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THE POTENTIAL OF A MORE CLOSED SYSTEM ON DAIRY FARMS TO IMPROVE THE ANIMAL HEALTH STATUS AND ECONOMIC RESULTS

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L'augmentation du confinement en élevage peut prévenir l'introduction de maladies infectieuses dans les fermes laitières et peut être un bon point de départ pour l'éradication de ces maladies. Dans une étude exploratoire il a été calculé que le confinement a eu une influence positive de plus de 1 florin hollandais pour 100 kg de lait de profit. Les causes de ce résultat sont analysées.

Dans une première phase du projet, les données ont été rassemblées en vue de dresser un inventaire des différents types de confinement aux Pays-Bas. Les objectifs de cette étude étaient d'analyser la question suivante : « Est-ce que les éleveurs ayant des statuts sérologiques différents en BHV1 ont des facteurs de risque différents en matière d'introduction de maladie, de gestion de la santé animale et des résultats économiques différents ? ». Le statut sérologique BHV1 de 214 fermes était connu grâce à des résultats sur le sang et/ou sur le lait de tank. Il y avait des fermes ayant des animaux positifs et des fermes indemnes de BHV1.

Le nombre d'animaux achetés, les résultats techniques et économiques des exploitations ont été connus grâce à une deuxième banque de données. Les méthodes de prévention de l'introduction et de la diffusion des maladies ont été recueillis auprès des éleveurs, par un questionnaire. La régression logistique a été utilisée pour analyser les relations entre plusieurs variables. Les facteurs de risque (achat d'animaux, participation à des foires...) associés au statut sérologique BHV1 sont présentés.

En outre, un suivi pendant deux ans sera effectué pour quantifier les associations entre le système d'élevage, le statut au regard des maladies et les résultats techniques et économiques de l'exploitation et les résultats techniques et économiques de l'exploitation et les relations entre ces paramètres.

Cette étude devrait permettre d'apporter des conseils pour prévenir l'introduction de maladie infectieuse et améliorer le statut sanitaire des exploitations.

INTRODUCTION

A more closed farming system may prevent introduction of infectious diseases on dairy farms and can be a good starting point for eradication of these diseases. The reported study has a general scope and does not focus on a particular disease. The study explores the possibilities of adaptations in management (i.e., a more closed system) on dairy farms to prevent introduction of diseases and improve the health status on the farm. The management measures investigated will be those advised by the extension services (i.e. Animal Health Service and National Reference Centre for Livestock Production). According to the extension service (Koole, 1995) diseases can be introduced on a farm in several ways and every infectious agent has its own routes. The major routes of introduction (risk factors) are:

1) transmission by other dairy cows (cows purchased, cows on cattle shows, etc.),
2) transmission by other animal species that are potential carriers of the disease (sheep, rats, dogs, etc.),
3) transmission by humans (visitors, veterinarians, etc.),
4) transmission by machinery (cattle trucks, manure applicators, tools, etc.),
5) transmission by foodstuff or water (e.g. ditch water),
6) transmission by air (currents).

In an exploratory study the technical and economic results of more or less closed farms were investigated (Van Schaik et al., 1997). Data from an accounting system were used to define the farms as 'open' or 'closed'. The results showed that 'closed' farms realised better economic results than 'open' farms. 'Closed' farms had a positive influence on net profit per 100 kg milk of almost Dfl 1. These results justified further research and the PhD project on 'Risk analysis and economic consequences of closed farming systems' was started. In the first phase of the project a survey was carried out to make up an inventory of the existing more or less closed farming systems in the Netherlands. In this phase introduction of BHV1 was chosen because good records existed of the BHV1 status of dairy farms. Most studies only mentioned a few possible risk factors for introduction of BHV1 but did not quantify these risk factors. The objective of this study was to quantify the risk factors for introduction of BHV1 on Dutch dairy farms. The hypothesis was that BHV1 positive farms had more risk factors for introduction of BHV1.

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MATERIALS EN METHODS

A case-control design was used (Martin et al., 1987). The farms were non-randomly selected dairy herds with a known serological status for BHV1. The farms were selected from two databases. One database consisted of approximately 1800 Dutch dairy farms participated in a monthly bulkmilk examination for BHV1-status. The other database consisted of 172 farms which participated in trials of the Animal Health Service. These farms were blood sampled twice a year. The farms were selected on the basis of geographical position, namely the northern provinces of the Netherlands. The cases were farms on which 1) all of nine monthly bulk milk samples were antibody titre positive (n=131), or 2) half yearly blood samples (n=83) showed that antigens positive cows were present in the herd. Milk and blood samples were tested by undiluted gB-blocking. The controls were farms on which all bulk milk samples or all blood samples were negative for antibodies against BHV1.

Data were collected by means of a questionnaire about husbandry practices, disease status, personal characteristics, technical farm results and possible risk factors for introduction of infectious diseases on the farms. The questions were asked about 1995 and four preceding years.

For the analysis a subgroup of 107 farms which said to have never vaccinated against BHV1 was used. The BHV1 status of the farms in the subgroup could basically only be caused by introduction of BHV1.

Hosmer and Lemeshow (1989) recommended such a subset approach for situations in which the total number of possible predictor variables greatly exceeds the degrees of freedom allowed in the model, as was the case in this study. First a univariate analysis was carried out on BHV1 status of the farm. The univariate analysis gave an idea which variables would be useful in further analyses. Furthermore, all risk factors based on the major routes of introduction advised by the extension services were also included in the multivariate analysis.

In the second part of the analyses the dependent variable (BHV1 status) was a dichotomous variable and therefore logistic regression was used to analyse the multivariate relationships between risk factors and BHV1 status (Hosmer and Lemeshow, 1989). The statistical analysis was carried out using the LOGISTIC REGRESSION procedure in SPSS 6.1 (SPSS Advanced Statistics 6.1, 1994). The odds ratios were derived by exponentiation of the betas.

RESULTS

Sixty-two farms were free of BHV1 and 45 farms were BHV1 positive. In Table I the model of associations between risk factors an BHV1 status is shown. The model correctly classified 76% of the farms for BHV1.

Table I

Multivariate logistic regression model of risk factors associated with positive BHV1 antibody status in unvaccinated dairy farms (n=107, -2loglikelihood=91.5, χ^2 = 0.54)

Variable	β	SE(β)	*P*	OR	95% CI	AP or PF
# of visits of AI technicians (10 visits)	0.04	0.05	0.43	1.04	0.94-1.15	0.04[1]
presence of farm clothing and/or boots	1.91	1.13	0.09	6.73	0.74-61.9	0.17
distance to nearest cattle farm (100 m)	-0.36	0.12	0.00	0.70	0.55-0.88	0.74[2]
participation in cattle shows	1.26	0.65	0.05	3.54	0.99-12.6	0.22
temporary worker	1.18	0.68	0.08	3.27	0.86-12.3	0.19
number of cattle purchased in 1995	0.28	0.07	0.00	1.32	1.15-1.52	0.31[3]
at least every week occasional visitors such as neighbours, family, friends etc. in the barn	1.40	0.59	0.02	4.06	1.28-12.9	0.35
interaction AI technician*farm clothing	-0.03	0.01	0.02	0.97	0.95-0.99	0.03[4]

1 The AP was calculated by comparing 10 visits per year or less with on average 101 visits of AI technicians per year.
2 The PF was calculated by comparing a distance of less than 100 m with on average 400 m.
3 The AP was calculated by comparing no cattle purchased with on average 6.6 cattle purchased per year.
4 The PF was calculated by comparing the lowest exposure (0) with the mean of the exposure of the rest (108).

Farms which never vaccinated against BHV1, and had a positive BHV1 status were more often visited by AI technicians, more often had farm clothing and/or boots, were closer to other cattle farms, more often participated in cattle shows, more often had a temporary worker, purchased more cattle, and had more occasional visitors in the barn. An odds ratio of 1.32 for 'number of cattle purchased' means that a farm which purchased one cow was 1.3 times more likely to be a BHV1 positive farm. 'Farm clothing' is more often present on farms with a positive BHV1 status. An interaction term of 'AI technician' and 'presence of farm clothing' was found significant at $P \leq 0.05$. The interaction term means that when AI technicians (or other visitors) used farm clothing and/or boots a farm was less likely to be BHV1 positive. Farm clothing was an effect modifier. The AP of 'number of visitis of AI tecnicians' and the interaction term of this variable with 'presence of farm clothing' of 0.04 and 0.03 respectively were very low. The AP or PF of the other variables in the model were of a considerable size, ranging from 0.17 till 0.74.

THE FOLLOW-UP STUDY: PHASE 2

The first phase of the project 'Risk analysis and economic consequences of closed farming systems' was an exploratory study. It provided a way to examine the influence of factors which might be associated with a positive BHV1 status of a farm. The purpose of the study was to identify factors that could be further examined in other ways or that might be amenable to manipulation for the purpose of prevention of introduction of infectious diseases on a farm. Furthermore, the opinion of farmers, veterinarians and AI technicians about introduction of BHV1 on dairy farms was quantified with conjoint analysis.

Many variables in the data from the questionnaire were correlated, suggesting associations between the type of farm(er), husbandry practices of the farmer, risk factors for introduction of diseases, and BHV1 status. Further research will be necessary to quantify these associations and prove possible causal relationships.
A follow-up cohort study (Martin et al., 1987) will be started in March 1997. Farms which differ in risk factors for introduction of diseases will be investigated during a two-year period. The farms will be divided in three groups with different risk profiles. One group of farms will be as closed as possible, a second group will only be closed for direct animal contacts and the third group of farms will be open.

1. Completely closed farms: no direct animal contacts, measures for visitors (e.g. farm clothing), measures for machinery and materials.
2. Partly closed farms: no direct animal contacts, no measures for visitors, machinery and materials.
3. Open farms: direct animal contacts occur, no measures for visitors, machinery and materials.

The number of farms necessary to measure introduction of diseases will depend on the variance in risk profile of the farms under investigation and of which diseases introduction can be measured. Every disease will have its own Relative Risk (RR) of introduction. Again the farms will be selected on BHV1 status. Participating farms should at least be free of BHV1. The incidence of introduction of diseases will increase with a more riskful ('open') management. The incidence of introduction of BHV1 on dairy farms is calculated with the excisting prevalence in the Netherlands (Vonk Noordegraaf, 1996). Farms which do not purchase cattle experience introduction of BHV1 once in five years. On farms which buy on average 12 cows per year BHV1 will be introduced once in two years. The difference in RR between 'open' and 'closed' farms will be 2.5. By vaccinating against BHV1 the chance of introduction of BHV1 will decrease til respectively, once in ten years and once in four years.
The farms will be selected from participants of the questionnaire. Introduction of infectious diseases on the farms will be measured as thoroughly as possible. The infectious diseases investigated will be BHV1, BVD, Leptospirosis hardjo, Salmonella dublin and Strept. Agalactiae (mastitis).
The farmers will be followed and interviewed about their management according to (introduction of) diseases. Records will be kept of technical and economic farm results and the most common factorial diseases mastitis, and low fertility to measure a possible relationship with (introduction of) infectious diseases. Farmers are asked to fill in standardised forms and are also offered the possibility to purchase a Management Information System (Optifarm, NEDAP) to improve their data collection. Data of the I&R-regulation (Identification and Registration regulation) will be obtained to check and date purchased cows. Data of the NRS (Dutch Cattle Syndicate) will be used for information about milk production, fertility and somatic cell counts. Data of accountants will be used for information about economic farm results.
With the data of the two-year period we hope to quantify the more causal relations between management, infectious diseases, factorial diseases and economic farm results. The results of the project will be used to create a computer model which can be used to support farmers in their decisions to derive a more or less closed farming system to prevent introduction of diseases. The decision-support model will be used as a tool to provide the farmer with a founded advice about the opportunities of a more closed farming system with respect to risk on introduction of diseases and the possible economic benefits of the system.

REFERENCES

Hosmer, D.W., and Lemeshow, S. 1989. *Applied logistic regression.* John Wiley & Sons, Inc., New York, 307pp.
Koole, H. Hygiene for dairy farms. IKC publication. Lelystad, 1995: 15 pp. (in Dutch)
Martin, S.W., Meek, A.H., and Willeberg, P.. 1987. *Veterinary Epidemiology, Principles and Methods.* Iowa State University Press, Ames, Iowa, 343 pp.
Van Schaik, G., Dijkhuizen, A.A., Huirne, R.B.M., Benedictus, G., Barkema, H.W. and Koole, J.L., 1997. An exploratory study on the economic value of a more closed farming system on Dutch dairy farms. *Veterinary Record.* in press.
Vonk Noordegraaf, A.. 1996. An epidemiological and economic simulation model to evaluate the spread and control of IBR in dairy cattle. MSc thesis. Department of Farm Management, Wageningen Agricultural University, 72 pp.