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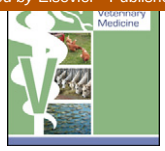

The perception of veterinary herd health management by Dutch dairy farmers and its current status in the Netherlands: A survey

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ABSTRACT

The importance of veterinary herd health management (VHHM) is increasing in both dairy farming and veterinary practice. Little is known, however, about how VHHM is perceived by farmers in terms of structure, content and satisfaction. In 2007 a questionnaire, containing questions about these three items was therefore sent to 800 Dutch dairy farmers. Farmers received two questionnaires, one for participants in VHHM and one for non-participants, allowing them to choose the appropriate one. Results were summarized and statistically analyzed. Farmers who were participating in VHHM had better farm performance. They were satisfied with the way VHHM was executed on their farm. However, there were some pressure points. Goal setting and evaluation was still not a regular part of VHHM, even though it is said to be effective in literature. Time spent on VHHM not visible to the farmer was often not charged or not clearly specified on the bill. The differences in opinions between participants and non-participants of VHHM indicated a lack of communication and/or product differentiation. Satisfaction with the way VHHM was executed on the farm had no significant influence on 305-day production. There was, however, some influence on calving interval and bulk milk somatic cell count (BMSCC).

1. Introduction

Over the past decades several changes have taken place in dairy farming. Industrialization of animal farming and increasing international competition has led to selective breeding of high producing cows. Consequence of this development, however, was higher susceptibility to disease (De Kruif and Opsomer, 2004). As a result of this, attention shifted from curing single animals to prevention of disease on herd level (LeBlanc et al., 2006). The concept of veterinary herd health management (VHHM), integrating herd health, animal welfare, public health and food quality assurance, was developed in the 1990s (Noordhuizen and Wentink, 2001), and has shown to be effective in the past (Sol and Renkema, 1984; Hogeveen et al., 1992).

At present, new developments start influencing dairy industry. The public opinion is becoming more and more important, and at the same time the availability of information is increasing fast. Important present day concerns in dairy production, like antibiotic resistance (Oliver et al., 2011), animal welfare issues (Croney and Botheras, 2010) and emerging zoonoses (Murphy, 2008) are being picked up, and sometimes enlarged, by the media. Given this (mostly negative) stream of information, consumers may become more critical towards dairy production in the future. In order to retain a "license to produce", dairy farmers need to invest in preventive strategies to secure herd health, animal welfare, food safety and public health.

Veterinarians also experience pressure from the public opinion. Discovery of MRSA in farm animals (Wulf and

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Voss, 2008) and the potential hazard of bacteria becoming resistant through antibiotics, prescribed on the farm, (Gilchrist et al., 2007) have led to the global discussion whether it is still desirable for veterinarians to make a profit out of selling antibiotics to farmers. A new business model thus needs to be developed. Many veterinarians believe that this new business model should involve selling knowledge. Given the veterinarian's broad knowledge on many farm and disease related topics, combined with the need for farmers to invest in prevention, expanding veterinary advice within the scope of VHHM could be the road to the future. However, there are some constraints. Several studies have shown that farmers' decision making is a complex process which involves many factors like intention to change, social environment and attitude towards the area of change (Willock et al., 1999; Bergevoet et al., 2004; Ellis-Iversen et al., 2010). The complexity of farmers' decision making has repercussions on daily veterinary dairy practice. The way information is communicated to the farmer and the priority of the information for the farmer may influence compliance.

Next to farmers' decision making, other areas of attention can be found. Some farmers appear to be hard to reach with preventive advice (Jansen et al., 2010b). Also, farmers feel their veterinarian is less qualified to handle management aspects of the farm (Kristensen and Enevoldsen, 2008). Finally, veterinarians sometimes give too many advices at once, or do not explain the added value of the advice to the farmer (Sorge et al., 2010). At the same time, little data is present about the differences in participating and non-participating farmers' opinions towards VHHM. In order to be able to expand veterinary preventive advice in practice, it is necessary to recognize reasons for farmers (not) to participate, and determine more area's of improvement of VHHM. Aim of this paper is to compare both participating and non-participating farmers' opinions on VHHM, to indicate areas of attention, to measure the satisfaction of participating farmers with VHHM and to determine whether a relationship between satisfaction and farm performance can be found.

2. Materials and methods

2.1. Study design

In 2007 two questionnaires were sent to two groups of 400 randomly selected Dutch dairy farmers, one questionnaire focusing on participants of VHHM and one focusing on non-participants of VHHM. Together with the questionnaires, an introduction letter and a stamped self-addressed envelope were sent. After two weeks all dairy farmers received a reminder. The returned questionnaires were analyzed and inferential statistics were applied.

2.2. Participants

Fourteen veterinary practices, scattered through The Netherlands, agreed to cooperate in this study. The dairy farmers approached were connected to those veterinary practices. All dairy farmers in the veterinary practices' files were put together and divided in two groups. The first group was participating in MPR (milk production registration), provided by CRV (Arnhem, the Netherlands). Participants in MPR receive information on milk yield, fat and protein percentages and somatic cell count of individual cows and on herd level. It was expected that participating farmers had a good overview of the health and production status on their farm.

The second group was participating in both MPR and PiR-DAP (Partners in Rendement), an online management program provided by CRV. Pir-DAP summarizes data from milk production recording, reproduction and identification and registration of animals on a farm into information that can be used by veterinarians to get a quick overview of the farm as a preparation for VHHM-visits. Participation in PiR-DAP was expected to be highly related to participation in VHHM.

All farmers were made anonymous by an external organisation first before making the selection. From both previously mentioned groups 400 farmers were randomly selected. Sample size calculations were performed. The percentage of participants (50%) was based on the percentage participants in PiR-DAP in the veterinary practices' database. The total population of dairy farmers in the Netherlands was 18,895 in 2007 (Central Bureau of Statistics, The Hague, The Netherlands). With a confidence interval of 95%, a margin of error of 10% and a population size of 9500 for both groups, 96 respondents in each group were needed. Since a response rate of 25% was expected, two groups of 400 respondents were approached. In total 800 farmers were asked to fill in the questionnaires (4%).

2.3. Questionnaire

The questions in both questionnaires were formulated using the Tailored Design Method by Dillman (2000). Farmers received two questionnaires, one for participants and one for non-participants. An accompanying letter asked farmers who participated in VHHM to fill in the questionnaire for participants, and farmers who did not participate in VHHM to fill in the questionnaire for non-participants. No definition of VHHM was provided. Both questionnaires contained questions about descriptive farm data and about participation in VHHM. The questionnaire meant for participants in VHHM also contained questions about contents and structure of VHHM and satisfaction with VHHM. To enhance user-friendliness most questions contained either five-point Likert scales or multiple choice variables. At the beginning of each item specific fill-in instructions were provided (e.g. explanation of the Likert scale items). The different items in the questionnaire together with example questions are shown in Table 1. The complete questionnaire is available from the corresponding author upon request.

Before the questionnaires were sent to the selected farmers, they were carefully tested. Nine dairy farmers, living in the Utrecht area, were asked to fill in the questionnaire and provide comments on its content. After these visits 12 out of 82 questions were adjusted because they were too vague.

A comparison was made with the national means for number of cows and production level (kg milk) to serve

Table 1
Items discussed in the questionnaires, subdivided in items used for both questionnaires and items used for the participants' questionnaire, including two sample questions.

Item	Questionnaire	Sample question
Descriptive data	Both	What was the average 305-day production on your farm in 2007? Are you participating in farmers' study clubs? (yes/no)
Participation in VHHM	Both	The reason to start participation in VHHM was: an on-farm problem (strongly agree; agree; neutral; disagree; strongly disagree) The reason to quit participation in VHHM was: the high costs (strongly agree; agree; neutral; disagree; strongly disagree)
Advantages and disadvantages of VHHM	Both	VHHM can prevent organisational blindness (strongly agree; agree; neutral; disagree; strongly disagree) VHHM is time-consuming (strongly agree; agree; neutral; disagree; strongly disagree)
Content and structure of VHHM	Participants	I receive VHHM every one/two/three/four/six/eight weeks (circle the right answer) How often is fertility discussed during VHHM? (always; often, frequency, . . .; when problems arise; never)
The role of the veterinarian	Participants	Does the veterinarian cooperate with other advisors, like the feed advisor? (yes/no) Is your veterinarian aware of the goals you want to reach? (yes, and they are used in VHHM; yes, but they are ignored during VHHM; no, I have goals but the veterinarian is not aware of them; no, I have no goals)
Financial management	Participants	Can you tell from the bill how the tariff for VHHM is constructed? (yes/no) How do you pay for VHHM? (fixed tariff per hour including performed acts; fixed tariff per hour with a separate charge for performed acts; fixed tariff per cow per year; packages, like an udder health package)
Satisfaction with VHHM	Participants	The background of the advice is explained to me (strongly agree; agree; neutral; disagree; strongly disagree) I received positive results with VHHM: the incidence of problems is reduced (strongly agree; agree; neutral; disagree; strongly disagree)

as a non-response analysis. No non-respondents were contacted after the survey, since the addressed farmers remained anonymous and it was not possible to detect which farmers had responded and which had not.

2.4. Statistical analyses

2.4.1. Descriptive data

Data retrieved from the returned questionnaires was summarized using descriptive statistics. General health and production data (*nr. cows, somatic cell count, 305-day production, calving interval, standardized milk production, milk quota*) of participants and non-participants in VHHM were checked for normality visually and compared using a two-sided *T*-test ($P \leq 0.05$). Missing values were not replaced.

2.4.2. Opinions on VHHM

Both questionnaires contained an identical set of twelve questions concerning the advantages and disadvantages of VHHM. Questions were answered using a 5-point Likert scale (*strongly disagree, disagree, neutral, agree, strongly agree*). The five points on the Likert scale were assumed to be interval variables. For every question the mean score of the participants was compared to the mean score of the non-participants using the Wilcoxon Mann Whitney test ($P \leq 0.05$). A non-parametric test was used since there was a significant difference in deviation between participants' and non-participants' answers (*F*-test $P < 0.05$). Missing values were not replaced.

2.4.3. The relationship between satisfaction with VHHM and farm performance

The questionnaire for participants contained 33 questions about the perceived satisfaction of VHHM, to be answered by five-point Likert scales (*strongly disagree, disagree, neutral, agree, strongly agree*). To measure the relationship between satisfaction with VHHM and farm performance, data analysis was performed in two steps.

First, to reduce the number of variables, a principal component analysis (PCA) was executed. To test the strength of the relationships among the questions a Kaiser–Meyer–Olkin measure of sampling adequacy and a Bartlett's test for sphericity were performed. The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.73 and the Bartlett's test for sphericity was significant ($P < 0.01$), justifying PCA. In the PCA only the factors with an eigenvalue > 1 and accounting for at least 5% of total variance were included in the varimax-rotation. All variables with a factor loading > 0.40 were said to be loading significantly on that factor. Variables with significant loadings on multiple factors were removed from the PCA. There were 5577 possible answers in the dataset of which 248 (4.45%) were missing. These missing values were replaced by the mean score of all answers given to this question to increase power. The analysis has been run both with and without implemented values. The outcome of both analyses was the same, justifying the implementation. Five factors with more than three variables were formed. These factors have been tested with a Cronbach's Alpha. All five factors had a correlation ≥ 0.65 and were combined to form

new variables by taking the mean of the underlying scores. The variables not grouped by PCA were seen as individual variables. The PCA was performed using SAS (SAS 9.2 for windows, SAS Institute Inc., Cary, NC, USA).

Second, linear regression analysis was performed. The satisfaction variables were used as independent variables and farm performance parameters like calving interval, somatic cell count and 305-day production were used as dependent variables. Linearity of variables was checked visually in a scatter plot and residuals were checked for a normal distribution and extreme outliers. All were (visually) linear and all residuals (visually) followed a normal distribution. No outliers were detected. Thereafter all analyses were performed at the univariate level.

Herd size was controlled for by adding it to the model. For all combinations the betas and *P*-values were calculated. All variables with a *P*-value of $P < 0.10$ were visualized in Table 5. The analyses in step two were performed using SPSS (SPSS 16.0.2 for windows, SPSS Inc., Chicago, Illinois, USA).

3. Results

3.1. Questionnaire part one: all farmers. Descriptive data and opinions on VHHM

3.1.1. Descriptive data

Of the 800 questionnaires sent to farmers, 254 were returned (31.75%). There were 169 questionnaires filled in by farmers participating in VHHM and 86 questionnaires filled in by farmers not participating in VHHM. Given the sample size calculations the aim was to have 96 respondents in each group.

Farmers were asked about their general farm data (Table 2). The general health and production data (*nr. cows, somatic cell count, 305-day production, calving interval, standardized milk production, milk quota*) were visually judged to be normally distributed. The mean farm size of all corresponding farmers was compared to the average Dutch farm size in 2007 as published in the year statistics of CRV (2007). In comparison to the average Dutch farm (66.3 cows) the mean farm size in this study (82.6 cows) was significantly larger ($P < 0.01$).

3.1.2. Participation in VHHM

Of all farmers in this study 26% defined VHHM as regular fertility checks, 6% as the regular check of farm performance, and 68% as a combination of both. For participants in VHHM these percentages were 26%, 2%, and 72%, respectively, and for non-participants in VHHM 23%, 12% and 65%.

Table 3 gives an overview of the reasons why farmers participated in, quit or did not participate in VHHM, according to the questionnaire answers. The answers were given on a five-point Likert scale. Mean and standard deviation are given in the table.

3.1.3. Advantages and disadvantages of VHHM

Both questionnaires contained questions about the (perceived) advantages and disadvantages of VHHM. The answers of participants (VHHM) were compared to the answers of non-participants (NVVHM) (Table 4).

3.2. Questionnaire part two: participants in VHHM. Content and structure of VHHM

Most farmers received VHHM every four (59%) or every six weeks (34%). The remaining farmers (7%) received VHHM irregularly or together with the obliged 3-monthly farm visits. There was a regular veterinarian involved in VHHM on 97% of the farms; 43% of the farmers were able to choose this veterinarian themselves.

VHHM was made up out of several parts, which are displayed in Fig. 1.

Fertility was one of the major components of VHHM: on 84% of the farms it was a point of discussion every farm visit. Most important actions were pregnancy check, checking the urogenital tract after calving, rectal palpation to determine moment of insemination and rectal palpation of problematic cows. Four farmers indicated that fertility management was done by advisors other than the veterinarian (e.g. the A.I. technician).

Milk production and udder health took up a substantial amount of VHHM. During the discussion of these two items the MPR findings were addressed. Time spent on udder health also included the sampling of milk for bacteriological culturing and discussing the results.

Nutrition and claw health are items that are also discussed with advisors other than the veterinarian, like the feed advisor (65%) or the claw trimmer (32%). Over half of the farmers discussed nutrition with the veterinarian only when problems arose or never.

3.2.1. The role of the veterinarian

The knowledge of the veterinarian concerning VHHM was assessed as good by 84% and as good on some parts by 13% of the farmers. Two percent of the farmers assessed the knowledge of their veterinarian as mediocre and 1% as bad.

On 50% of the farms, according to the farmer, the veterinarian was aware of the goals the farmer wanted to reach and used them in VHHM. On 23% of the farms the veterinarian had heard of the goals, but they were ignored during VHHM. The remaining 27% of the farmers said that the goals had not been discussed; 13% had goals but the veterinarian was not aware of them, 14% had no goals. Items discussed during VHHM were mainly selected by the farmer or by looking at recent problems. In 16% of the cases choosing items for VHHM was based on former visits.

Reasons for not following veterinary advice, given during VHHM, were not being able to fit it in daily work (44%), the unpractical nature of the advice (36%) or considering the advice as useless (20%).

In 82% of the cases where the advice did not have the right outcome it was perceived by the farmer as unpractical. In 18% of the cases the underlying problem was not correctly detected.

3.2.2. Financial management

On 75% of the bills sent by the veterinary practice the construction of the charged fee was understandable, on 15%

Table 2
General farm data divided in participants in VHHM (VHHM) and non-participants in VHHM (NVHHM), followed by the *P*-value of the difference in means.

Variable	Category	*n*	Mean	Sd	Min	Max	*P*-value
Number of cows	VHHM	166	86	39	38	380	0.028
	NVHHM	85	76	27	34	155	
Somatic cell count (cells/ml) (1000×)	VHHM	160	182	45	60	300	0.356
	NVHHM	85	188	57	60	325	
305-day production (kg milk)	VHHM	159	8.850	1.029	3.500	11.000	0.007
	NVHHM	83	8.473	1.031	6.458	11.993	
Calving interval (days)	VHHM	152	409	18	357	460	0.550
	NVHHM	80	403	17	368	453	
Standardized milk production	VHHM	163	42.4	4.3	26	52	0.003
	NVHHM	80	40.5	4.9	31	55	
Quotum (kg milk) (1000×)	VHHM	163	722	327	215	3.000	0.010
	NVHHM	83	616	236	233	1.320	

Table 3
Reasons to quit, participate or not participate in VHHM, answered by a five-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree), sorted for level of agreement.

Reasons to participate in VHHM	*n*	Mean Likert score	Median Likert score	Sd
Increasing output	167	4.32	4	0.69
Prevent organisational blindness	163	3.83	4	0.95
Structuring work	160	3.08	3	1.18
Existing problems	159	3.06	3	1.13
Advised by veterinarian	157	3.01	3	1.07
Routine control of production values	161	2.94	3	1.15
Reasons to quit VHHM	***n***	**Mean Likert score**	**Median Likert score**	**Sd**
High costs	20	3.85	4	0.61
Low returns	19	3.68	4	1.10
Advice was not practical	19	2.95	3	0.70
A lack of structure	19	2.89	3	0.96
VHHM was not fitted to the farm	19	2.79	3	0.92
Too time consuming	19	2.79	3	0.88
The problem is solved	19	2.42	2	0.86
Successor is not interested	15	1.47	1	0.62
Ending of the farm	18	1.33	1	0.48
Reasons not to participate in VHHM	***n***	**Mean Likert score**	**Median Likert score**	**Sd**
Expecting high costs	55	3.75	4	0.92
Expecting low returns	53	3.21	3	0.74
Too time consuming	53	3.11	3	0.92
Not interested	56	2.93	3	1.02
No computer available	51	2.73	3	1.50
No good administration	51	2.59	2	1.29
Other advisors	51	2.59	3	1.40
Farm is too small	48	2.31	2	1.14

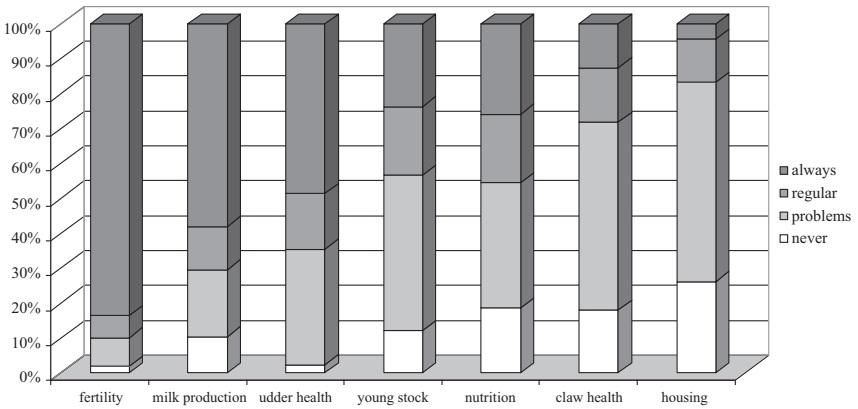

Fig. 1. Importance of different items of VHHM in terms of the frequency they are discussed during farm visits.

Table 4
Difference in the perceived advantages and disadvantages of VHHM between participants and non-participants in VHHM, answered by a five point Likert scale.

Advantages	Category	*n*	Mean Likert score	Sd	*P*-value
Higher production	VHHM	160	2.78	0.96	0.283
	NVHHM	82	2.63	0.99	
Support of the farm	VHHM	166	4.00	0.71	<0.001
	NVHHM	82	3.55	0.88	
Checking production values	VHHM	159	3.21	0.98	0.003
	NVHHM	81	2.83	1.03	
Prevent organisational blindness	VHHM	161	3.85	0.82	0.455
	NVHHM	81	3.74	0.91	
Awareness veterinary developments	VHHM	160	3.54	1.01	0.017
	NVHHM	82	3.20	1.09	
Structural problem solving	VHHM	160	3.98	0.78	0.001
	NVHHM	80	3.51	1.03	
Disadvantages	**Category**	***n***	**Mean Likert score**	**Sd**	***P*-value**
Costs	VHHM	166	3.31	1.14	<0.001
	NVHHM	80	4.08	0.93	
Time-consuming	VHHM	162	2.70	0.97	<0.001
	NVHHM	80	3.48	0.99	
Inconvenient moment	VHHM	161	2.12	0.91	<0.001
	NVHHM	80	2.75	1.04	
hard to gather information	VHHM	160	1.86	0.82	<0.001
	NVHHM	79	2.38	0.97	
Hard to follow up advice	VHHM	161	2.43	0.89	0.111
	NVHHM	80	2.61	0.89	
Veterinarian intervenes too much	VHHM	159	2.03	0.91	<0.001
	NVHHM	80	2.69	1.07	

it was moderately understandable and on 10% it was not understandable. A little over half of the farmers received a bill with a specified call out fee (56%). Preparation time was specified on the bill in 8% of the cases.

Most veterinarians charged per hour, including the performed acts (69% of the farms). Charging per hour, with a separate charge for performed acts, was also often used (28%). Less popular methods of charging were a fixed tariff per cow per year (2%) or packages, like a fertility package or an udder health package (1%).

Most farmers were content with the way they pay for VHHM (71%). Farmers that were not content preferred to be charged for a fixed fee per cow per year (39%), a fee per hour including performed acts (27%), a fee per hour without performed acts (21%) or packages (13%). There was no correlation between satisfaction with the way farmers paid and the veterinary practice they were attached to.

When the price charged for VHHM would increase with ten percent, 53% would still participate with the same amount of time. Forty percent would participate, but would lower the amount of time. Seven percent would stop participating in VHHM.

3.3. The relationship between satisfaction and farm performance parameters

Looking at the correlation between satisfaction with VHHM and farm performance parameters, in total eight satisfaction variables had correlation coefficients with a *P*-value < 0.10 (Table 5).

There was no significant ($P > 0.05$) correlation between satisfaction with VHHM and 305-day production in this study. There were, however, some significant correlations between satisfaction variables and dependent variables calving interval and bulk milk somatic cell count.

The calving interval was significantly shorter when farmers were satisfied with the support and problem approach VHHM offers. Also, satisfaction with the execution of VHHM and the explanation of given advice had significant correlations with calving interval. When farmers found that the effort, needed for VHHM, was outweighed by the progress they had a significantly shorter calving interval.

BMSCC was significantly lower in farms where the farmers were satisfied with the execution of VHHM and the explanation of given advice. When farmers felt there were problems involved in VHHM, however, they had significantly higher somatic cell count.

4. Discussion

Of the 800 questionnaires sent to farmers, 254 were returned (31.75%). This response rate was as expected, based on comparable studies (Lievaart and Noordhuizen, 1999; Pennings et al., 2002; Bergevoet et al., 2004). Even so, in this survey a large part of our selected population has not responded (68.25%), leading to possible bias.

Upfront, several measures were taken to avoid survey bias. Random selection was used; the percentage of participants was based on a comparison between the number of participants and non-participants in PiR-DAP in the veterinary practices' database and the formulation of the questions was done using the validated Tailored Design Method by Dillman (2000), to improve understandability and visual aspects of the questionnaires.

Table 5
Pearsons' correlation coefficients (betas) and *P*-values of farm performance parameters and satisfaction variables.

Independent variables	Dependent variables					
	Calving interval (days)		305-day production (kg milk)		Bulk milk somatic cell count (cells/ml)	
	Beta	*P*-value	Beta	*P*-value	Beta	*P*-value
1. Advantages: I changed my problem approach	−0.065	0.439	0.041	0.622	−0.137*	0.091
2. I achieved positive results: problems are less severe	−0.097	0.242	−0.103	0.207	−0.143*	0.077
3. The progress outweighs the effort	−0.236**	0.005	0.069	0.405	−0.014	0.862
4. Advices are explained well	−0.195**	0.016	0.073	0.362	−0.175**	0.027
5. The way VHHM is executed on the farm (factor)	−0.193**	0.018	0.052	0.518	−0.164**	0.039
6. Support and problem approach by the veterinarian (factor)	−0.165**	0.041	0.030	0.705	−0.023	0.776
7. Negative sides of VHHM (factor)	0.035	0.667	−0.143*	0.075	0.161**	0.042
8. Perceived problems of VHHM (factor)	−0.057	0.485	−0.098	0.220	0.177**	0.025

Loadings at Pearsons' correlations coefficients.
* $P < 0.10$, two tailed.
** $P < 0.05$, two tailed.

Only a small number of veterinary practices were involved in this study. This could lead to selection bias. The veterinary practices used were, however, scattered throughout the Netherlands. Since the combined areas of practice covered a substantial part of the Netherlands, it was expected that there were no regional or socio-economic biases. There could however be some bias in the way VHHM is executed. Since we have only used a small number of veterinary practices, the variance in the execution of VHHM on the surveyed farms might be smaller in this study than in the real situation.

Given the differences in herd size and production level between respondents and the national mean, even though our samples were random, it is expected there is at least some non-response bias. This was not totally unexpected; research by Pennings et al. (2002), for example, points out that in a mail survey responding farmers generally have larger farms (Pennings et al., 2002). Also, farmers who are interested in the subject of the survey, tend to respond more easily (Dillman, 2000). Since larger farms are often more complex in terms of management, support by the veterinarian may become increasingly important, and thus interesting, for this group of farmers. Even though it is of course undesirable to have non-response bias, the results in this survey may represent the population of the future. Over the past decade a trend in size and number of dairy farms has been recognized; the number of dairy farms has reduced, but the number of cows per farm has increased. In the future, small family farms may decide to quit, whereas large business-like farms may continue.

Over the past decade much research has been conducted on socially desirable responses in surveys. A prominent bias in survey research is respondents answering somewhat untrue to create better images of themselves (Paulhus, 2002). Research by Ong and Weiss (2000) on the other hand showed that anonymity can reduce the number of socially desirable answers substantially (Ong and Weiss, 2000). In this study anonymity was guaranteed, so we assume the answers to be a good indication of the true situation.

In this study we knowingly chose not to give a definition of VHHM, since it might hold farmers back to fill in the participants' questionnaire when they felt they did not totally fit the description. A drawback of this could be that it remained unclear how participating farmers defined VHHM. Probably a part of the participating farmers received only fertility checks. This assumption was supported by the answer to the question what farmers define as VHHM. Of all participants 26% indicated that VHHM is similar to regular fertility checks. Even so, we cannot rule out that this 26% was not receiving other parts of VHHM and we chose to keep these farmers in our analysis. Some caution is therefore recommended interpreting the results on the difference between participants and non-participants of VHHM.

4.1. Descriptive data

Sample size calculations pointed out that 96 respondents were needed in each group. In group two, the non-participants of VHHM there were only 86 respondents. The difference in margin of error however was 0.5% (10.5 instead of 10). Because of this small difference the original study approach was not changed.

Farmers in this study who were participating in VHHM were larger and produced better than non-participants did (Table 2). With milk quota abolished in 2015, many farms grow larger to strengthen their competitive position. As farms grow larger, management becomes increasingly important. VHHM can help support the farmer in decisions regarding management; therefore the larger farms might be predisposed to VHHM. With regard to farm performance the question remains, however, whether VHHM improves the farms, or whether better farms are more likely to join VHHM.

4.2. Participation in VHHM

The main reasons for not participating in VHHM were *expected high costs*, *expected low returns* and *expecting it to be time consuming*. Time consumption was an important reason not to start participating, while it was not an important reason to quit participating. The veterinarian might consider communicating the time consumption of VHHM to farmers who never participated.

In a comparable study Lievaart et al. (1999) found that the main reasons for not participating then were *no problems*, *low returns* and *high costs. High costs* and *low returns* were also mentioned as the main reasons for farmers to quit participating in VHHM (Lievaart et al., 1999). It appears that farmers have changed their views on the problem solving ability of VHHM, since the absence of problems was an important reason to quit VHHM in 1999, but was not in this study. Possibly farmers have shifted their approach from separate problems to a more holistic view. Another possibility could be that since farms tend to grow larger, the amount of problems increases, leaving no farm without any problems.

For most of the advantages and disadvantages the opinions of participants and non-participants showed significant differences. These differences might point to the existence of a faulty image of VHHM. Active acquisition, through stands on exhibitions or study groups for example, might help clear out misunderstandings.

Some of the differences might also be attributed to differences in type of farmer. Several studies have shown that farmers can be divided in different groups, based on their attitudes and entrepreneurial skills (Kiernan and Heinrichs, 1994; Bergevoet et al., 2004; Jansen et al., 2010b). In most veterinary practices, VHHM is an undifferentiated product (Kiernan and Heinrichs, 1994; Bergevoet et al., 2004). Differentiating the product VHHM, shaping it to different kinds of farmers, might help to overcome the disadvantages.

4.3. Contents and structure of VHHM

When reviewing literature on how VHHM should ideally be executed, a pattern can be recognized. This pattern includes goal setting, planning, execution and evaluation (Noordhuizen and Wentink, 2001; De Kruif and Opsomer, 2004; Cannas de Silva et al., 2006; LeBlanc et al., 2006; Mulligan et al., 2006). In this study, on 50% of the farms the goals the farmer wanted to reach were not integrated in VHHM and in 84% of the farm visits previous actions were not discussed, indicating a lack of evaluation. In literature the evaluation of veterinary communication skills during VHHM also showed that often no goals are set or evaluated (Jansen et al., 2010a). When advices are not evaluated properly veterinarians will not know whether their advice was useful. The absence of positive or negative feedback might be a drawback for the effectiveness and efficiency of veterinary advising. Also, not evaluating the advice might leave the farmer unsatisfied. When problems are not solved even after following the advice perfectly, the farmer will probably blame it on the quality of the advice. When this is not discussed with the veterinarian, other underlying problems will remain hidden and the trust of the farmer towards the veterinarian might decrease. Although from this study it remains unclear if there are specified reasons for farmers and veterinarians to ignore farm goals and not to evaluate previously given advice, there definitely is room for improvement of VHHM at this point.

Time spent on VHHM invisible to the farmer in this study was not always specified on the bill. One possible explanation could be that veterinarians believe that farmers base their decisions about VHHM on costs (Lievaart et al., 1999). They therefore may not charge, for example, preparation time and will try to build in these costs elsewhere. There is reason to believe that in some veterinary practices the loss of income is compensated with high margins on medication (Beemer et al., 2010). In the future this will be made more difficult; the discovery of MRSA (Methicilin-Resistant Staphylococcus Aureus) and ESBL's (Extended Spectrum Bèta-Lactamases) in dairy cattle, pigs and poultry have caused the ministry of agriculture to take steps to reduce the use of antibiotics in livestock (Convenant Partners Antibiotic Resistance Livestock, September 2010). Veterinarians thus will have to start charging VHHM directly to the farmer. This transition will probably take time, since Dutch farmers are not used to pay for off-farm hours. It is important to guide farmers through the tariff and the way it is constructed (e.g. call out fee, preparation time), so they understand what they are paying for. Also creating cost/benefit ratios might help the farmer to evolve into a new system. These analyses can be based on previously conducted research; there is some data available from Dutch field studies (Hogeveen et al., 1992).

4.4. Satisfaction with VHHM

Satisfaction with the way VHHM is executed in this study has limited relations with farm performance parameters. Several remarks need to be made at this point. First, the farm performance data used in this study were filled in by the farmer at one moment in time and can be looked at as a random indication. Second, possibly some farmers joined VHHM because of existing problems. When VHHM provides structured analysis and offers good solutions farmers will be satisfied. However, most problems do not get solved overnight, so farmers can be satisfied even though they still have moderate farm performance, especially if they started of with severe problems. Third, most problems have many-sided backgrounds. Especially 305-day production is influenced on many levels, like nutrition, housing and genetic background. To gain more insight in the relationship between VHHM and farm performance in future research these factors should not be overlooked.

Participating farmers in this study were satisfied with the way VHHM was executed. Most farmers however have limited options to compare their veterinarian and have high levels of loyalty towards their veterinary practice. Even so, with farm sizes increasing and margins declining, benchmarking might become more important in the future. It is therefore important to gain insight in the performance of the veterinary practice. Indicators for efficacy should be recognized and measured.

As mentioned before, farmers can be divided into different subgroups (Kiernan and Heinrichs, 1994; Bergevoet et al., 2004; Jansen et al., 2010a). This might create bias. There is, for instance, some evidence that different types of farmers have different relations with their veterinarian, and that the ones participating in VHHM are often quite positive about their veterinarian (Jansen et al., 2010b). Also, goals and objectives can differ between farmers. The way advice is adjusted to those goals, and objectives might have strong influence on farmers' compliance (Bergevoet et al.,

2004). Probably only those farmers who find the current form of VHHM suitable for their farms are participating now.

Even though in literature there is no direct link between type of farmer, participation in VHHM, farm size and production level, it is not unthinkable that such a relationship exists. As mentioned before, it is important to interpret the results on the differences between participants and non-participants with care. The authors recommend more research to determine whether there is a relationship between the type of farmer, farm performance and participation in and extension of VHHM. We also recommend veterinary practices to look at opportunities to differentiate the product VHHM and tailor it to different kinds of farmers.

5. Conclusion

There is room for improvement of VHHM. Goal setting and evaluation is still not a regular part of VHHM, even though it is said to be effective in literature. Time spent on VHHM not visible to the farmer is often not charged or not clearly specified on the bill. Satisfaction with the way VHHM is executed on the farm has no significant relationship with 305-day production. There is, however, a relation with calving interval and bulk milk somatic cell count.

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