

Digitalization in Veterinary Medicine - The Perception and Acceptance of Digitalized Animal Healthcare by Owners in Germany

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Abstract

Veterinary telemedicine is not as new as it seems. The technological advances in telecommunication and the coronavirus disease 2019 pandemic contributed to the fast adoption of telecommunications by veterinarians. The study aims to assess the perception and acceptance of digitalized animal healthcare by animal owners. An online-based questionnaire was used and shared with veterinary institutions and telehealth providers. A total of 362 responses were gathered between March and August of 2021 from all the states of Germany. Kruskal–Wallis, Spearman, and Wilcoxon rank sum tests were used for statistical analysis and hypotheses testing. The results show that while 71% of responding pet owners view telemedicine as an asset to their clinic or practice of choice, 84% have never used telemedical

services of any kind. The main factors contributing to hesitancy towards online consultations among pet owners were primarily limited examination methods (82%) and lack of personal component (32%). The main disruptive elements in connection with clinical visits were waiting times (59%), aggressive or nervous pets (55%), and general stress (39%). The study shows that despite many respondents having a positive attitude toward telemedicine, it is still underused in clinical practice in Germany. More research on how the adoption of telemedicine can be improved is needed.

Keywords: Digital transformation, digitalization of veterinary profession, telecommunication, telemedicine, veterinary profession

Introduction

Long-distance telecommunication devices such as telephone or telefax are examples of veterinary telemedicine devices that have been part of veterinary sciences for decades (Mars & Auer, 2006). More recently, the coronavirus disease 2019 (COVID-19) pandemic has made online communication with medical professionals a necessity (Magalhães-Sant'Ana et al., 2020). However, it is important to note that even before the COVID-19 pandemic, the field experienced rapid growth since it is bound to modern technological progress.

While telemedicine has been well established as a useful tool in human medicine, veterinarians are comparatively conservative when it comes to modern video telecommunication (VTC) being used for healthcare purposes. This topic is more relevant than ever due to the global pandemic and concurrent restrictions to personal contact, which should permit a more open discussion regarding the upsides and limitations of veterinary telemedicine.

Nevertheless, the current surge in interest should not outshine the already established advantages of the field. Economizing workflow, improving standard of healthcare, reducing customers', patients', and ultimately veterinarians' stress, and reducing the carbon footprint are only some of the scientifically researched upsides in connection with digitalizing medicine.

Telecommunication devices are not only useful for the veterinary profession during lockdowns, but they can help aspiring medical professionals increase their level of education, too. However, one of the most significant differences of veterinary medicine in comparison to its human counterpart—veterinarians' patients can't make use of telemedicine—appears to be commonly disregarded. To establish telemedical services in the veterinary field, the animal owner or customer must make use of them, even when not forced to do so by a global health crisis. The aim of this paper is to analyze the reasons according to the scientific literature, as well as provide insight into potential benefits of transferable human telemedical services for veterinary medicine.

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In addition, a survey was distributed, and data was gathered concerning the perception and acceptance of telemedical methods among German animal owners. In accordance with this, the paper will try to provide a theoretical framework for increasing digitalization successfully in the veterinary field, based on animal owner preferences. The analyzed data will try to quantify customer perception and acceptance of veterinary telemedical services, showing how the possible benefits of digitalization can be made available in everyday practice.

Literature Review

The Construct of a Digital Veterinary Branch—Telehealth and Telemedicine

The American Veterinary Medical Association (AVMA) describes telehealth as an umbrella term including all forms of technologically provided information, education, and remote care, dividable into different subspecialties (AVMA, 2021). The German Association of practicing veterinarians (BPT) specifically described veterinary telemedicine as the use of information and telecommunication technologies in order to aid in medical care, if veterinarians and owners with their pets are physically separated (Bundesverband Praktizierender Tierärzte e.V., 2021). Telemedicine has also simply been classified as the use of telecommunication to discuss patient clinical data and management (Gyles, 2019; Voyer & Jordan, 2018; Watson et al., 2019)

Telepathology consists of employing online communication to transfer pathologically relevant data, including images and videos. Its main areas of use are to consult, educate, research, deliver, or confirm diagnoses as well as give pathological insight remotely (Farahani & Pantanowitz, 2015). Computerized complete or whole slides are often used by veterinary pathologists to save information for a long time. Setting up a laboratory that fulfills requirements to practice telepathology is mostly a question of network connectivity (based on broadband access) and wireless telecommunications. Common telecommunication and online data sharing and storing platforms, e.g., Skype, Lync, Team Viewer, DropBox, etc., have been used successfully to establish professional exchange. More specifically SecondSlide and PathXchange are used as online file storage providers for telepathology (Farahani & Pantanowitz, 2015).

Teleradiology specializes in sharing diagnostic imaging from modalities like x-ray radiography, computed tomography, magnetic resonance imaging, as well as ultrasound or others (EKG, etc.). It has been around ever since telecommunication is usable in practice, but after major technological advances, it has become more frequently used as a telemedical device to acquire diagnoses remotely (Essman, 2011). With technological advancement, teleradiology has quickly found its place in everyday veterinary practice through supplying immediate input by radiologists. This allows more medical institutions, that would otherwise lack radiology expertise to consult specialized veterinary professionals (Essman, 2011). Especially “cross-sectional imaging,” as used in computed tomography or magnetic resonance imaging, benefits from modern technology.

Veterinary tele dermatology, as a subcategory of dermatology, deals with the remote assessment of skin lesions based on visual medical data provided via telecommunication services. Tele dermatology is a field in which the advances of modern-day technology can be used specifically for quick and reliable image-sharing mechanisms made possible by smart devices and computers nowadays. Thus,

the nature of the diagnostic approach, the inspection of the lesions with the naked eye, is compatible with telemedical processes like video consultation and picture sharing. Human medicine provides data that is likely transferable to veterinary medicine. Studies have shown that the overall precision of remote diagnoses in human dermatology settles in at around 70% (Eedy & Wootton, 2001; Lee & English, 2018), which is comparable to precision in face-to-face examinations.

Due to the similarities in the procedure of establishing a diagnosis in both veterinary and human medicine, the *modus operandi* for remote dermatology consultations could be adopted by veterinarians. This can be showcased when examining diseases like Atopic Dermatitis, a condition known to affect humans as well as pet and production animals. Immunological similarities have been noted in Atopic Dermatitis of humans and dogs (Arcique & Bajwa, 2020; Mayo Clinic, 2023; Diaz, 2020).

In professional circles, the term teleconsultation usually represents an exchange of two veterinarians, using some form of telecommunication to consult on a case, that one of them encounters. Usually, one of the veterinarians has a previously established business relationship with the customer and patient (or, a veterinarian-client-patient-relationship, a VCPR) (Pang, 2020; Roca & McCarthy, 2019). However, it is routinely used to describe the online consulting between customers and veterinarians too. Also, within a pre-existing VCPR (British Veterinary Association, 2021, Melchers, 2021)

Through teleconsultations between veterinarians, expert knowledge can be made accessible in everyday practice, without the specialist having to be physically present. This makes treatment of a formerly non-treatable patient possible, showing the way teleconsultations can improve veterinary care. It also shows that videoconferences using commonly available technological devices can be a viable option to improve patient care. Most veterinary institutions are probably already in possession of the required technical equipment (Bishop et al., 2018). Teleconsultations are the combining factor between fields of telepathology, teleradiology, and tele dermatology. By increasing the accessibility of expert evaluation through teleconsultations, the overall standard and efficacy of care are improved.

Client-veterinarian teleconsultation is a telemedical service using telecommunication tools allowing the veterinarian to get in contact with the client and assess the overall medical status of the patient without relying on a physical examination (British Veterinary Association, 2021; Melchers, 2021). However, teleconsultation is indeed a branch of telemedicine and should be treated as such, instead of using the terms telemedicine and teleconsultation synonymously, which creates a confusing space for argumentation and has occurred in scientific literature and discussion (Hess, 2017).

Client-veterinarian teleconsultation is a controversial topic among veterinarians. Some practitioners see the benefits of it, like the chance to view patients via video chat under everyday circumstances, rather than a stressed or fearful animal at their workplace. Also, patient development is easier to follow through picture and video exchange on smart devices (Chitty, 2019). Therefore, advocates of remote care see teleconsultation as an addition to their in-house work. It has also become incredibly relevant due to the COVID-19-mandated lockdowns, as a way of assuring patient care despite adverse conditions (British Veterinary Association, 2021; Caney et al., 2022).

On the other hand, critics of digitalization often criticize the idea of remote prescriptions and argue that only with an established VCPR and in person should a practitioner be able to prescribe medication to a patient. As this is being written, remote prescriptions are not legal in Germany. The opposing experts fear that if it were to become a reality, the standard of diagnostic work would suffer (Mars & Auer, 2006) and that the already criticized overuse of antibiotics would increase even further (Massin Teller & Moberly, 2020).

Current State of Telemedical Veterinary Services

Presently, telemedicine is still not widely practiced in veterinary medicine in Germany, even though the profession can benefit from modern technological advancement. The section will evaluate the reasons for the development, and how promoting digitalization in veterinary medical care can positively influence the field.

Causes of the growth of telemedical services

The human medical field already acknowledges the value of using advanced telecommunication systems to their advantage and determined ways of applying telemedicine efficiently and accurately. The veterinary field is lagging.

One of the reasons for the poor use of telemedicine tools in the veterinary practice is the combination of unwillingness and lack of technical know-how by veterinarians, and a shortage of capable, forward-thinking practitioners in the field. Research has shown that many veterinarians do not favor using telemedical services, no matter their age (Watson et al., 2019).

Data show that practitioners as well as students are hesitant towards digitalization itself as well as acquiring knowledge in IT-related subjects compared to workers in the industrial sector or service providers. Consequently, their already weak capabilities to work with modern tele technology are not improved upon, because opportunities for tele technology is rarely done (Stumpp et al., 2020). Understandably the deficit in technical knowledge raises questions about internet security. This issue is also often addressed by animal owners when confronted with the topic of telemedicine (Drewry et al., 2019).

Another reason why telemedicine is not fully accepted by the veterinary profession is the issue of remote prescription. Many practicing veterinarians reject this due to the risk of missing symptoms, difficulty assessing vital signs and other measurements, and mitigation of responsibility which could lead to misdiagnoses. Further, there is a risk for over-prescription of antibiotics, which has happened in human telemedicine settings before (Massin Teller & Moberly, 2020). They also lament that the practice of online consultations and counselling has the potential to further competition for clients, among vets, forcing less technology-experienced practitioners to forfeit customers (Loeb, 2019).

Practical benefits of veterinary telemedicine

There are prerequisites for routine use of veterinary telemedicine. It is necessary to investigate the interest of existing animal owners in using telemedicine for consultations. Widmar et al. (2020) showed that dog and cat owners, that participated in their survey, were willing to pay for online counselling, subsequently exerting disutility for vets and owners that decline veterinary telemedicine opportunities. Based on this information one could argue that there is a market for telemedicine in the veterinary field that is not being explored. Especially since telemedicine is an effective method to

extend business hours and therefore increase overall amount of patient visits, a number that has gone down, partly due to pet owners' increased use of the internet (Volk et al., 2011).

Telemedical considerations during the COVID-19 pandemic were a practical benefit for veterinary medicine. The highly unusual circumstances in connection with the global pandemic-induced lockdowns, have shifted the discussion from profitability to necessity, and thereby opened the doors for new telemedical technologies (Smith et al., 2022). As with many other areas of life, veterinary medicine has been impacted by the circumstances in connection with COVID-19. Out of a pool of 188 consultations, the possible impacts of COVID-19 are quantified, showcasing that it had definite effects on routine procedures and everyday appointments, thus highlighting the need for more sophisticated solutions concerning online veterinary medical care. Practicing remote care wherever possible, would decrease the risk of exposure for both personnel and clients. Advice given using telemedicine has been shown to decrease in-person visits (Littlehales et al., 2020).

Another deciding factor is usability. The outcome of human medicine studies can be compared to the usability of telemedicine in veterinary practice. Eedy & Wootton (2001) and Lee & English (2018) determined the accuracy and efficacy of dermatology-related remote diagnosis at around 70% after reviewing several studies of tele dermatology. As a result, the institutions that were studied were economizing their workflow, cutting back on waiting time for surgeries, and saving money in favor of both patients (£1.70 saved per patient) and healthcare (18% savings) (Heijden et al. 2011; Lee & English, 2018). These results can motivate the veterinary field to facilitate change in the same direction.

Overall, veterinary telemedicine offers some economic and ecological benefits that could improve veterinary-accessibility for animal owners that were previously unable to receive veterinary care for example due to geographical barriers (Lem, 2019). Teleconsulting is arguably the most efficient way to confer with peers. Using virtual meeting platforms, not only retrospective and clinical data can be exchanged, but patients can be viewed by the consultant without having to be present. Especially if the consulting veterinarian is a specialist, the use of teleconsultation can improve the level of care given to a patient. General practitioners could use teleconsultation to immediately refer patients to specialists without having to see them in person (Jin et al., 2019).

Also, some veterinary tasks could be performed online completely, the best example being post-surgical follow-up examinations. After everyday procedures like spaying or neutering, removal of superficial growths, or dental extractions, the online review of the patient is favorable. Bishop et al. (2018) found in their study, owners were pleased with the results of a remote check-up service and opted to make use of it on other occasions.

Implementation of veterinary telemedicine could also help practice management to optimize workflow. An increased capability to take on cases (Voyer & Jordan, 2018) in combination with improved distribution of labor (by more efficiently distributing patients to specialists after online counselling) would provide preferable conditions for employees. Therefore, this could improve retention of personnel, by creating a more harmonious company culture, within the usually stressful workspace that is the veterinary field.

Finally, like every other part of society, the veterinary medical sector should be hard-pressed to find ways to reduce carbon emissions, waste production, and strive for playing its role in decelerating global climate change. Telemedicine is an eco-friendlier option to treat patients, as it has the potential to reduce carbon dioxide production in connection with the health sector by 40–70 times. Transportation plays a huge part in global warming. Regarding healthcare personnel as well as clients, video telecommunication helps circumventing the need to drive, if remote treatment is a possibility. Conclusively, it is an effective way to reduce the amount of greenhouse gas emissions in relation to medical appointments. If telemedicine was to be used more widely, it could have considerable effects in decreasing emissions (Holmner et al., 2014).

Method

A questionnaire consisting of 16 questions was compiled by using the platform SurveyMonkey. It contained sociodemographic questions: e.g., place of residence, age, sex, and occupation. The questionnaire was purposely directed at possible clients of veterinarians, therefore, the share of the questionnaire focused on forums, websites, and social media groups that are animal related. More specifically, several veterinary clinics and practices as well as veterinary telemedical service providers were contacted and asked to share the survey with their established customer base. National Veterinary Associations in Germany were also asked to share the questionnaire with animal owners. The questionnaire was available online from March to August 2021 and invitations that included a link to the questionnaire were shared by e-mail, via Facebook groups as well as veterinary news platforms. It could be completed within 5 minutes and the responses were anonymous.

The following hypotheses were set up:

H1: If an animal owner has small animals, they are more likely to use telemedical consultations. (H0: Owning small animals has no effect on likelihood of using telemedical consultations).

H2: Younger animal owners are more likely to use telemedical consultations. (H0: Age of animal owners has no effect on likelihood of telemedical consultation usage).

H3: Rural and small-town populations are more likely to use telemedical consultations. (H0: There are no regional differences in the likelihood of telemedical consultation usage).

A total of 362 participants completed the survey. The responses were processed in MS Excel. In the statistical analysis Kruskal–Wallis, Spearman and Wilcoxon rank sum tests were used and the significance level was set at $p < .05$.

Results, Discussion, and Conclusion

Sociodemographic Characteristics of the Respondents

Most of the respondents lived in the southern states of Germany: 42.82% in Bavaria and 12.26% in Baden-Württemberg, followed by people living in North Rhine-Westphalia (12.15%). Around 46% of the respondents came from a rural background, followed by large-town (24%), small-town (21%), and medium-town inhabitants (9%).

The sex of this population leaned toward the female side, as 247 (68.23%) participants were women. Around 112 participants

(30.94%) were between 18 and 24 years of age, 102 (28.18%) between 25 and 34 years, and only 37 respondents (10.22%) were aged between 35 and 44.

Around 89.75% (325) of the respondents had pet(s) at the time of the survey and the distribution of pet animal species among the represented owners is shown in Figure 1.

Customer Perception and Acceptance of Veterinary Telemedical Services

Considering the three hypotheses no measurable relationship between place of residence and willingness to participate in online consultations ($p = .8187$, Spearman test) ($p = .06$, Kruskal–Wallis test) was defined. Also, there was no significant correlation between the age of the respondent and the likelihood to use online consultations ($p = .077$, Spearman test) ($p = .63$, Kruskal–Wallis test). Lastly, there seems to be no connection between owning small animals and likelihood to take part in telemedical consultations ($p = .595$, Wilcoxon rank sum test). These outcomes mean that none of the null hypotheses could be rejected. A possible interpretation of this outcome is that there are no preferences between the different sociodemographic groups of animal owners with different pets and the use of telemedicine.

Limiting Factors of Veterinary Digitalization

Despite that the raw data looked promising since the average respondent appears to be more likely to accept the telemedicine offers than not, it is still necessary to identify the reasons for limiting the potential of digital veterinary healthcare among the possible customers. To identify the limitations, possible factors that would urge respondents to decline online consultations were offered in the survey, which can be seen in Figure 2. Note that the questions were multiple-choice questions that allowed participants to give more than one answer. Therefore, the number of answers exceeds the number of participants.

The most common reason (82.04% of all participants or 53.04% of all the answers given to that question) why participants would decline a telemedical consultation was, the issue of insufficient treatment possibilities. There was also considerable concern with the lack of personal component (30.94% of all participants or 20% of all answers given) among animal owners. Other inconveniences that could occur alongside online consultations were technical complications (11.88% of all participants or 7.67% of all answers given) and insufficient internet connection (9.67% of all participants or 6.25% of all

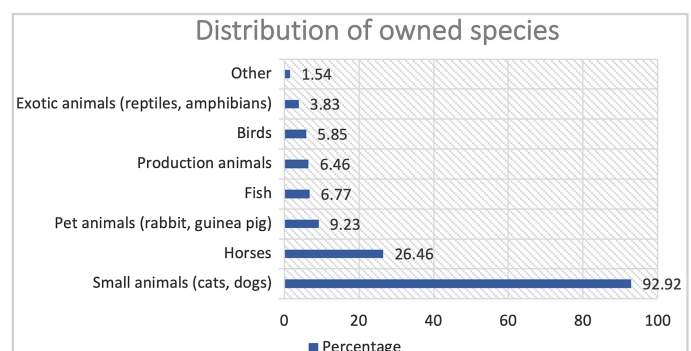
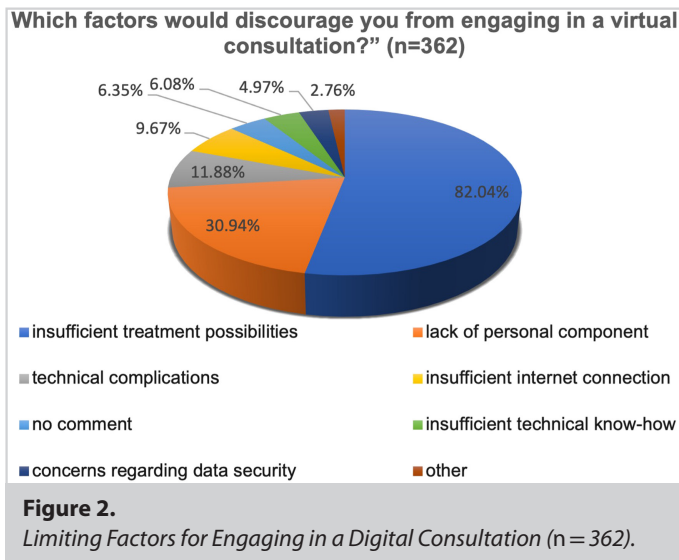


Figure 1. Distribution of Owned Animal Species (n = 325).



answers given). From the owner's point of view, insufficient technical know-how (6.08% of all participants or 3.93% of all answers given) as well as concerns regarding data security (4.97% of all participants or 3.2% of all answers given) were only viewed as minor problems. Around 23 respondents (6.35% of all participants or 4.1% of all answers given) chose not to answer.

Assessing Framework Conditions for Implementation of Digital Healthcare Systems

To judge acceptance of some of these methods, the survey was set up to gain insight into customers' negative experiences with the veterinarians, as well as their perception of possible solutions and improvements. When they were asked about things that would make a visit to the veterinarian undesirable, waiting times (59.21%) and aggressive or rather nervous pets (54.97%) were the two most frequent answers. General stress seems to be another negative factor in connection with a visit to a veterinarian, as it is experienced by 38.40% of participants. Around 107 respondents (29.56%) were bothered by the travel distance and, similarly, the required time was a nuisance for equally as many respondents (also 29.56%). The costs (11.05%) are not among the priority problems. Around 34 people (9.39%) did not answer this question.

Previous studies also implied that in general customers are willing to pay for telemedical services (Widmar et al., 2020), which is somewhat supported by the fact that people partaking in this questionnaire are overall likely to use online consultations. Therefore, an increased supply of, e.g., teleconsultations can be a source of additional income for veterinarians, alongside established benefits for patient healthcare such as less stress for owner and animal. As Bragg et al. (2015) established, there are measurable differences in physiological values of patients due to in-house physical examinations. This study also found that aggressive and nervous behavior of patients, likely due to stress during visits, was a problem for more than half of animal owners.

The following options were considered preferable for online scheduling: vaccinations (75.41%), follow-ups (61.60%), general examinations (57.73%), post-operative controls (45.30%), and special diagnostics, like ultrasound, x-rays, and blood tests (41.16%). On the other hand, emergencies seem to be a different matter, as only

8.84% of the respondents regarded this situation as online schedulable. Out of the 24 "Other" answers, 10 (2.76%) were variations of either "general examinations" or "check-ups" and the remaining 14 answers (3.87%) can be summarized as "online scheduling should not be practiced." Also, 215 respondents (59.72%) were in favor of it being legal for veterinarians to diagnose and prescribe virtually, while 145 (40.28%) were against it.

Majority of respondents (70.72%) think that telemedicine would indeed be beneficial, while the rest (29.28%) are not convinced. On the other hand, when asked whether they have ever used telemedical consulting with either a veterinarian or a physician, the responses showed that there was a little experience with the topic.

Out of 362 surveyed participants, merely 40 (11.05%) had used telemedical consultation with a veterinarian. Another 20 had had experiences in this regard with a physician (5.52%). A vast majority of 84.25% answered "No" when asked whether they had used any sort of online consultation. So, despite many people regarding it as a tool to a veterinary service, there is little to no use. The exact reasons accountable for this suggested gap in supply and demand are hard to gauge and would require further research in the future.

The data of this survey supports that overall, animal owners are likely to use telemedical services if offered. This implicates that if veterinary institutions would more focus on this service, they could reap its professional and, consequently, financial benefits. There are already studies that support this assessment (Voyer & Jordan, 2018). It would also be advisable to implement online scheduling for routine services. Participants of this survey were in favor of making appointments online for basic practices like vaccinations, general examinations, follow-ups, and post-op examinations as well as special diagnostics. This is an inexpensive method to save time and redistribute workforce in a more economical way.

The digital tool preferences of the respondents were relatively diverse, excluding Facebook and its messenger (4.14%) and Google Meet (8.84%) which are the two least favorite options. Considering the preferences for video-chat-focused tools, Skype (25.97%), FaceTime (29.28%), and Microsoft Teams (29.83%) had similar shares to each other. The exception being Zoom, another video communication platform, with 42.54% approval among participants. As regards to the more text-based digital applications, 37.85% of the respondents considered e-mail a decent option, while WhatsApp gathered 43.65% share overall. Using the telephone to communicate with their veterinarians was the preferred way of more than half of the respondents (51.93%) and thus the most popular tool.

Digitalization is present in every aspect of modern society, also in veterinary medicine, however, veterinarians are somewhat lagged in this regard. At the same time the findings in both the previous studies and the present survey show that telemedicine has more benefits than disadvantages and is fairly accepted by potential customers, if not always well understood in its entirety. Based on the findings of this survey it can be stated that the most common client's reason for declining online consultations was insufficient treatment possibilities. Since telecommunication is a method of facilitating interaction between two parties, more studies should focus on this bilaterality—rather than on either the professional or the customer's side. The limitations of this study are that its sample size, despite the authors' best efforts, is not quite satisfactory for making broader assumptions

or suggestions, and there is a geographical bias within Germany (towards Bavaria). At the same time, at least according to our present knowledge, this is a pioneer survey on the perception and acceptance of digitalized animal healthcare by animal owners in Germany.

Ethics Committee Approval: Ethics Committee Approval was not needed, approval was given by Laszlo Ovszvari, who is the vice rector for study affairs and head of department of Veterinary Forensics and Economics at the University of Veterinary Medicine Budapest, Hungary.

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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