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Exploring the Digitalization and Business Management of German Veterinary Practices

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1. RESEARCH BACKGROUND AND AIMS

1.1 Research Background

The veterinary profession in Germany is currently experiencing significant structural shifts, marked by a decline in small, independent practices and a rise in larger, partnership-based, or corporate-owned practices. These changes are driven by evolving market forces, the increasing humanization of pets, and the adoption of advanced management and marketing strategies. Additionally, pet owners today have greater access to health-related information online, which raises their expectations regarding both service quality and cost. In this environment, veterinarians must navigate not only clinical challenges but also the complexities of running a business. However, many small practices lack the necessary economic and managerial foundations, placing them at a disadvantage compared to larger, well-structured operations.

This dissertation addresses the critical gap in business management skills among veterinary professionals, focusing on the economic and operational challenges that hinder the sustainability of small and mid-sized practices. While veterinary education traditionally emphasizes clinical expertise, it often neglects the management skills essential for running a successful practice. This research aims to provide insights into effective practice management by exploring strategies for improving operational efficiency, client retention, and financial stability within the veterinary sector. Over the past two decades, the European veterinary market has shifted from a generalist model, where veterinarians offered broad services across multiple species, to one increasingly defined by specialization and niche expertise. This trend has been largely driven by the growing demand for specialized care in response to the rising number of companion animals. As specialized clinics become more prevalent and non-veterinary companies enter the market, competition has intensified not only in clinical expertise but also in business acumen.

Additionally, the profession faces demographic challenges such as an aging workforce, the feminization of the profession, and a limited number of young veterinarians willing to establish or invest in new practices. These factors further underscore the need for veterinary professionals to develop robust management skills. While digitalization and telemedicine are increasingly relevant in veterinary practice, they represent only one aspect of the broader management challenge. Telemedicine has been a part of veterinary services for decades, but recent technological advancements and the COVID-19 pandemic have accelerated its adoption. Nevertheless, the primary focus of this dissertation remains on the management strategies that can help veterinarians thrive in a rapidly changing market. This includes understanding how to structure practices effectively, implement strategic marketing, and optimize client services—all essential for maintaining a competitive edge.

This research also incorporates an analysis of veterinary telemedicine, not as an isolated technological trend, but as part of a broader strategy to enhance practice management. By surveying German pet owners regarding their perceptions of telemedicine, this study provides insights into how digital tools can complement traditional practice models and improve client engagement. However, the core emphasis remains on identifying actionable management solutions that can be readily applied in everyday veterinary practice. Overall, as the German veterinary profession continues to evolve, the integration of robust management principles alongside clinical excellence remains indispensable for long-term success. This dissertation addresses a notable gap in economic and managerial competencies within the field, offering practical recommendations for veterinarians seeking to establish sustainable and competitive practices in an increasingly complex market.

1.2 Objectives

The aim of this study is to explore the business management and marketing characteristics, market tendencies, and digitalization trends within German small animal and mixed veterinary practices, with a particular focus on the role of telemedicine. In this study small animals include dog and cat breeds and small mammals (e.g. guinea pigs, rabbits). Only small animals treated in mixed animal practices are included in the study, not farm animals such as ruminants.

The following hypothesis were formed and will be addressed:

Hypothesis testing related to digitalization and telemedicine:

1. H1: If an animal owner has small animals, they are likely to make use of telemedical consultations
2. H0: Owning small animals has no effect on likelihood of using telemedical consultations
3. H2: Younger animal owners are more likely to make use of telemedical consultations

   H0: Age of animal owners has no effect on likelihood of telemedical consultation usage
4. H3: Rural and small-town populations are more likely to use telemedical consultations

   H0: There are no regional differences in likelihood of telemedical consultation usage

Hypothesis testing related to business management and marketing:

1. H4: There is an effect of practice type on number of employees.

   H0: There is no effect of practice type on number of employees.
2. H5: There is a significant association between practice type and turnover.

   H0: Turnover is independent of the type of practice.
3. H6: The Number of Employees, Equipment and legal form are decisive for high turnover.

   H0: The Number of Employees, Equipment and legal form are not decisive for high turnover
4. H7: There is an effect of number of staff on use of marketing tools.

   H0: There is no effect of number of staff on use of marketing tools.
5. H8: There is an effect of age on views on the future/ marketing instruments.

   H0: There is no effect of age on views on the future/ marketing instruments.
6. H9: There is an effect of age on views on choosing the marketing tools.

   H0: There is no effect of age on views on choosing the marketing tools

2. MATERIAL AND METHODS

2.1 Digitalization Survey

The digitalization survey aimed to evaluate the acceptance and impact of telemedicine among pet owners in Germany. This study investigated various sociodemographic factors influencing the willingness of pet owners to utilize telemedical consultations. The survey employed a descriptive and correlational research design, targeting a broad spectrum of pet owners across Germany. Data collection took place from March to August 2021 using a comprehensive questionnaire designed on the SurveyMonkey platform, encompassing both closed-ended and open-ended questions.

2.1.1 Questionnaire Development, Feasibility Testing, and Data Processing

The questionnaire, initially drafted in Microsoft Word, comprised 16 questions across multiple sections, focusing on sociodemographic information such as place of residence, age, gender, and occupation. It underwent critical review by selected participants and academic faculty, leading to refinements for clarity and relevance. A pilot test with representatives from the target group provided feedback, resulting in final adjustments before broader distribution. Participants were assured of anonymity and data confidentiality, with their consent obtained in compliance with ethical standards. The survey, primarily administered via SurveyMonkey, required approximately five minutes to complete.

The survey targeted potential clients of veterinarians and was disseminated through forums, websites, and social media groups related to animals. Veterinary clinics, practices, and telemedical service providers facilitated distribution by sharing the survey with their customer base. Additionally, National Veterinary Associations in Germany were asked to circulate the

questionnaire among animal owners. Invitations, including a link to the survey, were shared via email, Facebook groups, and veterinary news platforms.

A total of 362 participants completed the survey. Data were initially processed in Microsoft Excel for basic evaluation and subsequently transferred to STATA for advanced statistical analysis.

2.1.2 Statistical analysis

Data processing began with descriptive statistics to outline the sociodemographic characteristics of the respondents, providing a foundational context for further analysis. Several advanced statistical tests were employed to explore the research questions:

Kruskal-Wallis Test: investigates correlation between regional differences in the likelihood of using telemedical consultations, the analysis could identify whether regional variations influence telemedical consultation usage.

Spearman Correlation: aims to evaluate the relationship between the age of respondents and their likelihood to use telemedical consultations, suggesting that the result could indicate that age could affect telemedical consultation usage.

Wilcoxon Rank Sum Test: aims to compare the likelihood of utilizing telemedical services between small animal owners and others (e.g. horse owners, farmers), analysing whether the type of pet influences telemedical consultation usage.

The significance level was set at $p < 0.05$ for all tests. The results were systematically analyzed to identify key trends and correlations.

2.2 Management characteristics survey

2.2.1 Study Aim and Design

The study's primary objective was to analyze critical management characteristics within German small animal practices, clinics and mixed animal practices treating small animals, focusing on aspects such as management practices, market trends, and business parameters. Adopting a descriptive and correlational research design, the target participants included owners and practice managers of small animal or mixed animal practices across Germany. The data collection took place from November 2020 to March 2021, providing ample opportunity to garner extensive responses and insights. A comprehensive questionnaire consisting of a mix of closed-ended and open-ended questions and questions incorporating different methods such as Likert scales was developed to capture diverse data pertinent to the research objectives. This survey was electronically distributed through emails, links sent to veterinary universities, professional associations, and hosted on platforms like the German Veterinary Association and the Association of Practicing Veterinarians websites. Information leaflets detailed the survey's scope, ensuring participants fully understood the study's purpose. To optimize engagement, abstracts promoting the study were published in veterinary magazines and on various relevant online platforms.

2.2.2 Questionnaire Development and Feasibility Testing

Initially drafted in Microsoft Word, the questionnaire featured 68 diverse questions across 7 comprehensive sections. The questionnaires employed in this research underwent multiple rounds of review and pilot testing to enhance clarity and consistency. Pilot participants provided critical feedback on question wording, format, and length, prompting modifications that improved face validity. However, formal reliability analyses (e.g., Cronbach's alpha) were not systematically conducted for all question sets. Consequently, while

the instruments were refined to reduce ambiguity, there remains a possibility of measurement error arising from inconsistent interpretation of items. To mitigate these concerns, closed-ended questions were formulated to minimize subjectivity, and training materials or explanatory notes were provided to participants when necessary. Nonetheless, the potential for residual bias in self-reported data must be acknowledged, as respondents may under- or overestimate certain behaviors or attitudes despite confidentiality measures.

2.2.3 Data Collection Process

All study participants provided written consent, ensuring compliance with ethical standards and voluntary participation. Anonymity and data confidentiality were stringently maintained. The SurveyMonkey platform was primarily used to administer the survey, designed to be completed within 25 minutes. Despite initial low response rates, persistent outreach through professional networks ultimately yielded 301 complete responses. The initial data processing was undertaken in Microsoft Excel, where data sets were evaluated for completeness, with 221 datasets deemed suitable for comprehensive analysis.

2.2.3.1 Sampling Method

A nonprobability (convenience/snowball) sampling strategy was adopted due to practical constraints, including the absence of a comprehensive and publicly available registry of veterinary practices or pet owners. This approach enabled broad initial reach through professional networks, social media groups, and partner clinics; however, it may limit the representativeness of the final sample. Certain subpopulations—such as those less active online or located in regions with limited veterinary infrastructure—might be underrepresented. In addition, the reliance on voluntary participation introduces self-selection bias, wherein individuals with a stronger interest in the topic could be more inclined to respond. While this method facilitated timely data collection and sufficient

sample sizes, caution should be exercised when generalizing the findings to the wider population of German veterinary practices or pet owners. Future studies seeking greater external validity might employ stratified or probabilistic techniques, ensuring a more balanced demographic distribution.

2.2.4 Statistical Analysis

Data meticulously transferred from SurveyMonkey to Microsoft Excel underwent preliminary evaluations to ascertain completeness, forming the basis for further advanced statistical examination in STATA. The detailed statistical analysis conducted in STATA was multifaceted. To expand upon the extensive statistical analysis performed in this study and approaching the research questions with precision, I utilized a diversity of statistical techniques and explored various dimensions of veterinary practice management in German small animal practices, clinics and mixed animal practices treating small animals. While the STATA-specific output files (i.e., do-files) are no longer retained, the Excel dataset is available for replication, enabling other researchers to re-run or extend these analyses.

2.2.4.1 Descriptive Statistics and Demographic Analysis

The basic demographic features (frequencies and percentages) were calculated to provide insights into the residences, states, workplaces, gender, and age distribution among the participants, as presented in ANNEX V. This baseline data served to establish the demographic context for further analysis and ensure a comprehensive understanding of our sample characteristics. The refreshed and analyzed data is shown broken down to the sections of the questionnaire in ANNEX V-XII.

2.2.4.2 Advanced Statistical Analysis Techniques

Chi-Square Tests were used to investigate associations between practice categorical variables such as the type of residence and workplace and the state

of the veterinary practice (geographic distribution). Results from these tests helped identify patterns which might affect practice operations based on geographic characteristics.

One-Way ANOVA was utilized to examine differences among various legal forms of practice and their associated practice characteristics like the length of practice operation and the types of services offered. Significantly different means would indicate the impact of legal structure on practice operations. Although ANOVA often assumes normality of residuals, explicit normality tests are not shown here. In the context of larger sample sizes and relatively balanced groups, ANOVA remains a reasonable choice.

Logistic Regression was performed to model the probability of achieving **high revenue** (defined as exceeding one million euros). Multiple predictors—such as practice type, number of employees, equipment, and legal form—were included in the model to determine which factors significantly contributed to higher financial performance. This analysis aimed to provide a deeper understanding of how these variables collectively influence the likelihood of exceeding a one-million-euro revenue threshold. The selection of the three variables for the logistic regression analysis was based on their theoretical relevance and prior research findings. For example, the first variable, practice size (e.g., number of employees), was chosen because previous studies have shown that larger practices tend to have different management and operational challenges, which could e.g. influence their use of digital tools and telemedicine or employment of practice managers, service offerings, etc. The second variable, turnover, was selected because financial performance is often a key driver in the adoption of new technologies or operational strategies in businesses, including veterinary practices.

Two-Way ANOVA was conducted to test whether practice type affects the number of employees. The analysis could show whether there are significant

differences among different practice types regarding their employee count, revealing insights into operational scale and scope impact staffing needs.

Fisher Exact Test was applied to explore the association between the type of practice and annual revenue to address the challenges of small expected counts in some cells of our contingency table. The result could imply if practice type would be a determinant of revenue.

Multiple Linear Regression was performed to predict financial outcomes (like revenue and revenue distribution) based on multiple predictors including practice type, number of employees, and types of services offered. The analysis aims to provide a deeper understanding of how various factors combinedly influence financial success.

3. RESULTS AND DISCUSSION

3.1 Digitalization Study of Veterinary Practices in Germany

The survey conducted revealed key insights into the demographics, perceptions, and limitations regarding the adoption of telemedical services in veterinary care. Most of the respondents were located in southern Germany, particularly Bavaria (42.8%) and Baden-Württemberg (12.3%), with significant representation from rural areas (46.0%). There was a distinct gender imbalance, with 68.2% of the respondents being female, and most participants were younger, between the ages of 18 and 34 (59.1%). One of the core findings was that most participants (89.8%) had pets, which is important when assessing potential use cases for veterinary telemedicine. The 10.2% of respondents who were not pet owners were retained in the analysis to provide a comparative perspective on attitudes toward digitalization and telemedicine. Their inclusion broadens the scope of the findings, offering insights into how non-pet owners perceive veterinary digital tools, which may influence societal acceptance and adoption. However, despite widespread pet ownership and increasing awareness of telemedicine, only 11.1% of the respondents had engaged in telemedical consultations with a veterinarian. This low rate of adoption points to a gap between theoretical acceptance and practical use of digital tools in veterinary healthcare. Further analysis revealed that neither the place of residence nor the age of respondents significantly influenced their willingness to participate in online consultations ($p=0,8187$ Spearman-test) ($p=0,06$ Kruskal-Wallis-test). The lack of a measurable relationship between these sociodemographic factors and the likelihood of using telemedicine suggests that hesitancy to adopt such services is not localized to specific population groups, a finding consistent with previous studies. Additionally, owning small animals did not correlate significantly with an increased

likelihood to engage in telemedical consultations, which implies a broad ambivalence toward telemedicine across different pet owner demographics.

The study identified several limiting factors for the adoption of telemedicine. The primary reason for rejecting online consultations was the perceived insufficiency of treatment options, as cited by 82.0% of participants. This suggests that many pet owners feel that telemedicine lacks the practical tools necessary for effective veterinary care. The absence of physical examination and hands-on treatment was a major concern, reflecting the critical role of in-person diagnostics in veterinary practice. In contrast, technological issues, such as poor internet connection (9.7%) and technical complications (11.9%), were not as frequently cited as barriers, and concerns about data security (5.0%) and insufficient technical know-how (6.1%) were relatively minimal. These findings contradict studies from abroad that highlighted technology-related barriers as primary impediments to telemedicine adoption. Regarding the potential for expanding telemedicine, respondents expressed a general willingness to adopt online scheduling for routine services. Vaccinations (75.4%), follow-ups (61.6%), and general examinations (57.7%) were among the most preferred services for online booking, which suggests that telemedicine could alleviate some of the logistical burdens associated with veterinary visits, such as waiting times (59.2%) and travel distance (29.6%). However, respondents were less inclined to use telemedicine for emergencies (8.8%), highlighting that telemedicine's utility may be limited to non-critical, routine care scenarios. An encouraging finding was that 70.7% of the respondents believed telemedicine would be beneficial, aligning with the view that the technology could improve veterinary service delivery by reducing stress for both pets and owners. This is corroborated by prior research, which suggests that the stressful nature of physical visits can negatively impact the well-being of animals, leading to more aggressive or nervous behavior. The

potential for telemedicine to reduce these stressors by allowing remote consultations offers a valuable pathway for improving patient outcomes.

However, the low actual usage rate of telemedicine, despite positive perceptions, points to a disconnect between theoretical acceptance and practical engagement. A deeper exploration of the reasons behind this discrepancy is warranted. It may be that while owners are open to the idea of telemedicine, current offerings may not meet their expectations or perceived needs. Additionally, the lack of experience with telemedicine could be due to an absence of awareness or marketing of available services. Only 11.1% of respondents had used telemedicine with a veterinarian, and an even smaller percentage had done so with a physician, indicating that digital healthcare services have yet to become a mainstream option for many.

The preferences for digital communication tools among respondents further illustrate the diversity in client expectations. While platforms like Zoom (42.5%) and WhatsApp (43.7%) were popular, the telephone remained the most preferred communication method (51.9%). This suggests that although there is an openness to using digital platforms, more traditional methods still hold significant value, indicating that telemedicine services may need to offer a hybrid approach that combines both digital and traditional consultation methods.

3.1.1 Customer Perception and Acceptance of Veterinary Telemedical Services

In order to contextualise how animal owners' view remote healthcare, participants were asked how likely they are to make use of telemedical services. Based on these values, sociodemographic influences were tested, as well as whether small animal owners in general are open to such procedures according to the following pre-determined hypotheses:

Hypotheses

- H0: Owning small animals has no effect on likelihood of using telemedical consultations
- H1: If an animal owner has small animals, they are likely to make use of telemedical consultations
- H0: Age of animal owners has no effect on likelihood of telemedical consultation usage
- H2: Younger animal owners are more likely to make use of telemedical consultations
- H0: There are no regional differences in likelihood of telemedical consultation usage
- H3: Rural and small-town populations are more likely to use telemedical consultations

The testing of the Hypotheses was done using correlation testing, namely the Spearman-, Kruskal-Wallis-, and Wilcoxon rank sum tests. The goal was to identify whether sociodemographic differences (age, place of origin) would significantly influence willingness to participate in telemedical services, and whether the species of the pet would significantly influence said willingness to participate.

The calculations, though not shown in detail in this section, revealed no measurable relationship between regionality and willingness to participate in online consultations (p=0,8187 Spearman-test) (p=0,06 Kruskal-Wallis-test). Between the age of the respondent and likelihood to make use of online consultations (p=0,077 Spearman-test) (p=0,63 Kruskal-Wallis-test), there was also no significant correlation. Lastly, there seems to be no connection between owning small animals and likelihood to take part in telemedical consultations (p=0,595 Wilcoxon rank sum test). This results in failing to reject all three of the null hypotheses. A possible interpretation of this outcome is, that there are no preferences between different sociodemographic groups and owners of different pets, concerning the use of telemedicine. In combination with the rather high likelihood to take part in online healthcare among the test group, it is arguably more universally accepted than previously assumed. But it is important to note that because of the small sample size and their rather one-sided geographical distribution, these results cannot be seen as a fair representation of the general public. These are therefore merely directions which more broadly distributed surveys could explore.

3.2 Veterinary Management Study

3.2.1 Sociodemographic Characteristics

The geographical distribution of respondents shows a relatively even representation across Germany's federal territories, with a notable concentration in Schleswig-Holstein. The residential areas of the veterinarians are primarily villages or small municipalities, whereas their workplaces are mostly situated in small towns with populations between 10,000 and 49,999. The age distribution shows that a majority of practitioners are in the 45-54 (32.9%) and 55-64 (33.6%) age ranges, with a noticeable gender disparity, especially in younger age groups. Female veterinarians, particularly those aged 35-44, outnumber male veterinarians significantly (79.4% - female

veterinarians), a trend consistent with the broader feminization of the veterinary profession observed globally. In 2022, Germany had a total of 44,618 veterinarians, with females making up 64.7% of the workforce. Of the 11,743 veterinarians who owned their own practice, 56.9% were female. This demographic shift prompts critical questions about the future leadership structure of veterinary practices and the specific challenges faced by women in attaining leadership roles. Succession planning will be essential as this aging workforce approaches retirement, especially considering the limited representation of younger male veterinarians.

3.2.2 Continuing Education and Professional Development

The study finds that veterinarians heavily rely on traditional forms of continuing education, such as journals (85.7%) webinars (79.3%), courses (73.3%), and congresses (72.3%), reflecting a commitment to maintaining clinical competence. The findings also indicate that a substantial proportion (83.8%) of participants routinely consult their colleagues for clinical advice. However, the relatively low engagement of the participants with business management courses and leadership training (15.1%) suggests a critical gap in professional development. As veterinary practice becomes more commercially competitive and operationally complex, it is imperative that veterinarians develop financial acumen and management expertise alongside their clinical skills.

3.2.3 General Characteristics of Small Animal Practices and Clinics

3.2.3.1 Practice Size and Legal Structures

Among the surveyed small animal clinics in Germany, 60.9% were owned by single proprietors, and 56.3% were classified as purely small animal practices. The majority of respondents (68.8%) reported operating as sole proprietors, while only 22.6% were in civil law partnerships and 7.5% were structured as limited liability companies (LLCs).

These statistics suggest a predominantly independent practice model, which may be beneficial in terms of personalized service and flexibility. However, sole proprietorships are also more vulnerable to market fluctuations, economic crises, and succession issues, especially as many practice owners near retirement. Exploring alternative legal structures, such as corporate partnerships or mergers, could offer stability by pooling resources and distributing operational risks across a broader base. The research question whether the type of practice is associated with annual turnover was investigated. A Fisher's Exact Test was employed to examine the relationship between two categorical variables: practice type and annual turnover. Fisher's Exact Test was chosen due to low expected frequencies in some cells.

Hypotheses

- H0: Turnover is independent of the type of practice.
- H5: There is a significant association between practice type and turnover.

The results of Fisher's Exact Test ($p>0.05$) suggest that there is no statistically significant association between the revenue and the type of practice. This implies that variations in revenue are not dependent on the type of practice. In other words, the type of practice does not appear to influence the financial performance, as measured by revenue, in a significant manner.

3.2.3.2 Facilities and Infrastructure

The average practice size was reported as 226.3 m², with essential facilities such as treatment rooms, X-ray rooms (86.2%), and dedicated pharmacies (84.0%) being common. However, 72.0% of practices lack separate wards for dogs and cats, which could affect animal welfare and infection control. Practices should consider enhancing facility design to better accommodate the needs of different species, ensuring that client expectations for high-quality care are met. Investments in separate species-specific waiting areas and wards could not only improve patient outcomes but also enhance client satisfaction and loyalty.

3.2.3.3 Staffing and Employee Structure

The study highlights significant differences in staffing levels across various types of practices (H4). The research question whether the type of practice is decisive for the number of employees was analyzed**.** A One-Way ANOVA was conducted to compare the average number of employees across different practice types.

Hypotheses

- H0: There is no effect of practice type on number of employees.
- H6: There is an effect of practice type on number of employees.

The One-Way ANOVA test indicates that practice type significantly influences the number of employees ($p < 0.001$). Specifically, small animal clinics employ significantly more staff on average (Mean: 22.05, SD ± 5.04) compared to mixed practices (Mean: 8.41, SD ± 5.00), small animal practices (Mean: 8.04, SD ± 3.86), and other practice types (Mean: 8.3, SD ± 4.57).

This variance reinforces the idea that specialization increases staffing needs, particularly in larger clinics that may offer 24-hour services or advanced surgical procedures. Adequate staffing is critical not only for maintaining high standards of care but also for expanding revenue generation capabilities. Practices must balance staff costs with patient volume and service offerings, ensuring that they have the workforce necessary to meet demand without compromising profitability.

3.2.4 Revenue Distribution and Its Determinants

3.2.4.1 Services, Patient Revenue and Fee System

The survey shows that over 80% of practices offer a wide range of services, including pharmacy, dental, X-ray, laboratory, and ultrasound. This extensive service provision reflects a trend toward comprehensive care within veterinary practices, aiming to increase client retention and boost revenue per visit. The analysis of patient revenue reveals that dog owners with their dogs are the most frequent visitors, with an average of 18.4 visits per day, followed by cats (14.8) and small mammals (4.2). Vaccinations (25.9 per week) and soft tissue surgeries (7.7 per week) are the most commonly performed procedures, suggesting that routine care and general surgery are the primary revenue drivers. This data indicates that 63.0% of visits for dogs generate revenue between €51 and €100, while only 47.6% of visits for cats fall within the same range. The difference in revenue per visit between species suggests that practices may benefit from targeted pricing strategies for different types of care and species to better align costs with service demand.

The GOT (Gebührenordnung für Tierärzte) german fee system establishes standardized pricing for veterinary services on a national level. It exclusively covers the costs associated with veterinary services, specifically reflecting the labor of the veterinarian, and does not include charges for materials or medications. It plays a pivotal role in shaping the financial dynamics of veterinary practices, with an average consultation fee multiplier of 1.54 (SD ± 0.36). The variability in emergency fees further underscores the need for practices to tailor their pricing strategies based on market demand and service urgency.

3.2.4.2 Revenue Composition

Revenue within veterinary practices is predominantly service-driven, with 69.1% of total revenue stemming from clinical services and approx. 30.9% from product sales. This distribution emphasizes the centrality of service quality and client retention in sustaining practice profitability. However, despite larger staff sizes, more than 50% of practices reported an annual income of €500,000 or less, highlighting the modest financial operations of many small practices. This suggests that even practices with larger teams may struggle with profit margins due to overhead costs or inefficient pricing models. Practices may need to reconsider their fee structures and explore diversification strategies, such as expanding services or introducing premium care packages, to improve financial performance. Dogs contribute the largest share of revenue (55.2%), followed by cats (37.7%), indicating that canine care remains the primary economic driver within small animal practices. Given the rising costs of veterinary care and the increasing demand for advanced procedures, practices may need to reassess their pricing models to remain competitive while ensuring profitability. Logistic regression indicates that the number of employees is a key determinant of high-revenue practices

(annual revenue > €1 million), with larger teams enabling more extensive service offerings, which in turn enhance revenue potential (H6).

3.2.4.3 Seasonal Revenue Fluctuations

The data on revenue fluctuations reveals significant seasonal trends, with peak revenue occurring from July to September and the lowest revenues seen from January to March. These patterns likely correlate with pet ownership behaviors, such as higher veterinary visits during summer holidays when boarding or travel services may be in higher demand. Practices should consider seasonal marketing strategies and targeted promotions during low-revenue periods to stabilize income throughout the year.

3.2.5 Strategic and Operational Controlling

3.2.5.1 Financial Management and Goal Setting

The study shows that most respondents take an active role in financial management, with 55.2% conducting monthly financial analyses and 32.6% setting annual operational goals. However, only 13.2% delegate management tasks to a dedicated practice manager, suggesting that many practitioners remain heavily involved in day-to-day operations. The legal form of the practice significantly influences the number of employees and the decision to employ a practice manager ($p < 0.05$) (H4). While hands-on management can ensure direct oversight, it can also limit the time available for clinical work and long-term strategic planning. The low rate of delegating management responsibilities points to the underutilization of professional managers, who could introduce more sophisticated strategic controlling measures and help practices grow by leveraging data analytics and operational metrics.

3.2.5.2 Legal and Accounting Support

Approximately 66.1% of practices utilize external legal and accounting services, though most do not retain full-time legal counsel (87.3%). This reliance on outsourced services may provide cost efficiency, but it can also introduce risks if legal or financial issues arise unexpectedly. Practices that regularly review their legal compliance and financial health are better positioned to respond to regulatory changes and market pressures. More proactive engagement with legal and financial experts could improve contract negotiations, tax planning, and risk management, particularly for those looking to expand or sell their practices.

3.2.5.3 Software Utilization

The results reveal specific patterns in the software preferences of the surveyed veterinary practices. EasyVet, used by 41.2% of practices, emerges as the most prevalent software system, followed by Vetera (12.2%). This demonstrates a clear preference for established, user-friendly platforms that integrate various functions, from appointment scheduling to billing. However, it is concerning that 5.4% of practices continue to use manual file card systems, which are prone to inefficiencies and errors. Moreover, while many practices have implemented software, only 59.7% utilize the financial functions of these systems regularly. This highlights a gap in the full exploitation of digital tools, particularly in the realm of financial management, which is crucial for optimizing revenue streams and cost control. Encouraging wider adoption of the financial features embedded within practice management systems could improve financial transparency and strategic planning across the sector.

3.2.6 Marketing Practices and Future Trends

3.2.6.1 Marketing Tools and Their Impact

The survey results indicate that the majority of practices rely on basic marketing tools such as websites (59.4%), vaccination reminders (38.5%), and Google My Business listings. The use of Facebook as a marketing platform was significantly associated with the number of employees ($p < 0.05$), suggesting that larger practices are more likely to engage with social media marketing. However, age did not show a significant effect on the adoption or perception of marketing tools, indicating that digital literacy is fairly consistent across different generations of veterinarians. This underscores the importance of effective client engagement, especially among first-time clients, which 90.9% of practices considered crucial to marketing success. Moving forward, practices could benefit from a more proactive approach to marketing, using tools like client loyalty programs, email newsletters, and targeted online ads to increase client retention and attract new business.

3.2.6.2 Effect of number of staff on the use of marketing tools

The Research question does a higher number of staff relate to increased usage of marketing tools, potentially managed by in-house teams was analyzed. Multiple One-Way ANOVA tests were performed to examine how the mean number of employees varied across different categories of marketing tool usage (e.g., having no marketing tool vs. using it vs. using it with an in-house team).

Hypotheses

- H0: There is no effect of the number of staff on the use of marketing tools.
- H7: There is an effect of the number of staff on the use of marketing tools.

The analysis revealed that Facebook was the only tool significantly influenced by the number of employees, albeit the number of users was limited ($p = 0.008$).

3.2.6.3 Effect of age on views regarding future marketing instruments

The research question does age influence respondents' views on future marketing instruments (e.g., telemedicine)? Though labeled "ANOVA" in the heading, a Kruskal-Wallis Test was conducted to compare the mean ranks of respondents' views across age categories.

Hypotheses

- H0: There is no effect of age on views regarding future/marketing instruments.
- H8: There is an effect of age on views regarding future/marketing instruments.

With a p-value of 0.569, the test indicates no significant difference across age groups in their views on future/ marketing instruments. Hence, age does not significantly influence how respondents perceive these instruments.

3.2.6.4 Impact of veterinarians' age on choosing marketing tools

The research question do older colleagues use fewer marketing tools than younger colleagues was analyzed. A One-Way ANOVA compared the mean number of marketing tools used across multiple age categories.

Hypotheses

- H0: There is no effect of age on the number of marketing tools chosen.
- H9: There is an effect of age on the number of marketing tools chosen.

As $p = 0.649$, there is no statistically significant difference among age groups in the average number of marketing tools used, indicating older colleagues do not differ substantially from younger ones in this respect.

3.2.6.5 Future Trends in the Veterinary Profession

Survey responses indicate a strong expectation for increased demand for specialized veterinarians (94.0%) and a rise in the number of employed veterinarians (76.5%). The impact of telemedicine remains debated, with a neutral stance on its future influence (mean score: 2.64 (Likert scale)). The study findings show that 70.1% of respondents advocate for structural changes to the veterinary curriculum. Notably, 64.2% expressed a need to integrate economics and business training into veterinary education, reflecting a recognition of the increasing complexity of managing modern veterinary practices. This shift toward incorporating business acumen into veterinary training will be critical for the future sustainability of the profession, as practitioners will need to navigate the dual demands of clinical excellence and business management.

4. CONCLUSION AND RECOMMENDATIONS

The results of this study underscore the profound impact of evolving demographic patterns in the German veterinary profession. The growing feminization of the workforce signifies opportunities for fostering innovation and service diversification; however, it also highlights persistent barriers that female veterinarians encounter in terms of career advancement and practice ownership. At the same time, aging practitioners face logistical and financial obstacles in transitioning clinics to the next generation, with many smaller practices lacking clear succession plans or structured mentoring frameworks. The future stability of the sector thus hinges on addressing both gender equity and generational transitions, as these factors collectively shape the professional landscape and determine whether longstanding practices can adapt effectively.

A recurring theme in the study is the critical role of solid management skills and financial literacy for veterinary professionals. In a market increasingly marked by specialization and corporate consolidation, small and independently owned practices are disadvantaged if they lack in-depth knowledge of finance, marketing, and operational efficiency. Many veterinarians exhibit limited exposure to structured business training, which curtails their capacity to respond proactively to competitive pressures. Introducing or strengthening management-related course offerings in veterinary schools could aid in closing these gaps. Moreover, continuing professional development programs serve as an avenue for seasoned practitioners to update their skills in finance, human resource management, and marketing, thereby bolstering the viability of smaller or rural clinics.

Digital transformation, and telemedicine in particular, emerged as a compelling avenue for innovation while also revealing the challenges of regulatory uncertainty and technological readiness. Although the COVID-19

pandemic cast a spotlight on remote services, many practitioners remain reluctant to embrace digital platforms due to perceived risks concerning data security, reimbursement structures, and client acceptance. The study shows that when properly implemented, telemedicine can enhance client access and streamline operations, especially for owners constrained by distance or time. However, widespread adoption requires clear legal guidelines, greater familiarity with digital tools, and cost-benefit analyses that illustrate tangible returns on investment. Targeted digital training and supportive policy environments could help accelerate the integration of telemedicine into routine care, thus modernizing clinical practice and potentially broadening the service portfolio for independent clinics.

Alongside technological considerations, the financial underpinnings of veterinary practices remain a prominent concern. Shifting fee structures, particularly around emergency and after-hours services, and the surge of corporate veterinary ownership create both competition and opportunities for collaboration. While corporate groups often benefit from economies of scale and sophisticated administrative systems, their expanding presence raises questions about practitioner autonomy, personalization of care, and client satisfaction. Independent practices may find advantages in adopting more strategic approaches to pricing, expanding or diversifying service offerings, and improving internal operational efficiencies. Nonetheless, any adaptation should remain true to the core values of the profession, namely the provision of empathetic, high-quality clinical care that resonates with clients' expectations.

It is important to situate the findings of this study within its methodological boundaries. A nonprobability sampling approach means that particular regions or practice types may be underrepresented, thus limiting the generalizability of certain conclusions. Furthermore, the cross-sectional design offers a static view that cannot account for the temporal evolution of telemedicine usage,

changing fee structures, or the long-term impact of corporate consolidation. The reliance on self-reported data opens the possibility of overestimation or underestimation of certain behaviors, thereby imposing caution on the interpretation of results. Moreover, while Germany provides a substantive context for exploring veterinary practice management, the outcomes may not seamlessly apply to jurisdictions governed by different legal and regulatory frameworks.

In light of these findings and limitations, several promising avenues for further inquiry emerge. Longitudinal research would offer valuable insights into how demographic shifts, digital adoption rates, and financial models change over time, capturing a dynamic picture of the profession's evolution. Considering how pivotal gender equity and succession planning are, in-depth qualitative studies examining successful transitions in smaller, family-owned, or female-led clinics could yield replicable strategies that other practices might adopt. Meanwhile, cross-national comparisons would help clarify how varying cultural and regulatory contexts influence veterinary business management, thereby illustrating whether corporate consolidation and technology integration unfold similarly across different countries. Complementary research focusing on the client side of the equation, including attitudes toward remote consultations and perceptions of corporate ownership, could also advance the profession's understanding of client loyalty and satisfaction. Lastly, more comprehensive analyses of diverse fee structures, emergency service models, and economic pressures facing rural practices may illuminate cost-effective methods for veterinarians to maintain competitive yet sustainable operations.

Summarily, this research indicates that demographic realities, economic imperatives, and technological advances are converging to reshape the German veterinary profession. Addressing the workforce's changing profile, closing gaps in management proficiency, and capitalizing on digital

opportunities are all critical steps toward strengthening practice resilience. By expanding on the insights offered here – through deeper, longitudinal, and comparative investigations – veterinary stakeholders can cultivate a robust professional landscape that balances profitability and growth with high standards of patient care and practitioner well-being.

5. NEW SCIENTIFIC RESULTS

- No statistically significant differences were found in the use of veterinary telemedicine consultations by pet species, age of owners and place of residence (rural vs. urban areas) in Germany. These results suggest that the use of telemedicine is consistent across these demographic groups. Among pet practices, the primary barrier to telemedicine adoption was perceived limitations to treatment effectiveness, rather than technological concerns, indicating that clients are generally comfortable with digital platforms.
- The type of the surveyed veterinary practices in Germany, whether practice, center, clinic, or mixed animal practice, was significantly related to the number of employees and the decision to employ a practice manager ($p < 0.05$). In contrast, no significant relationship was found between practice type or legal form and revenue ($p > 0.05$), suggesting that higher revenue is predicted by staff size (employee numbers) rather than structural classification or legal form.
- Of the surveyed German veterinary practices with a small animal clinic, the majority was single-owner businesses and was classified as purely small animal practices. The predominant legal form was sole proprietorship, while a minority operated as a civil law partnership (GbR) or limited liability company, and these types were generally associated with a higher number of employees. More than half of the practices surveyed had an annual income of €500 000 or less, reflecting the modest financial operations of many small animal practices.
- The vast majority of the practices surveyed offer pharmacy, dental, X-ray, laboratory and ultrasound services. The average number of patient visits per day was 18.4 for dogs and 14.8 for cats, with soft tissue and dental surgeries being the most common. Dogs accounted for more than half of

the practices' revenue, and the average revenue per visit typically ranged between €51 and €100. Within a calendar year the highest income in the practices surveyed was between July and September, while the lowest was between January and March.

- In the COVID-19 pandemic almost all the surveyed practices reported an increase in income with a huge average annual increase in 2020. Following the COVID pandemic, the vast majority of the responding practices planned to increase service prices, with the main investment priorities being in equipment, service expansion and postgraduate training. Various marketing tools such as websites, vaccination reminders, Google My Business and Facebook were prevalent in the veterinary practices surveyed, although Facebook use was the only platform that was significantly influenced by the number of employees ($p < 0.05$). Age did not show a significant effect on the adoption and perception of marketing tools, reinforcing the idea that effective communication and customer engagement - especially with first-time clients, which 90.9% of practices considered very important - is key to marketing success.
- Most veterinary respondents expected an increase in demand for veterinary practitioners and specialization, and predicted an increase in the number of employed veterinarians. There is also a strong call for greater political support and influence, and the majority of the participants called for educational restructuring of the veterinary curriculum, including the integration of economics.

6. PUBLICATIONS

6.1 Publications relating to the topic of the dissertation

1. Diez, E., Renner, A., Ózsvári, L., 2023. Digitalization in Veterinary Medicine - The Perception and Acceptance of Digitalized Animal Healthcare by Owners in Germany. Acta Vet Eurasia 49, 69–74. https://doi.org/10.5152/actavet.2022.0117

2. Diez, E., 2022. Corporate culture analysis of a small animal veterinary referral practice in Germany, in: Szilárd, BERKE; Katalin, SZABÓ; Beáta SZÜCS, Pató Gáborné (Szerk.) Organizational Behaviour and Leadership Theory in Practice. Magyar Agrár- és Élettudományi Egyetem Kaposvári Campus, Kaposvár, HU, pp. 23–31.

3. Diez, E., 2021. Cross ist das neue Marketing – aber was bedeutet das eigentlich? Veterinär Spiegel 31, 137–141. https://doi.org/10.1055/a-1494-0103

4. Diez, E., 2020a. Managing A Veterinary Practice: A Guide To Organizational Culture In Veterinary Practice. International Journal of Applied Research in Business and Management 1, 18–26. https://doi.org/10.51137/ijarbm.2020.1.1.2

5. Diez, E., 2020b. Unternehmenskultur ist wichtig! Wie fördern Sie Ihre? Veterinärspiegel 30, 168–172. https://doi.org/10.1055/a-1232-4157

6. Diez, E., Ózsvári, L., 2019. Marketing in German Veterinary Practices: Are Rural Veterinarians Keep Pace with Time? RBS 11. https://doi.org/10.33568/rbs.2407

6.2 Publications not relating to the topic of the dissertation

1. Diez, E., 2024a. The spine: anatomy and deformities (Die Wirbelsäule: Anatomie und Missbildungen). Tierisch Dabei 10–18.

2. Diez, E., 2024b. Helping dogs and cats strengthen their spine with nutrition and exercise (Mit Ernährung und Bewegung Hund und Katze den Rücken stärken). Tierisch Dabei 28–33.

3. Diez, E., 2024c. Painful spine: Spinal disorders (Schmerzhafter Rücken: Wirbelsäulenerkrankungen). Tierisch Dabei 20–27.

4. Diez, E., 2021a. When the shoulder causes lameness (Wenn die Schulter Lahmheitursache ist). Tierisch Dabei 26–31.

5. Diez, E., 2021b. The painful elbow (Der schmerzende Ellenbogen). Tierisch Dabei 18–24.

6. Diez, E., 2021c. Paw lesions & Co. (Verletzungen an Pfote & Co.). Tierisch Dabei 10–17.

7. Ross, F., Wohllebe, A., Diez, E., 2022. The Role of Personal Assistance in the Uptake of Smartphone-Based Tele-Audiology—An Extension of the Technology Acceptance Model. Int. J. Interact. Mob. Technol. 16, 18–31. https://doi.org/10.3991/ijim.v16i12.301