initiated (33, 51). Such aspects will have to be included in animal health decision making in the future. Formal economic analysis based on health and performance data may further help to dispel misconceptions regarding new production practices. Turner et al. (48) showed, for example, that group housing of pigs did only have a negative effect on growth performance in very young pigs, but this was negligible over the entire growth period.

But let’s bear with the purely economical benefits of data-based decision making. What would be the alternatives? Decisions based on (informal) experience and/or intuition are probably the most widely used approaches. Such methods are probably never formally evaluated. In order to be able to evaluate them, data would be necessary, which – by definition – are not used in such decision making. This suggests that data-based decision making has an inherent advantage in that it can be evaluated and, particularly, allows for evaluation in advance and not only ex post. Additionally, data-based decision making is transparent and reproducible. A similar conclusion led to the introduction of evidence-based decision making in clinical medicine. Due to the high costs related to health interventions in modern health systems, data-based selection of therapy alternatives is currently standard procedure in medicine including veterinary medicine. These considerations suggest an advantage of data-based decisions. This review of economic assessments for different types of porcine health decisions also showed that considerable benefit may be obtained by selecting optimal strategies as compared to others. However, if porcine health data are not correctly analysed or used in the wrong epidemiological and/or economical models, the decisions taken may still not be the best.

A review of economic models used in animal health decisions also highlighted that methods such as benefit-cost analysis were not adequate to reflect the full economic scope of impact of animal diseases (38). Inter-sectoral linkages, price dynamics and spillovers into other sectors need to be included using more integrated approaches. For example, modelling of the losses related to a potential FMD outbreak in the USA indicated that the prevention of adverse consumer reactions could reduce the anticipated losses by half (37). Disease control interventions may also have indirect effects on human health, particularly in the case of zoonotic pathogens such as – for example – brucellosis (30, 39). Additionally, field expenses can be shared between interventions targeted at animal health and human health (40).

The key requirement for economic analysis, however, remains the availability of data. Data collection does not only need to be expanded but also better adapted for usage in economic analysis (38). This will require changes in the organisation and coordination of data collection and information systems.

References
3. Anonymous (2003) Impacts of antimicrobial growth promoter termination in Denmark, the WHO international review panel’s evaluation of the termination of the use of antimicrobial growth promoters in Denmark. WHO, Geneva


