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## ORIGINAL RESEARCH

# Seeing the benefits, but not taking advantage of them: Dog and cat owners' beliefs about veterinary telemedicine

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## Abstract

**Background:** Telemedicine offers benefits to clients and their animals, but potential disadvantages are also being debated.

**Methods:** Using a questionnaire, we investigated dog and cat owners' ( $N = 2117$ ) use of and beliefs about telemedicine and whether beliefs impact past and expected future use.

**Results:** Although the majority of owners are aware that telemedicine can lead to the risk of something being missed, they see great potential in remote consultation in terms of usefulness for follow-up appointments or improving access to a specialist. However, only 12% of dog owners and 6% of cat owners have used telemedicine, and around 25% of owners who have never used it would be willing to use it in the future. Owners with a larger number of recent veterinary visits were more likely to have used telemedicine.

**Limitations:** Although a definition of 'telemedicine' was provided, respondents may have had different perceptions of what this meant.

**Conclusion:** Owners of dogs and cats recognise the potential benefits of telemedicine, but there is a mismatch with the actual uptake. This not only raises questions about the current availability of telemedicine but also should increase veterinary professionals' understanding of its potential benefits in veterinary practice.

## KEYWORDS

cat owners, dog owners, telemedicine, transnational questionnaire study, veterinary ethics

## INTRODUCTION

Small animal practice has seen tremendous developments that have not only improved patient care and simplified work processes<sup>1</sup> but have also led to changes in the way professionals and their clients communicate. One option that so far has had limited uptake, however, is remote patient care, including the option of telemedicine.<sup>2</sup> Telemedicine can be offered in a variety of formats, such as telephone, video call or web streaming,<sup>3,4</sup> allowing clients to have a consultation with a veterinarian without having to bring the animal to the clinic. The possibility of this has gained increasing attention in the wake of the COVID-19 pandemic.<sup>3,5–14</sup>

From a client perspective, telemedicine offers various benefits, including avoiding transporting the

animal.<sup>3</sup> It has also been suggested that veterinarians at the clinic often examine the animal in a short and stressful moment and hence do not see the patient in its normal state.<sup>15</sup> Telemedicine is seen as a way to provide patient care more easily, quickly and often more cost-effectively than in-person consultation.<sup>13</sup> Furthermore, even though patient care benefits from increasing specialisation,<sup>1,16</sup> specialists are often affiliated with bigger clinics or university hospitals that are typically located in urban or suburban areas. This well-known problem within the field of human medicine<sup>17</sup> can be observed in veterinary medicine as well.<sup>18</sup> Consequently, telemedicine could facilitate access to a specialist, especially in remote areas.

At the same time, however, possible disadvantages are subject to debate. For example, veterinarians must

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rely on owners' descriptions because they cannot physically examine the patient, which may increase the risk of mistakes in diagnosis and subsequent patient care.<sup>19–21</sup> With this in mind, veterinary organisations emphasise that telemedicine can only be provided in an appropriate way if a veterinarian–client–patient relationship has already been established.<sup>2,22</sup> This view is also supported by the results of a study among Portuguese veterinarians, in which 68% of respondents agreed that telemedicine must always be preceded by a face-to-face consultation.<sup>7</sup> Keeping this in mind, it has been argued that veterinarians can make a profitable business case for telemedicine to facilitate remote consultations.

However, studies in this field are limited. They either focus on small animal veterinarians' attitudes towards telemedicine,<sup>4,5,7</sup> are based on data collected from clients in special circumstances (such as during the COVID-19 pandemic),<sup>3,6</sup> focus on chronic disease management<sup>23</sup> or the impact on the veterinarian–client relationship<sup>24</sup> or include only cat owners.<sup>3</sup> To the best of the authors' knowledge, little empirical information currently exists about how dog and cat owners in general view telemedicine or the extent to which they would use it, if offered, as an alternative to an in-person consultation. Furthermore, existing studies among owners are based on convenience samples only.

By using a representative sample of dog and cat owners in Austria, Denmark and the UK, we aimed to study the use of and beliefs about telemedicine by investigating how many have used telemedicine, how many are willing to use it in the future, what they perceive as the benefits and risks of telemedicine, and their thoughts about the potential effects on the veterinarian–client bond. In this study, we define 'telemedicine' as the practice of using electronic devices such as laptops, tablets or smartphones to deliver advice and care 'at a distance' to enable animal owners to have a consultation with a veterinarian—for which they are charged—without having to take their pet to the practice.

The three countries differ in their level of digitalisation. For example, in Europe, Denmark ranks fifth in the integration of digital technologies, while the UK and Austria rank eighth and 17th, respectively.<sup>25</sup> This, in turn, may impact the use of telemedicine in the veterinary context. Besides this, factors such as client income, the animal species (dog or cat) or the number of visits to a veterinarian could have an impact on whether an owner has already used telemedicine. For instance, it might be expected that owners who have to go to the veterinarian more frequently, especially with a cat, may be more likely to use telemedicine since being physically taken to the veterinarian can be particularly stressful for cats.

This study aimed to address the following research questions. (1) How many dog and cat owners have already made use of telemedicine? (2) How many owners who never used it would be willing to use it in the future? (3) What are participants' beliefs about possible benefits, risks and changes in rela-

tional aspects between the client and the veterinarian related to telemedicine? And, to what extent do owners' beliefs, sociodemographic factors and animal-related aspects explain (4) whether they have used telemedicine already or (5) whether they would make use of it in the future instead of an in-person consultation? Throughout, we highlight the main similarities and differences between owners in the three countries.

## MATERIALS AND METHODS

### Target population and recruitment of participants

Participants were recruited by Norstat, a company that hosts panels of citizens from multiple European countries. The aim was to gather a representative sample of Austrian, Danish and UK citizens. Data were collected from 11 to 25 March 2022 in Austria, from 11 to 24 March 2022 in Denmark and from 8 to 23 March 2022 in the UK. In total, 17,747 citizens were invited to participate in the study: 5207 in Austria, 6075 in Denmark and 6465 in the UK. The invitation provided information about the background of the study, the participating universities, ethical approval, estimated time for questionnaire completion and participants' rights during the reply process. The entire project was approved by the Research Ethics Committee of Science and Health (Ref: 504-010300/22-5000) at the University of Copenhagen. We ensured informed consent by explaining the purpose of the study on the opening page and informing participants that by clicking on the button 'Next', they confirmed that they were over 17 years old and consented to participate in the survey.

### Effect size calculation

We did not perform power analyses prior to data collection, as we could not determine the exact number of cat and dog owners that would appear in advance through our data recruitment mode (observational, representative data). However, after data collection, we performed within-country power analysis to reveal the effect size level at which we could expect to identify statistically significant differences between cat and dog owners for the two main measures of interest described in more detail later (use of telemedicine [ $w_1$ ] and potential use of telemedicine if offered by a veterinarian [ $w_2$ ]). We used the goodness-of-fit tests for contingency tables available (chi-square test family) in G\*Power (version 3.1.9.6).<sup>26</sup> The results of the analysis revealed that, in all three countries, the sample size allowed the detection of statistically significant associations at the small effect size level, that is, where Cohen's  $w$  is greater than 0.10 and less than 0.30<sup>27</sup> (Austria: effect size  $w_1 = 0.11$  and  $w_2 = 0.12$ ; Denmark: effect size  $w_1 = 0.12$  and  $w_2 = 0.14$ ; UK: effect size  $w_1 = 0.11$  and  $w_2 = 0.14$ ; determined at  $\alpha = 0.05$  and power = 0.80) (see [Supporting Information S1](#)).

## Eligible participants for this study

A total of 4885 individuals clicked on the survey link, but 275 questionnaires were subsequently excluded due to being incomplete. With a dropout rate of 5.62%, the study includes 1500 Austrian, 1552 Danish and 1558 UK citizens. The response rate was 30.3% for Austria, 27.5% for Denmark and 25.3% for the UK. Since the target group of the present study was dog and/or cat owners, only a subset of the sample was used in this study. The final sample comprised 2117 dog and/or cat owners. Detailed information about the sociodemographic factors and the number of dog and/or cat owners per country is listed in [Supporting Information S2](#).

## Survey development

The questionnaire content was developed based on a transnational questionnaire study revealing veterinarians' attitudes towards a variety of aspects of modern small animal practice.<sup>28–31</sup> In relation to specific questions that address the use of telemedicine, a literature review was conducted<sup>2,7–14,19,20</sup> and served as the main basis for the development of items. Detailed information about the development of the survey in the three different languages and stages of pre-testing can be found in [Supporting Information S3](#).

## Survey design and measurements

In total, the questionnaire consisted of three sections (see [Supporting Information S4](#)). For the following detailed description of sections, only those questions and items of relevance to the present paper are considered.

The first section, A, included 19 closed-ended sociodemographic questions as well as questions related to the owned cat and/or dog. The second section, B, covered emerging topics in modern small animal practice, of which one subsection raised the topic of telemedicine. 'Telemedicine' was described as follows to ensure that respondents clearly understood this form of consultation: 'Telemedicine, defined as the practice of using electronic media to deliver advice and care "at a distance", has become an option in modern small animal practice. This enables animal owners to have a full consultation with a veterinarian—for which they are charged—without having to take their pet to the practice'. Subsequently, participants were asked to indicate whether they ever used telemedicine to obtain veterinary advice about their pet(s). The provided answer options were 'Yes', 'No' and 'I didn't know it was an option'. If respondents chose 'No' or 'I didn't know it was an option', they were asked if they would make use of telemedicine if their veterinarian offered it as an alternative to in-person consultation. Respondents could choose between 'Yes', 'No' and 'I don't know'. Furthermore, 13 statements were presented to explore participants' beliefs about the use

of telemedicine by focusing on benefits (e.g., could be helpful, as I find it difficult to travel to a veterinarian), risks (e.g., increases the risk of something being missed) and relational aspects (e.g., weakens the veterinarian–client bond). Respondents could indicate their level of agreement with each statement through one of eight answer options from 1 'strongly disagree' up to 7 'strongly agree' and 8 'I don't know'. Furthermore, respondents were asked about their total household income per year (before tax). Answer options ranged from 'less than 13,450€ (Austria)/100,000 Danish krone (DKK) (Denmark)/11,200 Great British pound (GBP) (UK)' up to 'more than 134,500€ (Austria)/1,000,001 DKK (Denmark)/112,000 GBP (UK)'. The answer options 'prefer not to say' and 'I don't know' were also provided.

A main explanatory variable was animal species (i.e., whether the owner has a cat or a dog). This dichotomous variable was constructed using a question where respondents stated whether they had one or more cats or dogs. In total, 18.5% of pet owners reported owning both dog(s) and cat(s) (see [Supporting Information S2](#)). We classified these respondents as belonging to either the cat or dog owner groups using a question earlier in the questionnaire where we asked owners of more than one animal species to think about their favourite animal. If the respondents that had both cats(s) and dog(s) identified the cat as being their favourite pet, they were ascribed to be cat owners, and vice versa if it were a dog. Since some of the owners did not choose a cat or a dog as their favourite animal, but for example, a horse, the eligible sample size decreased slightly to 2086.

## Data analysis

IBM SPSS Statistics (version 28.0; IBM SPSS Statistics) was used for all analyses. Univariate descriptive statistics were presented in tables or text. For bivariate analysis, chi-square tests were conducted to test whether the frequency distribution differed between the Austrian, Danish and UK sub-populations, as well as within-country differences between dog and cat owners with respect to past use of telemedicine and whether they would use it in the future if offered it instead of an in-person consultation. Since the data for the 13 statements reflecting respondents' attitudes towards telemedicine were not normally distributed, Kruskal–Wallis *H*-tests were performed to test whether the frequency distribution differed between the three countries studied.

The significance level was set at 0.05. The results of univariate and bivariate analyses were conducted with weighted data to mitigate the effects of any sample imbalances and to bring them more in line with the number of dog and cat owners in the three countries studied. Bonferroni correction was applied for all multiple comparisons and significant variables.

To examine the effect of animal- and owner-related aspects on whether telemedicine was used in the past, binary logistic regression analysis was conducted

**TABLE 1** Use of telemedicine to obtain veterinary advice about the owner's pet by animal species and country

	All countries ( <i>N</i> = 2086) <sup>a</sup>		AT ( <i>n</i> = 787) <sup>a</sup>		DK ( <i>n</i> = 622) <sup>a</sup>		UK ( <i>n</i> = 677) <sup>a</sup>		Chi-square test (differences between countries for dog and cat owners)
	Dog owner ( <i>n</i> = 1107)	Cat owner ( <i>n</i> = 979)	Dog owner ( <i>n</i> = 342)	Cat owner ( <i>n</i> = 445)	Dog owner ( <i>n</i> = 364)	Cat owner ( <i>n</i> = 258)	Dog owner ( <i>n</i> = 401)	Cat owner ( <i>n</i> = 276)	
Yes	12.0%	6.4%	12.7%	7.2%	5.7%	4.3%	16.8%	7.2%	Dog owner:
No	76.8%	79.8%	76.4%	81.5%	79.3%	78.5%	74.9%	78.4%	AT versus DK: <i>p</i> < 0.001 <sup>c</sup>
I didn't know it was an option <sup>b</sup>	11.2%	13.8%	10.8%	11.3%	15.1%	17.3%	8.3%	14.3%	AT versus UK: <i>p</i> = 0.466
Chi-square test <sup>e</sup>			<i>p</i> = 0.011		<i>p</i> = 0.445		<i>p</i> = 0.003		DK versus UK: <i>p</i> < 0.001 <sup>c</sup>
									Cat owner: <i>p</i> = 0.358 <sup>d</sup>

Abbreviations: AT, Austria; DK, Denmark; UK, United Kingdom.

<sup>a</sup>Number of respondents (*n*) were calculated with unweighted data. Proportions were calculated with weighted data; rounding errors lead to some differences between rounded-off numerical values and actual values.

<sup>b</sup>'I didn't know it was an option' answer option was excluded for bivariate statistics.

<sup>c</sup>Bonferroni correction was applied for multiple comparisons between countries and significant variables.

<sup>d</sup>Since the global test of differences between countries was not statistically significant at the 0.05 level, no further country-by-country tests were conducted.

<sup>e</sup>Test of differences between dog and cat owner within countries.

separately for each country. The dependent variable was inserted on a dichotomous scale (1 = Yes; 0 = No/'I didn't know it was an option'). Owner age (range 18–86 years) and number of visits to a veterinarian in the last 12 months were inserted as continuous predictor variables. Prior to the regression analysis, correlation analyses were conducted with all 13 statements that shed light on owners' beliefs about telemedicine in order to avoid including highly correlated statements. Based on this analysis, the following five statements were included as continuous predictor variables: the use of telemedicine (a) 'could save my pet from a stressful journey to the veterinarian', (b) 'enhances the veterinarian–client bond', (c) 'should cost less than a normal consultation', (d) 'has no benefit' and (e) 'is more convenient than attending in person'. Furthermore, the gender of the owner (1 = male; 2 = female), total gross household income per year (0 = 'I don't know'/'prefer not to say'; 1 = low; 2 = middle; 3 = high) and animal species (1 = dog; 2 = cat) were inserted as categorical variables.

In addition, binary logistic regression analyses were conducted separately for each country to examine the effect of sociodemographic and animal-related factors as well as owners' beliefs about telemedicine on whether owners would make use of telemedicine if the veterinarian offered it instead of an in-person consultation. The dependent variable was inserted on a dichotomous scale (1 = Yes; 0 = No/'I don't know'). The same predictor variables (described in the previous paragraph) were inserted in these analyses. The answer option 'I don't know' for the inserted statements was excluded from both logistic regression analyses.

## RESULTS

### Dog and cat owners' use of telemedicine

Only a small minority of pet owners had used telemedicine to obtain veterinary medical advice about their pet(s): between 4.3% and 7.2% of cat

owners and 5.7% and 16.8% of dog owners (Table 1). In Austria and the UK, significantly fewer cat owners made use of telemedicine than dog owners ( $p_{\text{Austria}} = 0.011$ ;  $p_{\text{UK}} = 0.003$ ). Furthermore, significantly more dog owners in Austria and the UK made use of telemedicine compared to Danish dog owners ( $p_{\text{AT,UK}} < 0.001$ ).

Respondents who indicated that they did not use telemedicine or did not know it was an option were asked if they would use it if the veterinarian offered it instead of an in-person consultation. Table 2 presents results separately for dog and cat owners in each country. No significant differences were identified either between dog and cat owners within countries or between countries.

### Dog and cat owners' beliefs about the use of telemedicine

In general, owners in all three countries believe that telemedicine can help to decide whether the pet needs to see a veterinarian, is useful for follow-up appointments and improves access to a specialist (Table 3). There was also agreement about the possible risk of something being missed and an expectation that telemedicine should cost less than a normal consultation. Regarding the question of the impact on the veterinarian–client bond, around one-third of owners agreed that telemedicine enhances the bond, while a similar proportion believed that it weakens the bond.

Although significant, differences across the three countries were generally modest. However, some marked differences should be highlighted. Compared to UK and Danish owners, Austrian owners were more likely to disagree that the use of telemedicine helps to decide whether the pet needs to see a veterinarian, is useful for follow-up appointments, improves access to specialists or is good in case of emergencies. Compared to Austrian and UK owners, Danish owners were less likely to agree that the use of telemedicine enhances the veterinarian–client bond or that it is not an option since owners do not have

**TABLE 2** Use of telemedicine if the veterinarian offered it instead of an in-person consultation, by animal species and country

	All countries ( <i>N</i> = 1890) <sup>a</sup>		AT ( <i>n</i> = 706) <sup>a</sup>		DK ( <i>n</i> = 590) <sup>a</sup>		UK ( <i>n</i> = 594) <sup>a</sup>		Chi-square test (differences between countries for dog and cat owners)
	Dog owner ( <i>n</i> = 977)	Cat owner ( <i>n</i> = 913)	Dog owner ( <i>n</i> = 296)	Cat owner ( <i>n</i> = 410)	Dog owner ( <i>n</i> = 343)	Cat owner ( <i>n</i> = 247)	Dog owner ( <i>n</i> = 338)	Cat owner ( <i>n</i> = 256)	
Yes	23.0%	25.9%	26.9%	28.7%	21.9%	25.7%	20.8%	21.6%	Dog owner: <i>p</i> = 0.172 <sup>c</sup>
No	43.4%	45.3%	45.5%	49.6%	38.2%	41.5%	46.7%	42.0%	Cat owner: <i>p</i> = 0.579 <sup>c</sup>
I don't know <sup>b</sup>	33.6%	28.9%	27.6%	21.7%	39.9%	32.8%	32.6%	36.4%	
Chi-square test <sup>d</sup>			<i>p</i> = 0.772		<i>p</i> = 0.593		<i>p</i> = 0.483		

Abbreviations: AT, Austria; DK, Denmark; UK, United Kingdom.

<sup>a</sup>Number of respondents (*n*) were calculated with unweighted data. Proportions were calculated with weighted data; rounding errors lead to some differences between rounded-off numerical values and actual values.

<sup>b</sup>'I don't know' answer option was excluded for bivariate statistics.

<sup>c</sup>Since the global test of differences between countries was not statistically significant at the 0.05 level, no further country-by-country tests were conducted.

<sup>d</sup>Test of differences between dog and cat owner within countries.

the necessary technical information technology (IT) skills/equipment. When comparing these statements between Austria and the UK, Austrian owners were less likely to agree than UK owners.

### What explains owners' past use of telemedicine to obtain veterinary advice about their pets?

For all three countries, the likelihood that owners used telemedicine in the past increased with the number of visits to a veterinarian in the last 12 months ( $p_{\text{Austria}} = 0.003$ ;  $p_{\text{Denmark}} = 0.005$ ;  $p_{\text{UK}} < 0.001$ ) (Supporting Information S5). In Austria and the UK, dog owners and younger owners were more likely to have used telemedicine compared to older owners (both  $p < 0.001$ ) and cat owners ( $p_{\text{Austria}} = 0.042$ ;  $p_{\text{UK}} = 0.014$ ). Furthermore, Austrian and UK owners who tended to agree that telemedicine enhances the veterinarian–client bond ( $p_{\text{Austria}} = 0.005$ ;  $p_{\text{UK}} < 0.001$ ) were more likely to have made use of telemedicine. In Denmark, owners who tended to disagree that telemedicine should cost less than a normal consultation ( $p < 0.001$ ) or that it has no benefits ( $p < 0.001$ ) were more likely to have made use of it.

### What explains whether owners would make use of telemedicine in the future if the veterinarian offered it instead of in-person consultation?

In all three countries, those owners who agreed that telemedicine has no benefit were less likely to make use of it instead of an in-person consultation (all  $p < 0.001$ ) (Supporting Information S6). Furthermore, Austrian owners who disagreed that it should cost less than a normal consultation were more likely to make use of it ( $p < 0.001$ ). In all three countries, owners who tended to agree that telemedicine enhances the veterinarian–client bond ( $p_{\text{Austria}} < 0.001$ ;  $p_{\text{Denmark}} = 0.008$ ;  $p_{\text{UK}} = 0.007$ ) and that it could save their pet from a stressful journey were more likely to make use of it

( $p_{\text{Austria}} < 0.001$ ;  $p_{\text{Denmark}} < 0.001$ ;  $p_{\text{UK}} = 0.004$ ). Furthermore, UK owners who believed that telemedicine is more convenient than attending in person were more likely to make use of it in the future ( $p < 0.001$ ).

## DISCUSSION

Our results show that, across all three countries, very few dog (12.0%) or cat (6.4%) owners have used telemedicine. Furthermore, three-quarters of dog and cat owners who have never used telemedicine would not make use of it, or are not sure whether they would use it, in the future. Against the background of the increased interest and use of remote consultations during the pandemic,<sup>3,5–7,10</sup> our results, with data collected in the post-pandemic period, are surprising. One explanation for the low use of telemedicine during the pandemic could be how practices in the three countries dealt with the required restrictions (e.g., reduced contact). It is possible that the veterinarians very quickly found models that worked well, for example, making appointments to see only one owner and their pet in the practice at a time, avoiding crowded waiting rooms, or admitting the pet while having the owner wait outside.

A further surprising aspect in connection with this low percentage of past and expected use in the future is that our findings indicate that owners generally have positive views of telemedicine. For example, our data show that owners agree that telemedicine can improve access to a specialist if there is none locally. As owners in rural areas are often disadvantaged by a lack of availability of (specialised) treatment for animals,<sup>18</sup> telemedicine can reduce the problem of differential access to (specialised) patient care. Furthermore, owners recognise that telemedicine may help them decide whether or not their pet needs to see a veterinarian, can save the pet from a potentially stressful journey and can be useful for follow-up appointments. Relatedly, Bishop et al.<sup>32</sup> found that dog owners who had remote consultations for postoperative rechecks indicated that this option saved time, and the dogs were less stressed and fearful than during in-clinic

TABLE 3 Dog and cat owners' beliefs about telemedicine

			All countries (N = 2117) <sup>a</sup>	AT (n = 800) <sup>a</sup>	DK (n = 626) <sup>a</sup>	UK (n = 691) <sup>a</sup>	Kruskal–Wallis H-tests
Perceived benefits							
The use of telemedicine ...							
1	could be helpful, as I find it difficult to travel to a veterinarian.	Disagreement	30.7%	32.5%	32.8%	26.8%	AT versus DK: $p = 0.373$ AT versus UK: $p = 0.024^d$ DK versus UK: $p = 0.003^d$
		Neutral	25.8%	26.3%	24.5%	26.3%	
		Agreement	38.3%	38.9%	34.4%	41.1%	
		I don't know <sup>b</sup>	5.2%	2.3%	8.3%	5.8%	
		Median [IQR] <sup>c</sup>	4 [3;5]	4 [3;5]	4 [2;5]	4 [3;5]	
2	could save my pet from a stressful journey to the veterinarian.	Disagreement	14.4%	16.7%	17.8%	8.9%	AT versus DK: $p = 0.633$ AT versus UK: $p < 0.001^d$ DK versus UK: $p = 0.002^d$
		Neutral	20.2%	20.5%	19.0%	20.8%	
		Agreement	60.6%	60.4%	56.7%	64.3%	
		I don't know <sup>b</sup>	4.8%	1.3%	6.5%	6.1%	
		Median [IQR] <sup>c</sup>	5 [4;6]	5 [4;6]	5 [4;6]	5 [4;6]	
3	could help me decide whether my pet needs to see a veterinarian.	Disagreement	9.8%	14.0%	8.5%	6.5%	AT versus DK: $p = 0.020^d$ AT versus UK: $p = 0.030^d$ DK versus UK: $p = 0.833$
		Neutral	20.4%	20.9%	20.2%	20.1%	
		Agreement	64.9%	63.4%	63.7%	67.8%	
		I don't know <sup>b</sup>	4.8%	1.8%	7.7%	5.6%	
		Median [IQR] <sup>c</sup>	5 [4;6]	5 [4;6]	5 [4;6]	5 [4;6]	
4	could be useful for follow-up appointment.	Disagreement	8.8%	14.5%	5.3%	5.6%	AT versus DK: $p < 0.001^d$ AT versus UK: $p < 0.001^d$ DK versus UK: $p = 0.080$
		Neutral	19.3%	20.6%	17.7%	19.1%	
		Agreement	66.9%	62.5%	68.6%	70.4%	
		I don't know <sup>b</sup>	5.0%	2.5%	8.4%	4.8%	
		Median [IQR] <sup>c</sup>	5 [4;6]	5 [4;6]	6 [4;6]	5 [4;6]	
5	could improve my access to a specialist if there are none locally.	Disagreement	8.8%	12.7%	6.5%	6.4%	AT versus DK: $p < 0.001^d$ AT versus UK: $p < 0.001^d$ DK versus UK: $p = 0.805$
		Neutral	22.5%	25.3%	21.4%	20.3%	
		Agreement	61.9%	58.3%	60.7%	67.0%	
		I don't know <sup>b</sup>	6.8%	3.7%	11.3%	6.3%	
		Median [IQR] <sup>c</sup>	5 [4;6]	5 [4;6]	5 [4;6]	5 [4;6]	
6	is good in case of emergencies.	Disagreement	11.1%	16.4%	6.0%	9.6%	AT versus DK: $p < 0.001^d$ AT versus UK: $p = 0.001^d$ DK versus UK: $p = 0.024^d$
		Neutral	18.0%	18.6%	16.6%	18.6%	
		Agreement	65.5%	62.2%	69.2%	65.8%	
		I don't know <sup>b</sup>	5.4%	2.8%	8.2%	5.9%	
		Median [IQR] <sup>c</sup>	5 [4;6]	5 [4;6]	6 [5;6]	5 [4;6]	
7	has no benefit.	Disagreement	33.5%	31.6%	36.5%	33.0%	AT versus DK: $p < 0.001^d$ AT versus UK: $p = 0.584$ DK versus UK: $p < 0.001^d$
		Neutral	36.4%	39.5%	38.5%	31.1%	
		Agreement	21.5%	23.3%	11.6%	28.2%	
		I don't know <sup>b</sup>	8.6%	5.7%	13.4%	7.7%	
		Median [IQR] <sup>c</sup>	4 [3;4]	4 [3;4]	4 [2;4]	4 [3;5]	
8	is more convenient than attending in person.	Disagreement	19.9%	26.7%	7.1%	11.7%	AT versus DK: $p = 0.019^d$ AT versus UK: $p < 0.001^d$ DK versus UK: $p < 0.001^d$
		Neutral	30.2%	33.7%	32.0%	24.7%	
		Agreement	44.6%	35.9%	39.8%	58.5%	
		I don't know <sup>b</sup>	5.3%	3.7%	7.7%	5.1%	
		Median [IQR] <sup>c</sup>	4 [4;6]	4 [3;5]	4 [4;5]	5 [4;6]	
Perceived risks and concerns							
The use of telemedicine ...							
9	should cost less than a normal consultation.	Disagreement	5.7%	7.2%	5.2%	4.7%	AT versus DK: $p < 0.001^d$ AT versus UK: $p = 0.001^d$ DK versus UK: $p = 0.639$
		Neutral	21.0%	23.8%	18.7%	20.0%	
		Agreement	67.7%	65.0%	68.2%	70.3%	
		I don't know <sup>b</sup>	5.5%	3.9%	8.0%	5.1%	
		Median [IQR] <sup>c</sup>	5 [4;6]	5 [4;6]	6 [4;6]	6 [4;6]	

(Continues)

TABLE 3 (Continued)

			All countries ( <i>N</i> = 2117) <sup>a</sup>	AT ( <i>n</i> = 800) <sup>a</sup>	DK ( <i>n</i> = 626) <sup>a</sup>	UK ( <i>n</i> = 691) <sup>a</sup>	Kruskal–Wallis <i>H</i> -tests
10	increases the risk of something being missed because the animal is not physically examined by the veterinarian.	Disagreement	8.6%	10.8%	7.1%	7.4%	<i>p</i> = 0.305 <sup>e</sup>
		Neutral	23.0%	26.3%	19.9%	22.0%	
		Agreement	63.4%	59.8%	65.5%	65.6%	
		I don't know <sup>b</sup>	5.0%	3.1%	7.5%	5.0%	
		Median [IQR] <sup>c</sup>	5 [4;6]	5 [4;6]	5 [4;6]	5 [4;6]	
11	is not an option for me as I don't have the necessary technical IT skills or equipment.	Disagreement	49.1%	46.9%	59.8%	42.2%	AT versus DK: <i>p</i> < 0.001 <sup>d</sup> AT versus UK: <i>p</i> = 0.003 <sup>d</sup> DK versus UK: <i>p</i> < 0.001 <sup>d</sup>
		Neutral	24.6%	28.0%	22.5%	22.7%	
		Agreement	21.4%	22.5%	9.3%	30.8%	
		I don't know <sup>b</sup>	4.9%	2.6%	8.3%	4.4%	
		Median [IQR] <sup>c</sup>	3 [1;4]	4 [2;4]	2 [1;4]	4 [2;5]	
Relational aspects							
The use of telemedicine ...							
12	weakens the veterinarian–client bond.	Disagreement	26.7%	32.5%	26.2%	20.6%	AT versus DK: <i>p</i> = 0.492 AT versus UK: <i>p</i> < 0.001 <sup>d</sup> DK versus UK: <i>p</i> = 0.003 <sup>d</sup>
		Neutral	30.0%	29.5%	31.5%	29.3%	
		Agreement	36.8%	34.8%	32.4%	42.7%	
		I don't know <sup>b</sup>	6.5%	3.3%	9.8%	7.3%	
		Median [IQR] <sup>c</sup>	4 [3;5]	4 [3;5]	4 [3;5]	4 [4;6]	
13	enhances the veterinarian–client bond.	Disagreement	22.3%	24.3%	26.6%	16.5%	AT versus DK: <i>p</i> < 0.001 <sup>d</sup> AT versus UK: <i>p</i> < 0.001 <sup>d</sup> DK versus UK: <i>p</i> < 0.001 <sup>d</sup>
		Neutral	39.0%	38.7%	43.5%	35.3%	
		Agreement	32.3%	34.1%	19.7%	41.2%	
		I don't know <sup>b</sup>	6.4%	2.9%	10.2%	6.9%	
		Median [IQR] <sup>c</sup>	4 [4;5]	4 [3.32;5]	4 [3;4]	4 [4;6]	

Note: Disagreement = 1 'strongly disagree', 2 'disagree' and 3 'somewhat disagree'; neutral = 4 'neutral (neither agree nor disagree)'; agreement = 5 'somewhat agree', 6 'agree' and 7 'strongly agree'.

Abbreviations: AT, Austria; DK, Denmark; IQR, interquartile range; IT, information technology; UK, United Kingdom.

<sup>a</sup>Number of respondents (*n*) were calculated with unweighted data.

<sup>b</sup>'I don't know' answer option was excluded for bivariate statistics.

<sup>c</sup>Median [IQR] was calculated based on the seven-point Likert scale (1 'strongly disagree' up to 7 'strongly agree'); proportions and median [IQR] were calculated with weighted data; rounding errors lead to some differences between rounded-off numerical values and actual values.

<sup>d</sup>Bonferroni correction was applied for multiple comparison between three countries and significant variables.

<sup>e</sup>Since the global test of differences between countries was not statistically significant at the 0.05 level, no further country-by-country tests were conducted.

consultations. Similarly, telemedicine may be beneficial in situations in which an animal requires ongoing or prolonged veterinary care. This was reflected in our study, as the likelihood of having used telemedicine increased with the number of visits to a veterinarian in all three countries.

A possible explanation for the limited past and predicted future use of telemedicine is that veterinarians either do not offer it as an option or do not make their clients aware of it, as suggested by Smith et al.<sup>5</sup> In relation to this, time pressure, the inability to perform a complete clinical examination, the potential for misdiagnosis and difficulties with communication or technology can be perceived as disadvantages that prevent veterinarians from promoting telemedicine.<sup>3</sup> Therefore, it is likely that these issues impact the availability on the veterinary professionals' side. However, we recommend increasing awareness on the professionals' side, both in terms of increasing availability and understanding the potential benefits of telemedicine to the clients and the practice.

Besides this, we aimed to identify whether factors related to the animal and the owner may impact the use of telemedicine. The data show that Austrian

and UK dog owners were more likely to make use of telemedicine than cat owners. This finding is contrary to our expectation, since we assumed that more cat owners would use telemedicine to avoid transport and thereby reduce stress for the cat.<sup>3</sup> However, our data also showed that, in general, cats are taken to the veterinarian less often than dogs, which may reflect that they are only taken when they are really ill, in which case telemedicine would be a less appropriate option than an in-person consultation. Another explanation may be that telemedicine is seen as more useful for follow-up appointments, and hence, they are more common with dogs because they are treated more often.

Furthermore, our study showed that younger Austrian and UK owners were more likely to make use of telemedicine, which is perhaps not surprising, as they are more likely to be familiar with and routinely use IT than older owners. However, an age effect was not found in Denmark, perhaps as far fewer Danish owners overall (less than 10%) stated that telemedicine was not an option for them as they do not have the necessary technical IT skills or equipment, compared with Austrian (22.5%) and UK (30.8%) owners. As Denmark



is considered one of the most developed countries in terms of the integration of digital technologies,<sup>25</sup> there could be a general positive impact from owners' IT skills.

Since the use of telemedicine is usually less expensive than an in-person consultation, we expected that owners with lower incomes might make more use of telemedicine, but this assumption was not confirmed by our data. We did find, however, that 65.0%–70.3% of owners agreed that telemedicine should cost less than in-person consultations. This is in agreement with other studies indicating that owners believe that telemedicine should not be too costly<sup>33</sup> and that they would expect to pay significantly less for a consultation with an unknown veterinarian via telemedicine.<sup>18</sup> Owners' expectations that telemedicine should cost less may be a reason why veterinarians are reluctant to offer it as an option, as charging for a virtual consultation may be challenging. Recent literature confirms that fees in relation to telemedicine are often more uncertain than fees for regular consultations since they are individually regulated by the veterinarian or the veterinary practice.<sup>2</sup> While there is no doubt that the costs involved in a remote consultation may vary depending on the duration and complexity of the consultation, veterinarians should provide owners with some idea of charges in a transparent way to avoid any confusion. In addition, due to the increasing use of pet health insurance,<sup>30</sup> pet owners should find out whether a policy will cover telemedicine before taking it out.

Last, regarding the question of how the veterinarian–client bond is impacted by remote consulting, for all three countries, more pet owners agreed that telemedicine weakens rather than enhances the bond. However, owners who were more likely to agree that telemedicine enhances the veterinarian–client bond were more likely to make use of it. Against the background that veterinary practice is a business in which a respectful relationship between veterinarian and client is important,<sup>1</sup> the option of telemedicine should primarily be used if a strong veterinarian–client–patient relationship already exists.<sup>2,22</sup> However, veterinarians should be alert to potential negative effects during remote consultations and take action where necessary, for example, arranging a face-to-face consultation where appropriate. Furthermore, it has to be noted that, in bigger or corporate-owned practices, owners typically do not see the same veterinarian every time, which can also have an effect on the establishment of the veterinarian–client bond.

Although this study includes three countries to provide a comprehensive investigation of owners' beliefs about and use of telemedicine, the study is subject to several limitations. First, although respondents were given a clear definition of 'telemedicine', it is possible that they had different perceptions of what this meant and how it could be used. Second, other factors may impact beliefs about telemedicine, such as the density of veterinary practices in an area and the availability of specialists. We therefore recommend that future studies consider this variable. Finally, as already indicated,

the way in which statements were worded may have further influenced the results.

To conclude, our results suggest that dog and cat owners recognise the potential benefits of telemedicine but that uptake of this service is low. This finding raises questions about the current availability of telemedicine but also about whether veterinarians believe that the potential benefits outweigh the risks and challenges and therefore make it available and promote it to their clients.

Future research should explore these aspects in more detail. For example, further research is needed on the technology and equipment required to optimise the delivery of telemedicine within veterinary practice. Research should also explore the impact on patient care and the clinical scenarios in which the use of telemedicine is most appropriate. In addition, we believe that increasing the use of telemedicine may affect the daily structure and routines of veterinarians' working lives, for example, by facilitating working from home, which merits further investigation.

## AUTHOR CONTRIBUTIONS

*Conceptualisation:* Svenja Springer, Thomas Bøker Lund, Sandra A. Corr and Peter Sandøe. *Data curation:* Svenja Springer. *Formal analysis:* Svenja Springer and Thomas Bøker Lund. *Funding acquisition:* Peter Sandøe. *Investigation:* Svenja Springer and Thomas Bøker Lund. *Methodology:* Svenja Springer and Thomas Bøker Lund. *Validation:* Thomas Bøker Lund. *Visualisation:* Svenja Springer. *Writing original draft:* Svenja Springer. *Writing review and editing:* Peter Sandøe, Thomas Bøker Lund and Sandra A. Corr.

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## CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.


## DATA AVAILABILITY STATEMENT


The data are fully available on request from the corresponding author.


## ETHICS STATEMENT


The project was approved by the Research Ethics Committee of Science and Health (Ref: 504-010300/22-5000) at the University of Copenhagen.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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