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Veterinarians' attitudes toward antimicrobial use and selective dry cow treatment in the Netherlands

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ABSTRACT

In the Netherlands, regulations have been in place since 2008 to reduce the overall use of antimicrobials to mitigate antimicrobial resistance. As part of these regulations, a ban on the preventive use of antimicrobials, such as applying blanket dry cow treatment, was introduced and alternative measures such as selective dry cow treatment (SDCT) were implemented. Both farmers and veterinarians play an important role in implementing these measures and have a shared responsibility with respect to prudent antimicrobial use (AMU). The attitude of Dutch dairy veterinarians toward restricted AMU and toward SDCT is unknown, but a favorable attitude toward this approach seems crucial for successful implementation. In 2015, an online questionnaire was collected from 181 veterinarians that contained questions with regard to their attitude and behavior toward reduction of AMU and toward SDCT. Descriptive statistics were used to describe the data, and multivariable logistic regression models with a logit link function were applied to evaluate potential associations between veterinarians' attitudes toward AMU and SDCT and the rationale behind their mindset, based on positive and negative aspects of reduction in AMU. The veterinarians were divided into 3 groups based on their opinion on 4 statements with regard to AMU and SDCT: veterinarians with an unfavorable, a neutral, and a favorable attitude toward reduction of AMU and toward SDCT. For the multivariable logistic regression analysis, the first 2 groups were combined and compared with the veterinarians with a favorable attitude. The general attitude of Dutch dairy veterinarians toward reduction of AMU was positive, and most expressed the belief that they can still be a good veterinarian when they prescribe less antimicrobials. Veterinarians indicated they progressively promoted SDCT beginning in 2013. Most veterinarians see the advice they provide to farmers on SDCT as the best possible approach and are convinced that their farmers apply this SDCT approach. The results of the multivariable analyses showed that veterinarians with a favorable attitude mentioned positive aspects of SDCT, such as an increased consciousness of AMU among farmers, improving animal health, reducing antimicrobial resistance, and a chance to add value for the farmer, more often than other veterinarians. The latter group significantly more often indicated negative aspects of SDCT, such as a higher risk of sick cows and feeling pushed to follow the rules. In conclusion, the general attitude of Dutch dairy veterinarians toward reduction of AMU and SDCT was found to be positive. However, given the influence veterinarians potentially have on the attitude of farmers and the variability found in their attitude and behavior, veterinarians need specific attention if regional or national programs are organized trying to change behavior of farmers and encourage prudent AMU and SDCT.

Key words: antimicrobials, udder health, selective dry cow treatment, veterinary attitude

INTRODUCTION

Prudent antimicrobial use (**AMU**) is of major importance to reduce the risk of development of antimicrobial resistance (Chantziaras et al., 2014). Several European countries closely monitor human as well as veterinary AMU. In the Netherlands, AMU in animal husbandry became subject of public debate around 2008. This debate led to regulations with respect to decreasing AMU, and AMU in animal husbandry is monitored not only at the national level, but also at the individual farm level and at the level of veterinary practices, with specific targets for each (Bos et al., 2015). Currently, in most western countries, the majority of the antimicrobials in the dairy sector are applied by farmers. The veterinarian subsequently has an advisory role toward AMU, with different responsibilities in different countries based on national legislation. Irrespective of legis-

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lation, however, farmers and veterinarians both have a role with respect to AMU and antimicrobial resistance and ought to share the accountability for prudent on farm AMU.

In the Netherlands, preventive use of antimicrobials in animal husbandry has been prohibited since November 2012 and farmers and veterinarians are encouraged to restrict curative AMU, specifically of antimicrobials that are critical in human medicine. For many years, approximately 60% of AMU in dairy cattle was related to mastitis, of which roughly two-thirds could be assigned to dry cow treatment (**DCT**; Kuipers et al., 2016). Since the ban on preventive use of antimicrobials, blanket DCT (**BDCT**) has been replaced by selective DCT (**SDCT**; Santman-Berends et al., 2016). To optimize AMU in the Netherlands, including the introduction of SDCT, farmers and veterinarians have a shared responsibility that is reflected in a compulsory one-on-one relationship between them that was introduced as part of the new legislation (Speksnijder et al., 2015b); together, they have to make a herd health plan and a herd treatment plan, which is based on the actual herd situation. The herd health plan contains the main points of disease monitoring and prevention at the herd level. The herd treatment plan contains the therapies for diseases such as mastitis and lameness that are treated by the farmer solely.

Rules and regulations such as this are an important cue to change human behavior, besides other factors such as education, social pressure, economics, and tools that are part of the RESET Mindset Model described by Lam et al. (2017). Apart from the actual behavior of dairy farmers and veterinarians with respect to AMU and DCT, the veterinarians' behavior is also of importance with respect to influencing farmer behavior (De Briyne et al., 2013; Postma et al., 2016; Higgins et al., 2017).

At the time when BDCT was prohibited in the Netherlands, it was unclear how to select cows for SDCT, which complicated implementation. Additionally, given the fact that BDCT had been fiercely promoted to that point (Lam et al., 2013), implementation of SDCT was perceived to be quite a challenge, specifically for veterinary practitioners as the primary udder health advisors for farmers (Lam et al., 2011). At the end of 2012, when SDCT became the standard, no guidelines were available on how to interpret and implement SDCT. Nevertheless, in 2013 most farmers implemented some form of SDCT according to their own comprehension (Santman-Berends et al., 2016). In January 2014, the Royal Dutch Veterinary Association launched a guideline for veterinary practitioners on how to select cows for DCT (KNMvD, 2014).

As of the introduction of SDCT, a major change in the farmers' approach toward the use of dry cow antimicrobials has taken place. In general, farmers have had a positive attitude toward reduction of AMU and toward SDCT (Scherpenzeel et al., 2016). Understanding the attitude of the veterinarian toward AMU, and specifically toward SDCT, seems crucial to maintain and support responsible use of antimicrobials in dairy practice. In the Netherlands, however, that attitude is unknown. Therefore, the objective of our study was to obtain insight into the attitude of Dutch dairy veterinarians toward reduction of AMU and use of SDCT.

MATERIALS AND METHODS

Study Population

In the Netherlands, all veterinary practitioners that want to work with dairy cattle are obliged to be registered as qualified cattle veterinarian in the database Geborgde Rundveedierenarts (SGD, 2015). In March 2015, all 648 Dutch dairy veterinary practitioners in that database were approached twice by email, requesting their participation in an online questionnaire. The questionnaire was subsequently distributed to the respondents who agreed to participate.

Survey Questionnaire

The detailed questionnaire was distributed online to collect data on the opinion of veterinarians on SDCT as compared with BDCT, their attitude toward AMU and SDCT, their experiences with SDCT, and their experience on positive and negative aspects of reduction of AMU in general. The survey also contained generic questions about demographics of the veterinarian and their veterinary practice.

Open questions, multiple choice questions with predefined answer categories, and statements that had to be filled in on a 5-point Likert scale (Likert, 1932) were included. Veterinarians were asked about their attitude toward and knowledge from AMU and SDCT, as well as their self-reported prescribing practices, interaction with farmers, and perceived role in advising on reduction of AMU and specifically on SDCT. To study which aspects of SDCT and reduction of AMU were perceived as most important, veterinarians were asked which 3 positive and 3 negative aspects they considered most important in a multiple choice question. This question contained both predefined answers and open spaces to provide the possibility to mention aspects that were not included in the list provided. Subsequently, veterinar-

ians were asked to rank these aspects from most to least important.

The questionnaire was piloted and pretested for completeness, wording, and time needed to answer all questions by 3 veterinary practitioners; their feedback was discussed in an expert meeting and incorporated in the final version (Rattray and Jones, 2007). At the start of the questionnaire, it was clearly stated that it would take 15 min on average to complete it and that the answers provided would remain anonymous. The questionnaire was distributed online through SurveyMonkey (SurveyMonkey.com LLC, Palo Alto, CA) on March 24, 2015, and was open for reply until April 23, 2015. Email reminders were sent on April 4 and 18, 2015.

Classifications and Definitions

Four statements about the attitude of the veterinarians toward reduction of AMU in general, and specifically toward SDCT, were defined to enable classification of the respondents into groups that were unfavorable, neutral or favorable. The 4 statements were:

1) It is a good thing that antimicrobials are no longer used for preventive reasons in animal husbandry;
2) It is a good thing that antimicrobials are no longer allowed for preventive use in dry cow treatment;
3) It is commendable that a guideline for selective dry cow treatment has been developed; and
4) I am positive about selective instead of blanket dry cow treatment.

The statements were answered on a Likert scale with 5 answer categories. Using a principal component analysis (**PCA**) in SAS version 9.1.2. (SAS Institute Inc., Cary, NC), we subsequently evaluated whether the 4 statements resulted in sufficient additional value to be used in the grouping process. The number of retained factors was based on an inclusion criterion of an initial eigenvalue ≥ 1 after rotation using Varimax (Kaiser, 1960) to simplify their structure and enhance interpretability while maintaining factor independence. Based on the scores of the veterinarians for each of the 3 factors, a total score was calculated that was used to classify each of the veterinarians into 1 out of 3 groups: unfavorable (**UNF**), 33% of the veterinarians with the lowest total score; favorable (**FAV**), 33% of the veterinarians with the highest scores; and neutral (**NEU**), the 33% in between.

The results on the attitude were illustrated with quotes derived from the free text box at the end of the questionnaire. The quotes were translated to English as literally as possible.

Statistical Analysis

Descriptive statistics, such as median and percentage, were used to describe the study population. Univariable nonparametric tests, such as the Kruskal-Wallis test (Kruskal and Wallis, 1952) and proportion test, were used to evaluate the association between the attitude of the veterinarian toward AMU and SDCT (UNF, NEU, FAV) and factors such as age, size of the veterinary practice, years since graduation, employer/employee, and geographic location (north, central, south of the Netherlands) of the veterinary practice. Differences between groups with $P \leq 0.05$ were considered significant.

In addition, we evaluated whether the veterinarians' attitude toward the changed approach of AMU was associated with their perceived top 3 positive and negative aspects of reduction of AMU and SDCT. For this evaluation, the answers of the veterinarians that were not favorable toward AMU and SDCT (groups UNF and NEU together; n = 111, 61%) were compared with the answers of veterinarians that had a favorable attitude (FAV) toward AMU and SDCT (n = 70, 39%) in 2015. Logistic regression models with a logit link function in Stata 14 (Statacorp, 2014) were used for this analysis, where the group status (UNF/NEU vs. FAV) was included as a dependent variable. The positive and negative aspects of reduction of AMU and SDCT were included as independent variables. Three sociodemographic characteristics were forced into the model based on their relevance, specifically age of the veterinarian, sex, and years since graduation as a proxy for experience.

The association between group status and attitude variables were prescreened using univariable regression techniques. The 3 sociodemographic variables together with the other variables that had a P-value <0.30 in the univariable logistic regression analysis (Wald test) were considered to be potentially associated with the group status and were included as independent variables in the multivariable model. The best multivariable model was selected using a backward selection procedure (without removal of the sociodemographic characteristics). Because of the relative small number of observations, all parameters with an overall P-value <0.10 (Wald test) were retained in the final model. The best model was deemed the model with the Akaike information criterion closest to 0 (Akaike, 1974). During the selection and elimination procedure, confounding was monitored, where a variable was considered a confounder if an esti-

mate of another variable changed >25% after inclusion or exclusion of the (nonsignificant) confounder variable. The amount of variance explained by the final model was evaluated using McFadden's pseudo coefficient of determination. A Pearson goodness-of-fit test was used to evaluate whether the final fitted model was correct.

RESULTS

Survey Response and Respondents' Characteristics

Of the 648 veterinarians that were approached with the request to participate in the questionnaire, 207 eventually responded, received, and filled out the questionnaire. Data from 26 veterinarians were excluded from analysis because of incomplete results. Eventually, 181 dairy veterinarians (28%) completed the questionnaire and their results were included for further analysis.

The study population was checked for representativeness by comparing the social demographic factors of our study population with a survey of the veterinary profession in Europe done by the Federation of Veterinarians in Europe, which includes the majority of veterinary practitioners (FVE, 2015). Based on the results, we concluded that our population provided a good representation of the Dutch veterinarians that participated in European survey (i.e., comparable age, years since graduation, and ratio of employer to employee).

The 181 participating veterinarians were subsequently categorized based on the total score of the PCA (the rationale behind the use of the PCA for this purpose is included in Supplemental Figures S1 and S2 and Supplemental Table S1; https://doi.org/10.3168/jds.2017-13591), in which the 4 statements were combined to 3 factors with an eigenvalue above 1 (statement 1 and 2 were combined within 1 factor). Although we aimed to distinguish 3 equal groups of veterinarians (33% UNF, 33% NEU, and 33% FAV), the size of the groups differ slightly because multiple respondents had the same total score. Ultimately, 60 veterinarians were included as UNF, 51 were NEU, and 70 were FAV. The characteristics of the respondents for each of the groups are shown in Table 1.

The median age and number of years since graduation of the participating veterinarians was 42 and 15, respectively. We found no significant differences between the 3 groups with regard to sex (roughly two-thirds of the respondents were male), location in the Netherlands, and size of the veterinary practice (Table 1). Significant differences between the groups were the age and the number of years since graduation. Veterinarians in the UNF group were older and had a higher number of years since graduation compared with veterinarians in the FAV group.

Table 1. Respondents' characteristics for 3 groups of dairy veterinarians with a favorable, neutral, and unfavorable attitude toward reduction of antimicrobial use and toward selective dry cow treatment in the Netherlands

	Unfavorable n = 60			Neutral n = 51			Favorable n = 70			Total n = 181			
Item	No.[1]	Median or %	25–75 Percentile	No.[1]	Median or %	25–75 Percentile	No.[1]	Median or %	25–75 Percentile	No.[1]	Median or %	25–75 Percentile	Missing no.[1]
Age	51	47[a]	33–55	39	42[ab]	34–55	67	39[b]	32–48	157	42	33–53	24
Years since graduation	52	19[a]	6–28	42	14[ab]	8–28	68	13[b]	5–20	162	15	6–26	19
Sex (male/female, %)	52	77/23	NA[2]	41	73/27	NA	68	63/37	NA	161	70/30	NA	20
Region (north/central/south, %)	60	19/45/36	NA	51	40/45/15	NA	70	35/49/16	NA	181	31/47/22	NA	0
Number of dairy vets in the practice	59	4	3–5	50	4	3–6	69	4	4–6	178	4	3–6	3
Number of dairy farms in the practice	56	86	50–128	45	130	80–180	67	120	70–174	168	110	60–160	13
Employer/employee (%)	52	58/42	NA	42	60/40	NA	68	49/152	NA	162	55/45	NA	19

[a,b]Categories that are statistically different ($P \leq 0.05$) are presented with different letters.
[1]No. = number of respondents.
[2]NA = not applicable.

Attitude

Results of the opinions of 181 dairy veterinarians on statements toward AMU in the animal industry and toward SDCT in the Netherlands are shown in Figure 1. The majority (92%) of the veterinarians agreed or partly agreed that it is important that AMU in the animal industry is restricted, and 89% considered that they can still be a good veterinarian when they use less antimicrobials. Most of the 181 veterinarians believe that their farmers can still be good farmers when using less antimicrobials (90% agreed or partly agreed). Of the respondents, 88% indicated they actively encouraged their farmers to reduce AMU. Only 8% of the veterinarians (partly) agreed with the statement "Since the introduction of SDCT, udder health has improved on the farms in my practice." Most veterinarians (89% agreed or partly agreed) see the advice they provide the farmers on SDCT as the best possible approach and are convinced that their farmers apply this SDCT approach (68% agreed or partly agreed). The opinions of veterinarians about the attitude of other veterinarians toward SDCT varied but was generally considered to be neutral to positive.

Thus, the majority of veterinarians seemed to have a positive attitude toward the changed AMU policy, which was reflected by quotes such as, "I am positive about the [changed antibiotic] policy. For me the antibiotic policy may even be more strict, because there still are dairy farmers and veterinarians that could improve by implementing certain preventive measures rather than using antibiotics."

The veterinarians indicated that "Further increased consciousness of animal health and usage of veterinary medicines" (80%), "Improving the image of the dairy industry" (58%), "Chance to add value for the dairy farmer" (40%), and "Reducing antimicrobial resistance" (40%) were the most positive perceived aspects of reduction of AMU (Table 2).

We noted some significant differences with regard to positive aspects of reduction of AMU between the 3 groups. Veterinarians in the FAV group indicated "Farmers have increased consciousness of animal health and usage of veterinary medicines" significantly more often as a positive aspect of reduction of AMU than did veterinarians in the UNF group (Table 2). The UNF group indicated "No positive aspects at all," "Improving the image of the dairy industry," and "Increasing consciousness of the veterinarian" significantly more often as 1 of the top 3 positive aspects of reduction of AMU than the FAV group (Table 2).

Two percent of all veterinarians could not name a single negative aspect of the reduction of AMU. Overall, 73% of the veterinarians considered a "Higher risk of sick cows" as the most important negative aspect of reduction of AMU, followed by "Limited choice of antimicrobials" (60%). Some veterinarians answered that "Lack of clarity about improvement of public health" (36%) or "Uncertainty whether a sick cow will recover without using antimicrobials" (29%) as the most important negative aspect.

With respect to the negative aspects of reduction of AMU, we also observed some significant differences between the 3 evaluated groups. Veterinarians with an

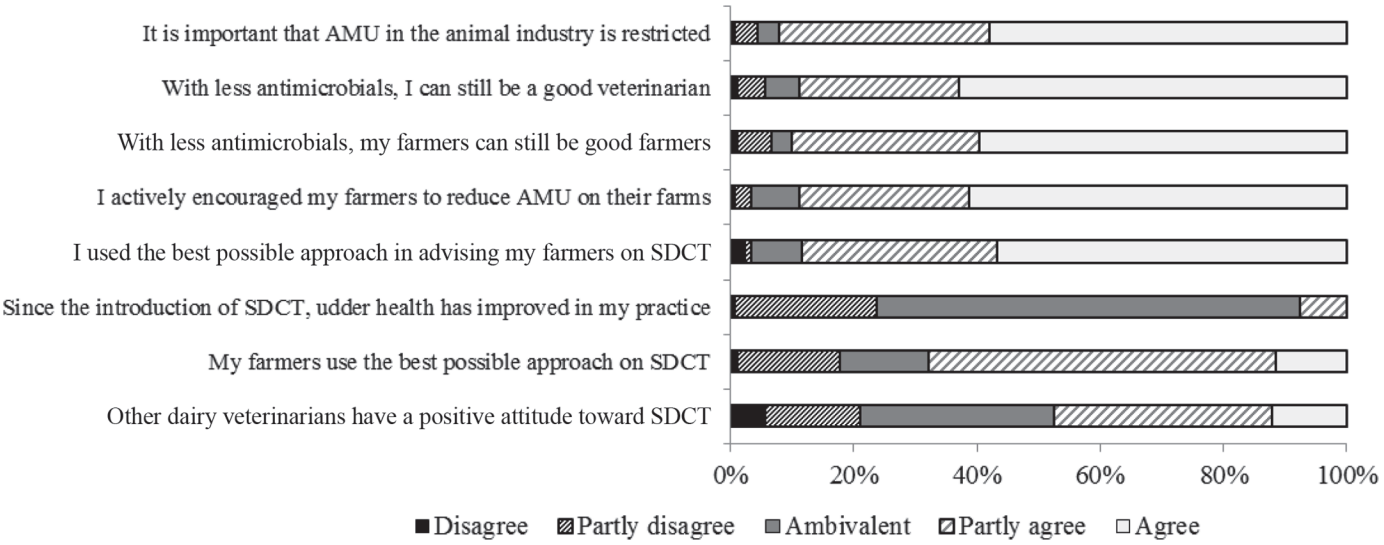

Figure 1. Opinions of 181 dairy veterinarians on statements toward antimicrobial usage (AMU) in the animal industry and toward selective dry cow treatment (SDCT) in the Netherlands.

Table 2. The most important (top 3) positive aspects of the reduction of antimicrobial usage (AMU) according to 181 dairy veterinarians in the Netherlands in 2015, categorized as unfavorable, neutral, and favorable attitude toward reduction of antimicrobial use and toward selective dry cow treatment (SDCT)

	Attitude toward reduction of AMU and SDCT							
	Unfavorable (n = 60)		Neutral (n = 51)		Favorable (n = 70)		Total (n = 181)	
Item	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Farmers have increased consciousness of animal health and usage of veterinary medicines	73[a]	60–84	78[ab]	65–89	87[b]	77–94	80	73–86
Improving the image of the dairy industry	61[ab]	47–73	67[a]	52–79	49[b]	35–61	58	50–65
Chance to add value for the dairy farmer	20[a]	11–33	43[b]	29–58	54[b]	42–66	40	33–48
Reducing antimicrobial resistance	39	27–53	31	19–46	47	35–59	40	33–48
The veterinarian becomes increasingly conscious of animal health and usage of veterinary medicines	44[a]	31–58	27[ab]	16–42	21[b]	13–33	31	24–38
Improving animal health	10[ab]	4–21	6[a]	1–16	19[b]	10–30	12	8–18
Improving public health	8	3–19	12	4–24	13	6–23	11	7–17
Creating resilient cows	5	1–14	10	3–21	6	2–14	7	4–11
No positive aspects at all	15[a]	7–27	0[b]	0–6	1[b]	0–8	6	3–10
Less withholding of milk and meat	5[a]	1–14	7[a]	2–19	0[b]	0–4	4	2–8
Improving farm management	2[ab]	0–9	6[a]	1–16	0[b]	0–4	2	1–6
Financial consequences for my farmers	2	0–9	2	0–10	0	0–4	1	0–4

[a,b]Categories that are statistically different ($P \leq 0.05$) are presented with different letters.

UNF attitude significantly more often answered that they "Feel pushed to follow the rules, although they do not agree with the policy" and that they experience a "higher risk of sick cows" as compared with veterinarians in the FAV group. In addition, veterinarians with a FAV attitude significantly more often considered "Risk of making the wrong choice about treatment of sick cows" as one of the most important negative aspects of reduction of AMU compared with the UNF group (Table 3).

These answers showed that several respondents were reluctant about the changed policies, which was illustrated by quotes such as "I am annoyed by the army of profiting auditors who think they have an important task by checking veterinarians. The dairy farmers believe this serves only the employment of the auditors,

Table 3. The most important (top 3) negative aspects of the reduction of antimicrobial usage (AMU) according to 181 dairy veterinarians in the Netherlands in 2015, categorized as unfavorable, neutral, and favorable attitude toward reduction of antimicrobial use and toward selective dry cow treatment (SDCT)

	Attitude toward reduction of AMU and SDCT							
	Unfavorable n = 60		Neutral n = 51		Favorable n = 70		Total n = 181	
Item	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Higher risk of sick cows	83[a]	71–92	74[ab]	60–85	63[b]	50–74	73	66–79
Limited choice of antimicrobials	59	46–72	54	39–68	66	53–77	60	53–68
Lack of clarity about improvement of public health	44	31–58	38	25–53	29	18–41	36	29–44
Uncertainty whether a sick cow will recover without using antimicrobials	19	10–31	34	21–49	33	22–45	29	22–36
Worries about animal health	24	14–37	20	10–34	17	9–18	20	15–27
Harder for farmers to take care of their dairy cows	15	7–27	16	7–29	9	3–18	13	8–19
I feel pushed to follow the rules, although I do not agree with the policy	22[a]	12–35	6[b]	1–17	3[b]	0–10	10	6–15
Risk of making the wrong choice about treatment of sick cows	0[a]	0–5	12[b]	5–24	11[b]	5–21	8	4–13
Extra labor for the farmer	8	3–19	8	2–19	6	2–14	7	4–12
Financial consequences for my veterinary practice	7	2–16	2	0–11	7	2–16	6	3–10
No negative aspect at all	0	0–5	2	0–11	4	1–12	2	1–6
Changes in added value for me as veterinarian	0	0–5	2	0–11	1	0–8	1	0–4

[a,b]Categories that are statistically different ($P \leq 0.05$) are presented with different letters.

Table 4. Results of the univariate logistic regression analysis of the association between the attitude of veterinarians toward reduction of antimicrobial use and toward selective dry cow treatment, and the most important aspects indicated by them on the changed approach of antimicrobial usage and selective dry cow treatment in the Netherlands

Item	Unfavorable/ neutral (%)	Favorable (%)	Odds ratio	95% CI	*P*-value
Positive aspects					
The veterinarian becomes increasingly conscious of animal health and usage of veterinary medicines	36	21	0.5	0.2–1.0	0.04
Chance to add value for the farmer	31	54	2.7	1.4–4.9	0.002
Improving public health	10	13	1.3	0.5–3.4	0.55
Farmers have increased consciousness of animal health and usage of veterinary medicines	75	87	2.2	1.0–5.0	0.06
Improving animal health	8	19	2.6	1.0–6.4	0.04
Improving farm management	4	0	NA[1]	NA	NA
Creating resilient cows	7	6	0.8	0.2–2.7	0.68
Less withholding of milk and meat	6	0	NA	NA	NA
Reducing antimicrobial resistance	35	47	1.62	0.9–3.0	0.12
Improving the image of the dairy industry	64	49	0.5	0.3–1.0	0.05
Financial consequences for my farmers	2	0	NA	NA	NA
No positive aspects at all	8	1	0.16	0.0–1.3	0.09
Negative aspects					
Higher risk of sick cows	79	63	0.5	0.2–0.9	0.02
Limited choice of antimicrobials	57	66	1.5	0.8–2.7	0.24
Lack of clarity about improvement of public health	41	29	0.6	0.3–1.1	0.09
Uncertainty whether a sick cow will recover without using antimicrobials	26	33	1.4	0.7–2.7	0.30
Worries about animal health	22	17	0.7	0.3–1.6	0.42
Harder for farmers to take care of their dairy cows	16	9	0.5	0.2–1.4	0.16
I feel pushed to follow the rules, although I do not agree with the policy	15	3	0.2	0.0–0.8	0.02
Risk of making the wrong choice about treatment of sick cows	6	11	2.2	0.7–6.7	0.16
Extra labor for the farmer	8	6	0.7	0.2–2.3	0.53
Financial consequences for my veterinary practice	5	7	1.6	0.4–5.7	0.47
No negative aspects at all	1	4	4.8	0.5–47.4	0.14
Changes in added value for me as veterinarian	1	1	1.6	0.1–25.4	0.75
Sociodemographic characteristics					
Age (mean)	45.2	40.7	0.96	0.93–0.99	0.01
Years since graduation (mean)	17.5	13.9	0.97	0.94–1.0	0.03
Sex: female	25	37	1.8	0.9–3.5	0.10

[1]NA = not applicable.

which they have to pay," and "I have the feeling that the committee that determines which antimicrobials can be used is paid by the industry, they do not care about integrity, and lack practical experience." In addition to these reactions, we also noted veterinarians that generally endorsed the policy but nevertheless showed concerns, which was reflected by quotes such as "I fully support the reduction of antimicrobials and completely endorse the guideline on SDCT. However, the way in which the Dutch Food and Consumer Product Safety Authority (NVWA) maintains this policy and tightens the norms and rules is not good. The possibility of being sued or fined while you honestly and sincerely do your job annoys me."

Multivariable Analysis

In the univariable prescreening model of the multivariable analysis, 15 of 24 parameters (Table 4) that were evaluated for their association with the veterinarians' attitude had a *P*-value $\leq$0.30 and subsequently entered the multivariable model (FAV versus NEU/UNF). Additionally, the sociodemographic characteristics sex, age, and years since graduation were also included in the model.

The final multivariable model contained 4 positive and 2 negative aspects of reduction of AMU (Table 5). The final model had the lowest possible Akaike information criterion, showed no evidence of incorrectness of the fitted model (*P*-value = 0.29), and explained 21% of the variation in attitude of veterinarians (pseudo R^2 = 0.21). Veterinarians who indicated the statement "Farmers have increased consciousness of animal health and usage of veterinary medicines" or "Chance to add value for the farmer" as one of the most important positive aspects of reduction of AMU and SDCT had a 2.8 and 4.5 times higher odds, respectively, to belong to the FAV group compared with veterinarians that did not

Table 5. Results of a multivariable logistic regression analysis of the association between the attitude of veterinarians toward reduction of antimicrobial use and toward selective dry cow treatment, and the most positive and negative aspects indicated by them on the changed approach of antimicrobial usage and selective dry cow treatment in the Netherlands[1]

Item	Odds ratio	95% CI	*P*-value
Positive aspects			
Farmers have increased consciousness of animal health and usage of veterinary medicines	2.8	0.9–8.6	0.07
Improving animal health	4.0	1.2–12.9	0.02
Reducing antimicrobial resistance	4.0	1.6–9.9	0.003
Chance to add value for the farmer	4.5	1.9–10.6	0.001
Negative aspects			
Pushed to follow the rules, although I do not agree with the policy	0.1	0.0–0.7	0.02
Higher risk of sick cows	0.4	0.2–0.9	0.04
Sociodemographic characteristics			
Age	0.9	0.8–1.0	0.13
Years since graduation	1.1	0.9–1.3	0.26
Sex			
Male	Reference		
Female	1.2	0.5–2.8	0.62

[1]Veterinarians that had a favorable attitude toward this change (n = 70) were compared with those that had a less favorable attitude (the combination of the group unfavorable and neutral, n = 111).

indicate this positive aspect. In addition, veterinarians who indicated "Improving animal health" or "Reducing antimicrobial resistance" as one of the most important positive aspects of reduction of AMU and SDCT had a 4.0 times higher odds to have a FAV attitude. Veterinarians who indicated the statement "I feel pushed to follow the rules, although I do not agree with the policy" as one of the most important negative aspects of reduction of AMU and SDCT had a 10 times lower odds to belong to the FAV group as compared with veterinarians that did not indicate this negative aspect (Table 5). Furthermore, veterinarians that indicated that they believed a "Higher risk for sick cows" existed with the changed policy on AMU had a 2.5 times lower odds to have a FAV attitude. The sociodemographic parameters that were included in the model were not significant.

DISCUSSION

The aim of our study was to provide insight into the attitude of Dutch dairy veterinarians toward reduction of AMU and toward use of SDCT. The results showed that Dutch veterinarians in general had a positive attitude toward reduction of AMU and toward use of SDCT. Selective DCT was taken up progressively, with 92% of the veterinarians expressing that reducing AMU was important and 88% claiming to have actively encouraged their farmers to reduce AMU on their farms. We must realize that several respondents were reluctant about the changed policies and that some respondents generally endorsed the policy but showed concerns. Whether or not this is right or wrong, it indicates that proper communication to all involved parties is crucial for successful adoption of rules and regulations and implementation of changed behavior.

In our study, we classified veterinarians into 3 groups based on their opinion with regard to 4 statements on AMU and SDCT. Several studies have stressed the importance of farmers' compliance to implement preventive strategies on farm to reduce diseases and AMU in livestock animals, as well as the important role of veterinarians as advisors for farmers herein (Friedman et al., 2007; Cattaneo et al., 2009). Our findings on differences between veterinarians in the FAV and the UNF group show that the former seem to have a mindset in which long-term consequences for farmers play a more important role as compared with short-term effects. This was supported by our findings that veterinarians with a FAV attitude indicated long-term aspects, such as reducing antimicrobial resistance and the chance to add value as a veterinarian for the farmer, more often as important positive aspects than veterinarians with an UNF or NEU attitude. With their positive attitude, these veterinarians are likely to have a positive effect on the farmers as well, with a higher probability of success in further implementation of prudent AMU. In our study, veterinarians with a FAV attitude were more proactive and willing to keep their farmers engaged with the changed antimicrobial policy. This was reflected by the fact that veterinarians with a FAV attitude felt that it was positive that the changed policy increased the consciousness of their clients (i.e., the farmers). The veterinarians with an UNF attitude mainly focused on the negative effects of reducing AMU. Those veterinarians more often felt pushed to follow the rules and that the changed policy resulted in a higher risk of sick cows. With respect to the consequences of the changed

approach of AMU for animal diseases, individual positive and negative experiences with the use of SDCT may have influenced the veterinarians' attitude.

Our findings on differences between veterinarians in the FAV and the UNF group show variability in attitude and behavior. Earlier work of Higgins et al. (2014), however, described that it is important for veterinarians to be homogeneous in clinical beliefs (expectations and demands) to optimize their influence on disease control and mastitis management on the dairy farm. As Jansen et al. (2010) showed, farmers differ based on their trust in external information sources regarding mastitis management and their orientation toward the outside world. To effectively change mastitis management and DCT decisions in practice, it is important to approach different types of farmers proactively, using different tools and through different channels, although it is essential that they are aware of their own attitude (Lam et al., 2017).

In theory, veterinarians are the ideal advisors on udder health and dry cow management, including DCT. In daily practice, however, room for improvement exists. Although most veterinarians have the intention of working proactively on reducing AMU, feel that a constructive approach of this issue comes within their professional remit, and consider encouraging their farmers is an important task, their actual behavior is sometimes different. This ambiguity between their intentions and the actual behavior is described in earlier work from Lam et al. (2011). Given the apparent influence of veterinarians on the attitude of farmers and the differences found between the attitudes of veterinarians, different types of veterinarians also seem to need different approaches to effectively improve prudent AMU on dairy farms.

Our questionnaire was executed in March and April 2015 and included questions on the attitude of the veterinarians in 2013 with respect to their advice on herd health management and on SDCT. Hence, some recall bias may have occurred. However, behavior and attitude does not change easily (Hardeman et al., 2002), and we assumed the attitudes measured had not changed tremendously between 2013 and the moment the questionnaire was conducted.

Our results did not show significant differences between the veterinarians with an UNF and FAV attitude toward reduction of AMU and toward SDCT with regard to the demographic parameters age and years since graduation, although a trend can be recognized that veterinarians in the FAV group seemed to be younger and had less working experience. This fits with recent work by Higgins et al. (2017), who concluded that "When considering how to best facilitate a change from BDCT to SDCT, we propose a multifaceted approach that clearly recognizes that the issues hampering this change are markedly different for vets at different stages of their career."

The multivariable analysis showed that the most important negative aspect contributing to an UNF attitude toward reduction in AMU and toward SDCT was the perception that they were forced to follow the rules when they did not agree with the policy. This indicates a group of veterinarians exists that has a negative mindset toward the chancing policy on AMU and is not willing to change their behavior related to the subject. This mindset seems comparable to that of the reclusive traditionalist among dairy farmers, as described by Jansen et al. (2010). These are mainly inward oriented people that generally do not appreciate interference of external actors and do not seek alliance with others. Specific attention needs to be given to this group of veterinarians by program organizers, to change their attitude toward reduction of AMU and toward SDCT or to compensate that effect in another way in order to make those programs successful.

Although we found no significant differences between groups on the size of the veterinary practice, we noted a trend toward veterinarians in larger practices being more positive toward the changed policy. Thus, it seems recommendable for veterinarians to work in groups with veterinarians of different age groups, as younger veterinarians are possibly more favorable to policy changes than the older generation, as previously described by Speksnijder et al. (2015a). From the perspective of Higgins et al. (2017), composition of groups of veterinarians in large dairy practices needs explicit thought regarding the team members (e.g., years of experience, age). It is thus important for senior veterinarians to take a leading role and adapt more easily to change, which may require specific attention from practice managers. How veterinary practices are organized is up to the veterinarians, but it may be of interest to give specific attention to veterinarians when regional or national programs are organized trying to change behavior of farmers and encourage prudent AMU and SDCT.

CONCLUSIONS

The attitude of Dutch dairy veterinarians with respect to the reduction of AMU, and specifically to SDCT, was found to be generally positive, although a small group of veterinarians was negative about these changes. Given the influence veterinarians potentially have on the attitude of farmers, and given the variability found in their attitude and behavior, veterinarians

need specific attention when organizing regional or national programs with the aim of changing the behavior of farmers and encouraging prudent AMU and SDCT.

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