

ORIGINAL RESEARCH

What influence do vets have on vaccination decision of dog owners? Results of an online survey

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Abstract

Background: This study was performed to analyse the influence of veterinary advice as well as other sources of information on vaccination decision of dog owners.

Methods: A total of 1480 dog owners participated in this exclusively online conducted survey. Mean comparisons and correlation analyses were performed to check bivariate relationships between general data from the dogs, the dog owners, the vaccination decision making and risk/benefit analyses.

Results: The results confirm that veterinarians are the most important source of information on vaccination for dog owners. Nevertheless, the World Wide Web including social media has also to be taken into consideration as a strongly influencing factor. Additionally, the availability of serious information about vaccinations on the internet and on social media has to be reconsidered in general by the veterinarian professional sector.

Conclusions: Veterinarians should be aware of their significant influence on the owner's decision about vaccination and use this knowledge in a targeted way to achieve a high vaccination rate in order to ensure effective herd immunity. Communication strategies for veterinarians to improve information transfer to dog owners are required.

KEYWORDS

communication strategies, human-dog relationship, information sources, satisfaction with information sources, vaccination decision

INTRODUCTION

Many infectious diseases of our pets have become manageable due to the development of effective vaccines and their consistent application. Despite extensive vaccination possibilities, infectious agents such as for distemper, parvovirus, leptospirosis, cat epidemic, feline rhinitis, leucosis, etc. are not defeated. Some of which result in fatal outcome. Vaccination is therefore still essential and provides effective protection against many viral and bacterial diseases.

According to the German Pet Supplies Industry Association (IVH) for the year 2019, a total of 10.1 million dogs and 14.7 million cats are kept in German households.¹ Today, dogs are no longer companion animals only needed as working dogs for guarding and protecting people. They increasingly assume the status of pure pets, whose relationship to humans is based on an emotional bond.^{2,3} The number of pets in single households continues to increase. About 30%

of pets live in single-person households.¹ The animal is therefore an important partner in the life of many people. This high priority leads to differentiated considerations of the owner regarding the health care of his pet. As the position of dogs and cats is often defined by owner as 'family member', the question arises if the extent and scope of veterinary care, as well as the decision-making for or against vaccination, can probably be compared to the decision-making of parents for the medical care of their children. In contrary to the human field, there has been little research on decision-making on vaccination in the veterinary sector. However, scientific publications on parental decisions concerning children vaccination may be applicable to pet owners.

Vaccinations of dogs are non-mandatory. Only customs regulations for international travel often require valid protection against rabies.⁴ Furthermore, participation at pet shows or a stay in an animal shelter may require certain vaccination certifications. There

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are scientifically based recommendations for vaccination of dogs. In Germany, these recommendations are issued and regularly updated by the German Standing Committee on Veterinary Vaccination (StIKoVet).⁵ A trend towards vaccine fatigue and opponents to vaccination in both the human and the veterinary sectors has developed during recent years. Vaccine fatigue has been identified by the World Health Organization (WHO) as one of the top 10 threats to global human health.⁶

Pet owners get unsettled by public or personal statements, which question the effectiveness of vaccinations or blame vaccinations as harmful and associated with common adverse events. The trend of veterinary vaccine fatigue and vaccination scepticism has been taken into account in recent years by both research and vaccine development as well as the veterinarian professionals. Confirmed habits on the regular use of pet vaccines have recently been changed and replaced by evidence-based guidance for individual products. So-called modular systems have been developed for the individual vaccination components in contrast to the vaccination intervals of 1 year recommended for many years in the past.⁷ This enables individual 'personalised' vaccination schemes, adapted to the living conditions and needs of the respective animals. The commitment for vaccination 'as little as possible, as much as necessary' is strongly recommended for veterinary professionals.

We hypothesized that veterinarians have a major influence on the vaccination decision of dog owners in Germany. However, how strong is the influence of other information sources such as the internet and social media on the vaccination decision compared to the veterinarians? Furthermore, we investigated whether there are differences in satisfaction of dog owners with veterinary advice compared to other sources of information.

MATERIALS AND METHODS

The questionnaire was developed on the basis of an American study analysing parent attitudes toward immunizations and healthcare providers⁸ and the parents' survey on childhood vaccination by the German Federal Centre for Health Education.⁹ After a pilot study, the questionnaire containing 66 questions for dog owners was published exclusively online. This method of online survey enabled the anonymous and cost-effective survey of a larger number of participants.¹⁰

After a short introduction in the main part of the questionnaire, the participants were asked about basic immunizations and booster vaccinations of their dogs, about the knowledge and experiences on the subject of vaccination, side effects as well as disease risks and sources of information. Condition for participation in the study was the ownership of a dog for at least 6 months.

Within the questionnaire, there were the following questions to analyse the source of information:

Question 1 (a): Please tick the box (multiple answers are possible) where you search for information on vaccinations and 1 (b) how satisfied you are with the information received

	Satisfied	Not at all	Little	Moderate	Predominantly	Completely
☐ Veterinarian	☐	☐	☐	☐	☐	☐
☐ Animal healer	☐	☐	☐	☐	☐	☐
☐ Breeding association	☐	☐	☐	☐	☐	☐
☐ Boarding kennels and obedience schools	☐	☐	☐	☐	☐	☐
☐ Friends	☐	☐	☐	☐	☐	☐
☐ Internet/search engines	☐	☐	☐	☐	☐	☐
☐ Internet fora	☐	☐	☐	☐	☐	☐
☐ Social media groups	☐	☐	☐	☐	☐	☐

Question 2: Which information source was decisive for your vaccination decision?

The participants could choose among *veterinarian, animal healer, breeding association, boarding kennels and obedience schools, friends, internet/search engines, internet for a, social media groups and other*.

The assessment of the relationship between the dog owner and its veterinarian was asked in a further question:

Question 3: How do you rate your relationship with your vet?

The participants could choose among *very poor, rather bad, satisfactory, good and very good*.

In the second part of the questionnaire, general information about the dog owner, its dog and the living conditions were collected.

By providing preset answers, choosing an answer should be facilitated. Free text expressions were only possible to a limited extent. The online version of the questionnaire was created in cooperation with the Computer Centre of the University of Gießen using the provided program 'Limesurvey'. The questionnaires were available from 03.07.2019 to 23.01.2020.

The possibility to omit questions resulted in a number of incomplete data sets. Therefore, depending on the question, the number of answers varies. A total of 1.480 questionnaires are available.

All questions of the questionnaire and the answers of the dog owners were coded. The data were analysed using IBM SPSS Version 23 statistics software (SPSS Inc., Chicago, IL). Mean comparisons and correlation analyses were performed to check bivariate

FIGURE 1 Sources of information where dog owners search for information (multiple answers were possible)

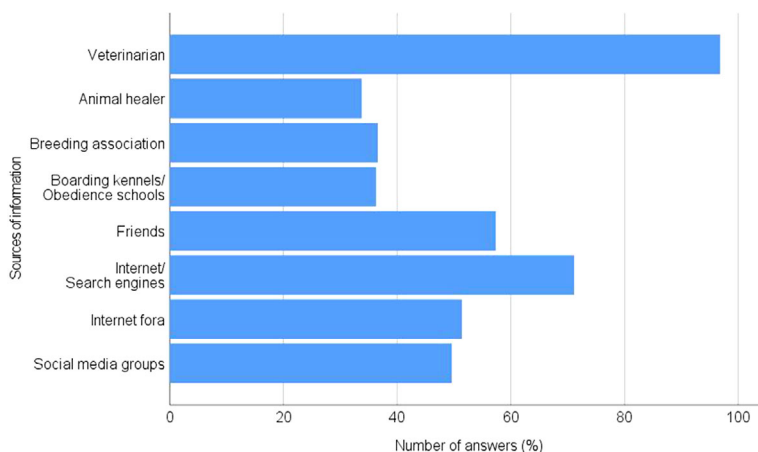
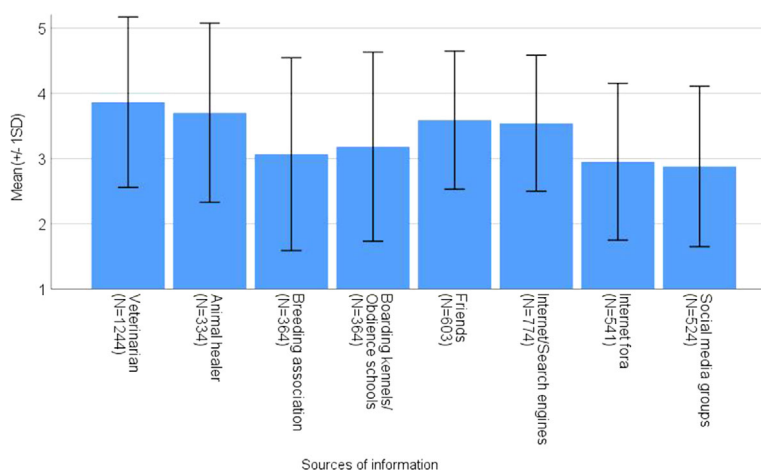


FIGURE 2 Dog owners' satisfaction with information sources (mean values $\pm$ 1 SD; 1 = not satisfied at all ... 5 = very satisfied)



relationships between general data from the dogs, the dog owners and the vaccination decision making. The significance level was set at $p < 0.05$. P values were corrected according to Bonferroni for multiple testing, and significance was approved by McNemar's and Mann-Whitney's tests. A principal component analysis (PCA) with varimax rotation was conducted in order to analyse the relationship between the different sources of information on vaccination.

RESULTS

Influence of the information source

All p -values of the seven pairwise comparisons between veterinarian versus other sources (corrected according to Bonferroni for multiple testing) are highly significant in the McNemar's test with $p < 0.001$. A very high proportion of dog owners stated in this study that they use veterinarians as a source of information. However, 71% also search for information on the internet. Friends as a source of information are used as much as internet fora and social media groups. About one third of the participants stated that they use animal healers as a source of information (Figure 1).

Satisfaction with information sources

The satisfaction scale was measured from 1 (= not satisfied at all) to 5 (= very satisfied, Figure 2). The pairwise comparisons to check whether the differences

in satisfaction are significant were not carried out because in this case very different numbers of answers are included in the individual mean values: Satisfaction could only be answered by those persons who also use the source of information. For example, 1244 people expressed satisfaction with the veterinarian, but only 334 expressed satisfaction with the animal healer. A test which takes into account that the data are not independent (Wilcoxon test) would only include those persons who were able to evaluate both veterinarian and animal healer; and it can be assumed that these would be systematically different from those who only know the veterinarian.

The survey of satisfaction with the different sources revealed that dog owners rate veterinarians better if they do not consult animal healers (Figure 3). A comparative analysis of satisfaction about the information received from veterinarians and animal healers showed that dog owners who asked veterinarians and animal healers about vaccinations were clearly less satisfied with the information source veterinarian ($M = 3.1$, $SD = 1.5$, $N = 306$) than dog owners who only asked the veterinarian ($M = 4.2$, $SD = 1.1$, $N = 612$). This difference is significant according to Mann-Whitney's test ($p < 0.001$).

Which information source was decisive for dog owners' vaccination decision?

Statistical verification of dog owners' satisfaction with the different sources of information revealed that all

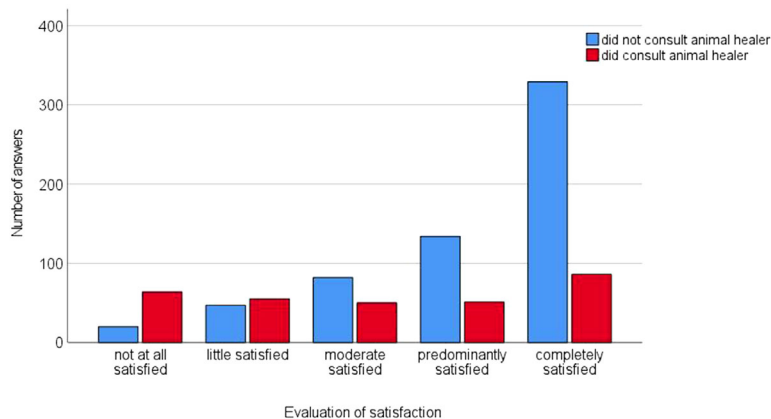


FIGURE 3 Mean values of dog owners' satisfaction about veterinarian and animal healer as information source

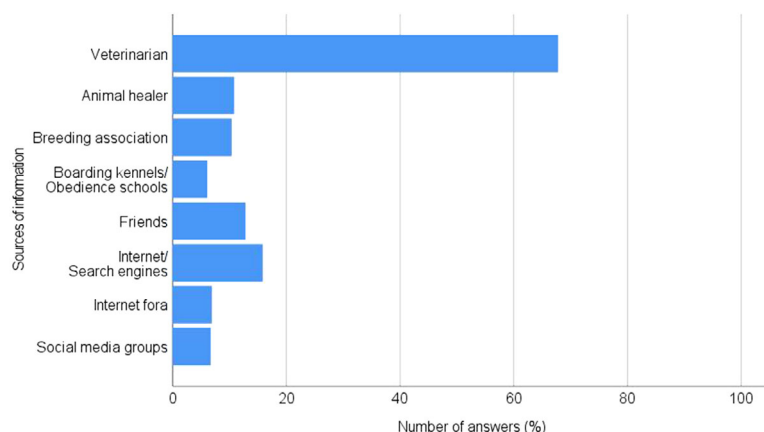


FIGURE 4 Decisive source of information for dog owners

differences in the comparison between veterinarians and other sources of information are very strong. The result shows that veterinarians are more often the source of information (Figure 4). All p -values of the seven pairwise comparisons between veterinarian versus other sources (corrected according to Bonferroni for multiple testing) are highly significant in the McNemar's test with $p < 0.001$.

The PCA with varimax rotation was conducted in order to analyse the relationship between the different sources of information on vaccination: Internet-based sources as social media, online discussion fora and internet search engines and not internet-based sources as friends, veterinarians, animal healers, breeding associations, boarding kennels and obedience schools (Table 1).

The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.685, and Bartlett's test of Sphericity was significant ($p < 0.001$), indicating that correlations between items were sufficiently large for performing a PCA. Eight factors had eigenvalues larger than or only slightly below 1. The scree plot and comparison of the interpretation of the seven-factor solution versus the eight-factor solution supported the latter, so eight factors were retained. As shown in Table 1, the eight factor solution was selected as being the most appropriate of those tested. Correlating variables show high values on the same components (= factors).

The eight factor solution explains just over 76% of the variance and includes 20 items of the question-

naire. By performing the PCA four of the 20 items cluster on factor one, which can be interpreted as a summary of 'internet, social media and friends'. Factor two (three items) represents the information source 'veterinarians', factor three (three items) represents 'animal healers'. Factor four (three items) represents 'social media and online discussion fora' as own category, factor five (two items) represents 'internet search engines', factor six (two items) represents 'breeding associations', factor seven (two items) represents 'boarding kennels and obedience schools', and factor eight (one item) represents only 'friends'.

As a measure of internal reliability, Cronbach's Alpha was computed for each factor. Alpha larger than 0.7 is interpreted as good. Alpha larger than 0.5 is interpreted as acceptable, if the number of items of this scale is very small (two or three).¹¹ Reliability was high for factor one (alpha = 0.80) and acceptable for factor two, three, four and five (0.67, 0.58, 0.62 and 0.69, respectively). Reliability was low for factors six and seven (0.47 and 0.28) and could not be computed for factor eight, which consists only of one item.

Dog owners' relationship with their vet

Many participants (81%) assessed the relationship with their veterinarian as good or very good (Figure 5). Based on the answers to the question "**How do you rate your relationship with your vet?**" and the information provided by the dog owners on how often

TABLE 1 Relationship between the different sources of information on vaccination shown as factor loadings: Internet-based and not internet-based sources (PCA: eight factor solution, rotation method: Varimax with Kaiser Normalization, empty cells: factor loadings below 0.3.)

Based on the three questions:

- Please tick the box where you search for vaccinations.
- Which information source was decisive for your vaccination decision?
- On what did your vaccination decision depend decisively? (= additional verification question in the questionnaire)

Source of information	Component							
	1	2	3	4	5	6	7	8
Search for information <i>Internet fora</i>	0.826							
Search for information <i>Social media groups</i>	0.783			0.406				
Search for information <i>Internet/search engines</i>	0.730				0.433			
Search for information <i>Friends</i>	0.618							0.495
Vaccination decision depended finally on <i>Veterinarian</i>		0.830						
Decisive source of information <i>Veterinarian</i>		0.816						
Search for information <i>Veterinarian</i>		0.800						
Decisive source of information <i>Animal healer</i>			0.898					
Vaccination decision depended finally on <i>Animal healer</i>			0.895					
Search for information <i>Animal healer</i>	0.562		0.594					
Decisive source of information <i>Social media groups</i>				0.788				
Vaccination decision depended finally on <i>Social media groups</i>				0.726				
Decisive source of information <i>Internet fora</i>				0.621				
Decisive source of information <i>Internet/Search engines</i>					0.852			
Vaccination decision depended finally on <i>Internet/search engines</i>					0.807			
Decisive source of information <i>Breeding association</i>						0.923		
Search for information <i>Breeding association</i>		0.445				0.744		
Decisive source of information <i>Boarding kennels/obedience schools</i>							0.967	
Search for information <i>Boarding kennels/obedience schools</i>	0.433	0.450					0.481	
Decisive source of information <i>Friends</i>								0.915
<i>Cronbachs Alpha</i>	0.802	0.673	0.580	0.615	0.685	0.473	0.279	n.A.

their dogs get booster vaccinations (after a completed primary vaccination), a vaccination compliance was determined (Figure 6). A total of 96.6% of the dogs received primary vaccinations, and 58.8% of the dogs get annual booster vaccination. The relationship with the veterinarian is clearly better assessed by the dog owners who vaccinated their dogs in time compared to the group of dog owners who did the vaccination later than recommended or never. According to Mann-Whitney's test, this difference is clearly significant ($p < 0.001$).

DISCUSSION

It can be stated that for all vaccineable diseases a high morbidity leads to a higher vaccination readiness, which leads to high vaccination coverage rates. If many individuals are vaccinated, rare vaccination risks may happen. This consequence can lead to a reduced willingness to vaccinate. A reduced morbidity as a result of high vaccination rates due to protection against a disease may also lead to a reduction in vaccination willingness because the infectious risk is no

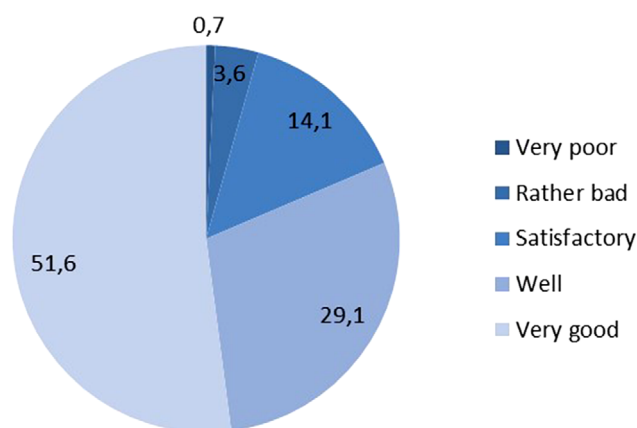


FIGURE 5 Dog owners' assessment of their relationship with the veterinarian (expressed as percentage)

longer present. To avoid these effects means of education and communication are very important.¹²

As both morbidity and mortality of vaccine-related diseases have reached record lows, vaccination can be described as one of the most successful tools for biomedical science and public health.¹³ This success has led to vaccinations being considered unimportant or even dangerous. After all, reports of side effects after vaccinations are more frequent and more serious than non-existent reports of disease. Side effects of preventive and therapeutic interventions attract attention today and are increasingly less tolerated, especially when administered to healthy people or healthy animals. Vaccinations are so to speak victims of their own success. This is a dangerous development, which may lead to the spreading of infectious agents. Therefore, a major aim of this study was to investigate the role of veterinary surgeons within the decision process of pet owners in Germany to vaccinate their dog.

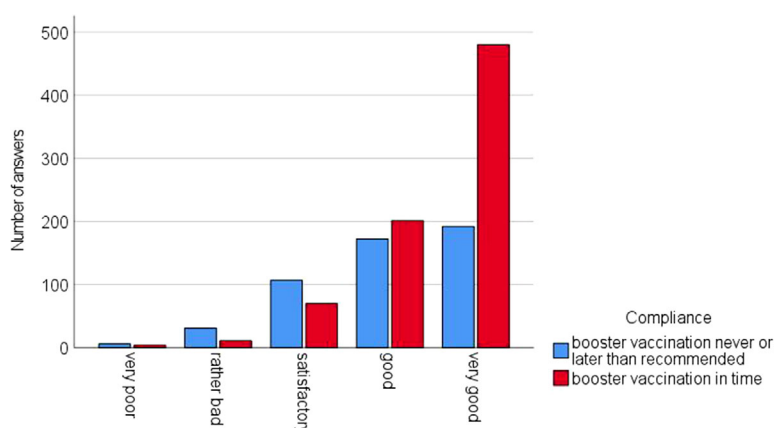
One of the results is that veterinarians are by far the most important and decisive source of information on vaccination for dog owners. However, all other possible sources are also used from 71% (internet search machines) to 34% (animal healers). In this context, the results concerning the question about the source of information, which was decisive for the vaccination decision is somewhat surprising because vets reach 'only' 68% which is clearly lower. In addition, the PCA shows that veterinarians are a very important source of information for dog owners regarding the search for vaccination information. However, other sources like internet search machines and social media (factor one of the PCA) strongly influence the vaccination decision. It has to be noted that the sources internet search engines, social media and discussion fora as sources of information are not used individually but in combination. The fact that also friends loaded on this component (internet/social media/discussion fora) could imply that dog owners, who search for information in social media and discussion forums, actually inform themselves in their closer circle of friends. Then again, this value could also mean that they refer to social media as their circle of friends.

In the context of information about vaccinations, there is some veterinarian research about vaccine or health care compliance depending on the relationship between pet-owner and veterinarian. Two studies carried out in Germany analysed the vaccination compliance of cat and dog owners.^{14,15} The results of the cat study showed a history of travelling abroad or visiting cat shows or a cattery, and thus, regulatory requirements, had the greatest positive impact on the current vaccination status of the cats. In addition, cats were more likely to be currently vaccinated if owners had a detailed veterinary vaccination advice.¹⁴ For the dog's part, the age of the dogs, the attitude and stays abroad as well as vaccination recommendations by veterinarians were detected to be decisive for vaccination decisions of the owners and thus for the achievement of a sufficient vaccination rate.¹⁵ A web-based questionnaire to explore cat owners' attitudes towards vaccination in the UK revealed that vaccination as a kitten was the strongest predictor of up-to-date vaccination status, followed by the intention to take the cat to a cattery or cat show in the next year.¹⁶ The owners' perception of the importance of stress on the cat, the age of the cat or the cost of vaccination was associated with the cat's current vaccination status. Owners who perceived the severity of infectious diseases or veterinary advice as very important were more likely to vaccinate their cats than owners who perceived these factors as less important. A close customer relationship is based on communication, which is understandable and comprehensible to the pet owner.¹⁷ Sufficient time for communication during the visit to the veterinarian,¹⁸ education about various preventive measures and the communication style of the treating veterinarian are decisive for the satisfaction of pet owners.^{19,20}

In this study, about 81% of the participants rated the relationship with their veterinarian as very good or well. A good relationship between the dog owner and the veterinarian leads to a better vaccination compliance. However, the dog owners of this study consider veterinarians as a source of information only with a decisive influence of 68% on their vaccination decision. The fact that only 58.8% of the participants' dogs receive annual booster vaccinations after primary vaccination confirms the compliance problem. What could cause this loss of compliance?

First of all, it is important to become aware of the high potential influence of veterinary advice. In future, it will probably become more and more important for veterinarians and veterinary associations to maintain and improve general animal health with the help of education and information transfer. Since the internet and social media play a very important role in today's information transfer, the influence of statements against or critical of vaccination on these platforms must be taken into account by improving the flow of information to the pet owner. Assuming that the dog as partner and family member plays an important role in the life of the pet owner, this automatically leads to differentiated considerations with regard to its health care. Based on the assumption that many

FIGURE 6 Vaccination compliance as a function of the relationship with the veterinarian



dog owners value their animals as family members, it is worth to take a look at the human side concerning the management of vaccination hesitancy.

As mentioned above the WHO categorized vaccine fatigue as one of the top 10 threats to global health.⁶ International expert groups have been dealing with this subject for many years.^{21,22} The published 5C model²³ describes five main psychological antecedents for the vaccination fatigue: confidence (trust), complacency (risk perception), constraints (barriers in the execution), calculation (extent of the information search) and collective responsibility (sense of responsibility for the community). The 5C model is a psychological extension of an established 3C model of the WHO.²² In the human sector, several studies have shown that communication by the doctor, which is positively evaluated by the patient, can even have a positive effect on the patient's recovery.²⁴

Taking into account the above mentioned model, the German Medical Journal for the human sector published the following communication recommendations for a better process of vaccination advice²⁵:

- Step 1: Show empathy and establish credibility*
- Step 2: Address briefly the concerns - if any are expressed*
- Step 3: Explain the disease risks*
- Step 4: Explain effectiveness of vaccinations as protection against diseases*
- Step 5: Express a strong personal recommendation*
- Keep the dialogue open!*

These five steps seem to be worth considering in the veterinary dialogue as well.

A study¹³ performed with the American and Canadian versions of the search engine Google and by using vaccination-related search words to identify websites of vaccination opponents to examine their content revealed that such websites primarily use emotional influence by providing personal experience reports with photos of vaccination damage or scary needles. The purpose was to appeal to parents' decision making for the benefit of their children and presents parental love in contradiction to scientific (vaccination) recommendations. All websites analysed in this study questioned the safety and effectiveness of vaccines.

Some websites even rejected the scientific proof of microorganisms as pathogens. A lot of misinformation was found, and the author concluded that vaccination deniers ignore scientific facts and uncompromisingly advocate their version of 'truth'. A veterinarian study as well revealed that pet owners who preferred to gain information via online research encountered confusing knowledge regarding the safety of preventive medicines. Whereas a good relationship with their veterinarian or veterinary practice, television commercials about certain diseases, advice from a breeder and getting to know infected animals personally seemed to motivate owners to use preventive medicines.¹⁹ Thus, through the internet and the easily accessible websites of vaccination opponents, drastic misinformation and falsehoods are widely spread and consolidated, which is not easy to correct. Unfavourable as well for confidence in public vaccination recommendations seems to be the fact that social networks play an increasingly important role in vaccination decisions in general.

Vaccination-sceptical parents more often use social online networks as sources for their decision than vaccination advocates.²⁶ It is likely that this fact can also be applied to the veterinarian sector. This confirms the presumed negative influence of media on the perception of vaccination. One of the major problems for parents and probably also for dog owners seems to be that they often receive too little information on vaccination from their direct medical contacts.²⁷ This leads more often to the search for information via search engines and social media than to a renewed conversation with doctors or research on official websites. The question of whether the participants in this study shared this experience cannot be conclusively answered on the basis of the questions asked. However, this would be a possible explanation for the high loss of compliance concerning vaccination decision despite a very good or well assessed relationship with their veterinarian.

For parental vaccination intention and vaccination behaviour perceptions of infection and vaccination risks are predictors.²⁸ The individual vaccination decision is psychologically understood as a risk/benefit analysis. Any information that influences these two antagonistic risks influences the vaccination decision. About 50% of parents are vulnerable for misinformation on the internet,

because they are either still undecided or sceptical about vaccinations. The probability of finding pages from the public health is reduced if search terms are entered that have a risk reference.²⁹ This may be due to the fact that many public sector websites talk about 'vaccine safety' rather than about 'vaccination risks'. The so called positive framing of the content is suggested as a means of successful health communication.³⁰ However, the only thing to consider here is to also write about risks or at least by linking risk-related keywords to increase the probability that searchers (in human and veterinary sector) will find reliable content on regular search engines. Furthermore, information seekers tend to click on the link that fits to the existing mental representation of a topic.³¹ People who search for information about possible vaccination risks are more likely to open the websites that deal thematically with risks - not with security.

This may explain the result that dog owners, who consult veterinarians and animal healers by searching for information about vaccinations, are satisfied with the information provided by animal healers to a larger extent. Those dog owners who use both contacts might have a different basic setting towards vaccinations and animal health care in general. However, it could also be possible that animal healers take more time for vaccination advice and thereby satisfy the dog owners more than veterinarians do.

As with all studies conducted exclusively online, this study might have sampling biases compared to the general population. Familiarity with internet technology is not uniform across demographic, cultural and geographic groups.^{32,33} These basic conditions could influence the search for information of dog owners. The Federal Statistical Office in Germany reported an Internet access rate of 86 per 100 inhabitants (from the age of 14 years) for 2019 which suggests that the participants represent a high proportion of the German population.³⁴ A conclusion on a large percentage of dog owners is therefore reasonable.

CONCLUSION

This study confirms that veterinarians are by far the most important source of information on vaccination for dog owners. Nevertheless, the World Wide Web including social media has also to be taken into consideration as a strongly influencing source of information of vaccinations and vaccines.

Communication strategies for veterinarians to improve information transfer should be developed to avoid that dog owners get the impression to have to search for information in social media or discussion fora. Additionally, the availability of serious information about vaccinations on the internet and social media has to be reconsidered by the veterinarian professional sector. Veterinarians should be aware of their significant influence on the owner's decision about vaccination. The detailed vaccination interview, preferably on an annual basis and with a sufficiently

fixed time frame is part of customer care in a veterinary practice. Please use this opportunity, dear colleagues!

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CONFLICT OF INTEREST

There are no protected, financial, professional or other personal interests, and therefore no conflict of interest which could influence the contents or statements presented in the manuscript.

AUTHOR CONTRIBUTIONS

Franziska Kuhne, Elke Schwedinger and Andreas Moritz designed the study. Franziska Kuhne and Elke Schwedinger designed the questionnaires. Elke Schwedinger performed the survey. Elke Schwedinger and Franziska Kuhne analysed the results and wrote the manuscript in consultation with Andreas Moritz. Responsible for the overall content is Elke Schwedinger.

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