

Telehealth for Human's Best Friends

Team 3 Members: Andy Tertzakian | Matt Pribadi | Frances Leung
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Overview

67% of U.S. households or approximately 85 million families own a pet. In 2019, the estimated expenditures on pets in the U.S was \$75 billion. Welcome to the world of pet parents. Pets to many households represent an important part of a family. They require the same level of care and attention that rival our human counterparts. When a pet is doing great, all goes well. When it has illnesses, it could be difficult to diagnose without the support and guidance from the professionals, particularly for specific medical conditions. Access to the experts and services can be challenging depending on one's location. For those living in the prairies or the suburban neighborhoods, there may be very limited options to receive the veterinary consultations that they need.

Advancements in communication and information technology provide opportunities for new approaches to the delivery of healthcare and medicine, not just for humans but also human's best friends.

Telehealth as the focus of this proposed research refers broadly to the electronic and telecommunications technologies and services used to provide care and services at a distance.

This in contrast to telemedicine refers to the practice of medicine using technology to deliver care at a distance, over a telecommunications infrastructure, between a patient at an originated site and a physical or other practitioner licensed to practice medicine at a distance site [5].

This proposal is for a study to be conducted on the current state of veterinary telehealth in North America to identify gaps and opportunities of services/features in a marketplace that is still in its nascency. The study will leverage data on solution providers that offer veterinary platforms as well as clinics or practices that have or have not yet adopted the related technologies. With regards to research scope, region wise, focus will be placed on the North American market including the U.S. and Canada. Given cats and dogs together represent nearly 80% of total U.S. household pet ownership [2], emphasis will be placed on them from a research analysis perspective. As for coverage of the types of veterinary practices, our target research subjects will be those from non-specialty establishments (i.e. Large animal, farm/livestock animal or exotic animal veterinary practices will be excluded from this study).

As the broader world of telehealth continues to expand, findings from the study will also provide insights on standardization considerations and support innovations in the delivery of veterinary services.

Research Question

Key questions:

- Are veterinary practices that are more established or larger in scale more likely to adopt telehealth services or vice versa?
- What is the average pet related expenditure by household income? And for that, what is the split between telehealth vs non-telehealth related expenditures?

Sub-questions:

- What is the geographical distribution of clinics in the U.S. and Canada that have or have not yet adopted provision of virtual services in their practices?
- What are the key product features/services that are made available by major veterinary telehealth providers?
- Has there been an increase in telehealth expenditure over the years?
- What are the product gaps in veterinary telehealth services?
- Are there services provided in human telehealth that are not yet available for veterinary telehealth? Is there a divide?
- Are there challenges with veterinary telehealth adoption?
- What may be the factors that deter veterinary telehealth adoption both for service providers and consumers?
- Is there a correlation between a veterinary clinic's revenue or size vs. technology's adoption (such as telehealth)?

Data

We will be leveraging data sources that cover household pet ownership and veterinary information in the United States and Canada on an annual basis. To focus the scope of this study, the data will be narrowed down to the top five categories of pets (cats, dogs, birds, fish/reptiles, and small mammals). These datasets can include available statistics on veterinary practices from veterinary medical associations, financial performance of the veterinary industry, and government census data. For a robust research design, we anticipate the requirement of a statistically significant sample size, covering of diverse demographics for the target surveyees. With the assumption that those who have access to telehealth services would also be those who have regular access to technologies and the internet, it would be important to also collect data points from those who are less likely to be utilizing smartphone applications or have a lesser level of access to technology or the internet (e.g. rural areas).

To supplement the above, surveys are expected to be collected from pet owners and veterinary practitioners on their adoption and perspectives on telehealth technologies for pets due to the novel market of telehealth for both human and veterinary service.

Specific data desired for this study:

Veterinary practices information

- Company information of the veterinary clinics (e.g. Number of employees, number of patients, revenues, expenditures, etc.)
- Current telehealth technologies implemented (e.g. Online services, apps, etc.)
- Current expenditures on telehealth services as a percentage of total expenditures
- Geographic distribution of veterinary practices and those offering virtual services in their practice

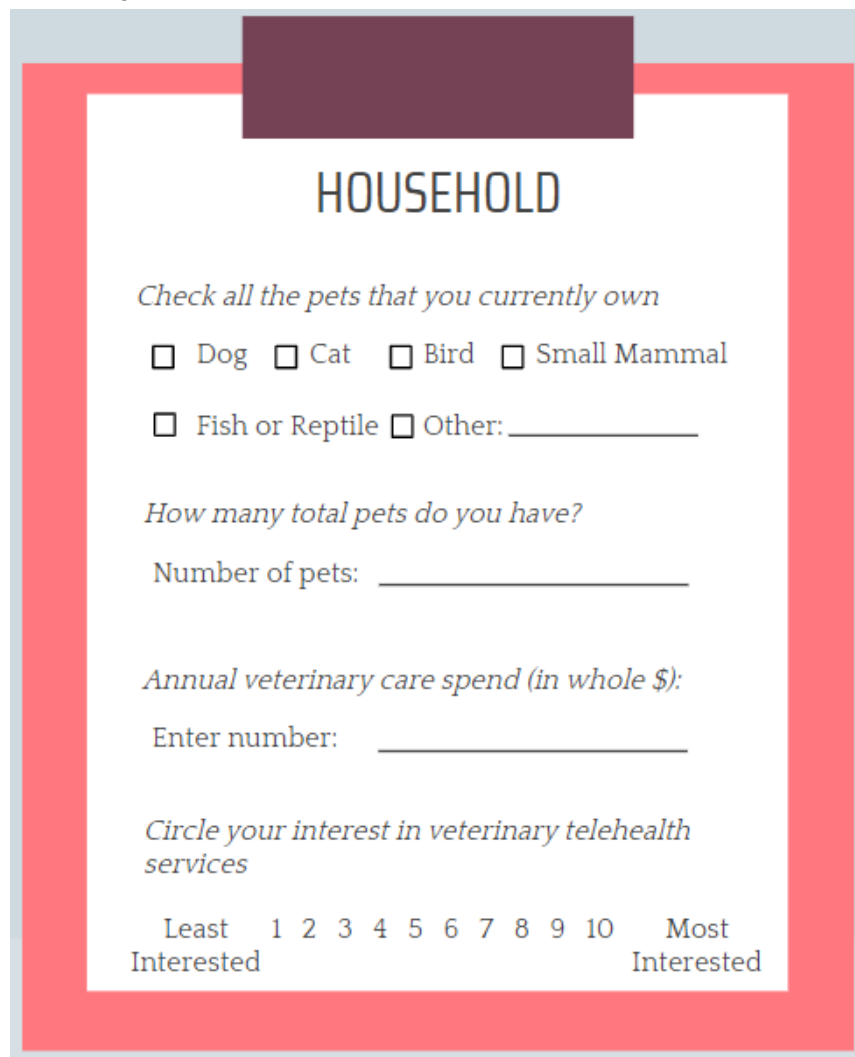
Household data

- Public data regarding household income, pet ownership, average annual spend on veterinary services
- Selected telehealth app data regarding those using the services, their household income, pets, and average annual spend on pet medical bills from this app

Study Design

The main design will be based on observational work and insights gathered from data collected at a point in time depending on the availability of data. This will not be an experiment, rather, it will be a combination of a survey and exploration of data on telehealth usage in veterinary clinical practices. Data collected for this study will not violate any ethical boundaries as surveyees will be requested to sign an agreement to enable data to be released and made public. These surveys will aim at gathering quantitative and qualitative information. The aim is to gather financial expenditures as a relation to a family's household wealth, as well as one's interest in veterinary telehealth services. We need to ensure that the questions are balanced between concise and informative for the surveyors. See below for some sample questions.

Sample Household Survey Questions



HOUSEHOLD

Check all the pets that you currently own

☐ Dog ☐ Cat ☐ Bird ☐ Small Mammal

☐ Fish or Reptile ☐ Other: _____

How many total pets do you have?

Number of pets: _____

Annual veterinary care spend (in whole \$):

Enter number: _____

Circle your interest in veterinary telehealth services

Least Interested 1 2 3 4 5 6 7 8 9 10 Most Interested

Sample Business Survey Questions

BUSINESS

What is the annual revenue of your business (round to nearest thousand \$)?

Enter number: _____

Annually, how many animals do you provide medical care to?:

Enter number: _____

How much does your business annually on telehealth veterinary care (round up to the nearest thousand \$)?

Enter number: _____

In addition, we would ask for the surveyee's demographic information as well (e.g. Household income levels, age, and highest degree completed). These surveys will primarily be distributed online through as many outlets as our budget allows (e.g. paid survey advertising on major social media platforms such as Instagram, Facebook, LinkedIn, etc.). In addition, we will reach out to veterinary practices from the U.S. and Canada and ask them to include this survey in their veterinary care routines to gather insights on those in rural areas as well. Though not expected to be fully effective, we will send out physical survey letters, targeting those in the rural areas as well as those who may not have access to the internet.

The goal of this design is to answer the two main research questions:

1. Are veterinary practices that are more established or larger in scale more likely to adopt telehealth services? The purpose of this is to take a look at telehealth from the company or clinic's perspective.

- We will survey the industry of veterinary clinics and hospitals throughout North America and gather financial data (e.g. The number of employees, revenues, expenditures, etc.) and group the data based on size of the clinic utilizing normal distribution and standard statistical methods
 - We will also survey the prevalence of telehealth usage throughout all subsets of the veterinary clinic groups for some conclusions:
 - What percentage of their total expenditures do each clinic spend on telehealth service, if any?
 - Are larger clinics more likely to invest in telehealth versus smaller clinics?
2. What is the average pet related expenditure by household income? What is the split between telehealth vs non-telehealth related expenditures? The purpose of this is to take a look at the average citizen's interest and use in telehealth.
- From this data, we would be grouping people based on set buckets of normalized household income in order to properly compare different demographics of households. The purpose of this is to understand if telehealth is exclusive of certain demographics and to see if we can engage all people who have pets. From this data, we would then try to gather conclusions for the following questions:
 - What percentage of the household income is spent on pet expenditures?
 - What percentage of those expenditures is spent on telehealth versus standard veterinary care?
 - How do these percentages compare throughout the different groupings of household income?

Sample

For our investigation, we will collect a large random sampling of veterinary clinics. We will also be looking at the 'patient' side of the equation, and so we will canvas households to the same effect.

For Clinics:

- There are approximately [120,000](#) veterinarians in the United States, and an additional [14,000](#) in Canada [1][6].
- We will survey/collect data from 1000 of these doctors in order to gather the information needed from them. This sample size will allow us to have a 95% confidence interval, with a 3% margin of error. This sample size was calculated using the Cochran equation for sample size. Furthermore, this number of surveys is reasonably within our budget and timelines.
- Since there exist many different kinds of veterinary clinical practices, we will be limiting our samples to only those that deal with the five most common kinds of pets.
- **Inclusion Criteria**
 - Any clinic that does not fit into the exclusion criteria
- **Exclusion Criteria:**
 - Free care clinics

- Specialization care clinics (i.e. focuses on a particular niche/animal).
- Top decile clinics by price
- Bottom decile clinics by price

For Households (Pet Owners):

- It is estimated that roughly [67%](#) of households in the United States and Canada
- We will aim to survey 1000 households [5]. This sample size will allow us to have a 95% confidence interval, with a 3% margin of error. This sample size was calculated using the Cochran equation for sample size. Furthermore, this number of surveys is reasonably within our budget and timelines. It will also be aligned with our sample size for care clinics.
- As was the case with veterinary care clinics, there exist many different kinds of households with pets. We will control for this by surveying only for the five most common types of household pets.
- **Inclusion Criteria**
 - Any household that does not fit into the exclusion criteria
- **Exclusion Criteria:**
 - Households with greater than 3 pets
 - Households with a non-typical pet (e.g. Owned by less than 5% of the population, they fall into the categories of large animal, farm/livestock animal or exotic animal.)
 - Households with top decile earnings
 - Households with bottom decile earnings

Variables and/or Intervention

The below table summarizes the research variables that are to be used in the analysis. The survey subjects will be divided into two groups: (1) Pet Owners and (2) Veterinary Practitioners.

To mitigate independence risks, each survey subject is to act as either a pet owner or a veterinary practitioner but not both. In other words, if a veterinary practitioner surveyed is also a pet owner, he or she is to respond to questions aimed at veterinary practitioners only. See the Risks section for more details on independence.

To avoid duplication of survey inputs, control will be put in place to ensure that only a single member from the surveyed household is to complete the survey. The same applies to veterinary establishments whereby only one representative from each surveyed veterinary clinic or practice is to respond to the survey.

To improve pet owner survey outcomes, the research team is to recruit veterinary establishments to support raising awareness and garnering interest from their customers (i.e. pet owners) to participate in the survey. In return, participating veterinary practitioners are to receive complimentary insights from the research. They are to be provided with the needed

guidance to provide instructions to target pet owner surveyees. It is expected that these veterinary establishments selected are to respond to the survey as veterinary practitioners.

Given demographics and personal information such as household income, company revenues or size are collected, each target subject is to be requested to fill out a consent form on the collection and usage of the related information. These demographics details are strictly to be used for classifying the subjects into the respective categories for research analysis purposes only. The results to be published will represent aggregated results only.

Research variable	Format	Target Subject	
		Pet Owner	Veterinary Practitioner
Total number of pet(s) owned	Integer	X	
Type(s) of pet(s) owned	Multi-select multiple choice + textual response/comments	X	
Pet owner's age	Single-select multiple choice of age range	X	
Pet owner's highest degree completed	Single-select multiple choice of highest degree completed	X	
Annual household income	Dollars in USD or CAD	X	
Annual household pet expenditures	Dollars in USD or CAD	X	
Has knowledge on telehealth	Binary response (Yes/No)	X	
Has received telehealth services	Binary response (Yes/No)	X	
Types of telehealth services received	Multi-select multiple choice + textual response/comments	X	
Types of telehealth services hope to see as a pet owner	Textual response	X	
% of annual income spent on pet expenditures	Percentage (%)	X	
% of annual pet expenditures spent on telehealth related offerings	Percentage (%)	X	

Country of origin of pet owner	Binary response (U.S or Canada)	X	
Veterinary practice annual revenues	Dollars in USD or CAD		X
Currently offers telehealth services	Binary response (Yes/No)		X
Types of telehealth services offered by respective practice	Multi-select multiple choice + textual response/comments		X
Types of telehealth services hope to see as a veterinary practitioner	Textual response		X
Number of employees in veterinary establishment	Integer		X
Annual veterinary establishment's expenditures	Dollars in USD or CAD		X
% of annual veterinary establishment's expenditures spent on telehealth related offerings	Percentage (%)		X
Country of origin of veterinary practitioner	Binary response (U.S or Canada)		X

Statistical Methods

- We will follow statistical best practices when it comes to conducting surveys.
- As mentioned above, our sample size was calculated to ensure that we could meet a 95% confidence level, with a 3% margin of error in our final findings for both our clinic and household findings.
- Once our data has been collected using the methods outlined above, we will use a multivariate linear regression to gauge the relationship between all of the variables in question. Specifically, the outcome variable in one regression will be the telehealth-related expenditure for a given clinic. Another will be the interest level (measured on a scale of 1-10) of a household in telehealth based on their responses to our survey questions.
- Where appropriate, we will apply transformations to our dataset and associated variables. An example of this could be a log transformation for a highly skewed variable. Another transformation may be a multiplication of two input variables together where there is believed to be interaction between the two.
- We will gradually introduce models of increasingly complex nature, constantly comparing back to a reduced base-case model. Analysis Of Variance (ANOVA) F-tests will allow us

to compare each model we produce to the previous for prediction accuracy. Through such an iterative process we will arrive at a model which best predicts the variable in question for our main research questions.

- We will attempt to meet all Classical Linear Model (CLM) assumptions for multivariate regression analyses. If we are unable to meet all assumptions required for a CLM case, we will revise our investigation for a descriptive case, rather than a causal one.

Potential Risks

Below is a list of some of the immediate risks our investigation may encounter (in no particular order):

- *Data Collection*: It is possible that we may be unable to canvas 1,000 veterinarians from different clinics within our timeline and budget. The same can be said for any potential inability to gather data from 1,000 pet-owning households. Despite these two examples of the same kind of risk, we believe that our method and timeline outlined below will allow us to gather said samples without any issues.
- *Independence*: We must make sure that we do not survey the same household and/or clinic twice. (e.g. same house, different people - same clinic, different veterinarian). We will implement responses tracking processes to ensure that we can minimize this kind of risk.
- *Privacy*: Same doctors/business owners, as well as pet owners, will be hesitant to share with us their personal and business information. We must ensure that we anonymize their information so that they are not traceable. It is worth noting that this risk may be related to the risk of data collection in that some may not want to share these sensitive pieces of data, thereby impacting our amount of data collected.
- *Identical Distribution*: There exist many types of animal clinics. Though we attempt to control for this, it is possible that not all clinics we will sample will be comparable. We believe that our inclusion/exclusion criteria for sampling listed above will be sufficient for our investigation, but we would be remiss if we did not mention this risk. We will pivot as required through an iterative process to ensure this risk is addressed.

Deliverables

Ultimately, the main outcome of this investigation will be a summarized report with an accompanying presentation. These will include both high-level conclusions, as well as detailed breakdowns, where appropriate.

Phase 1 - Finalize scope and complete survey design (2 Weeks)

- Conduct review meeting with stakeholders to confirm research design scope and approach
- Incorporate inputs/feedback received and any additional considerations
- Finalize survey design and methodologies

Expected Phase 1 outcomes:

- Research design and plan finalized
- Alignment gained between stakeholders and research design team
- Research ready to begin

Phase 2 - Data collection and cleansing (6 Months)

- Collect available datasets (This includes literature review and compilation of latest datasets on North American pet ownership, veterinary practices, telehealth solution providers and the related statistics.)
- Identify and confirm veterinary establishments to send surveys to
- Identify and confirm outlets to reach pet owners
- Prepare consent forms
- Finalize survey questions
- Create surveys in the required format
- Distribute surveys to the target subject pools via the chosen platforms or outlets (i.e. social media platforms, mail)
- Monitor survey turnout and engage target subjects to improve outcome
- Close survey and collect results
- Consolidate survey results
- Perform data cleansing

Expected Phase 2 outcomes:

- Non-survey related datasets collected and compiled
- Surveys finalized and generated
- Surveys released to target pet owners and veterinary establishments via the appropriate outlets
- Survey results collected and compiled
- Non-survey and survey related datasets cleansed

Phase 3 - Data analysis (1 Month)

- Perform analysis on non-survey and survey related data that has been cleansed
- Document observations and findings made

Expected Phase 3 outcomes:

- Data analysis on non-survey data completed
- Data analysis on survey outputs completed

Phase 4 - Final report preparation and presentation (2 Weeks)

- Prepare final report and final presentation

Expected Phase 4 outcomes:

- Final report and presentation draft made
- Peer review on final report draft received
- Presentation and final report on analysis delivered

References

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<https://todaysveterinarybusiness.com/veterinary-telemedicine-leading/> Statement of Contribution

Statement of Contribution

Each member took a lead in a specific section of this project. Frances Leung was in charge of the overview, research questions, variables and/or intervention, deliverables and references sections. Matt Pribadi covered the data and research design sections. Andy Tertzakian took over the sample data, statistical methods, and risk sections. Afterwards, we all came together and worked through the deliverables together. In addition, we all checked the document for grammatical and logical errors and ensured our research design is one coherent document.

Teammate reflection from Frances Leung

This group project is a wonderful way to enable a small team to experience the collaborative research design process from topic pitch/selection, research question formation, study design conceptualization, methodologies formulation, all the way to deliverable definition and planning.

Although the intent of this project was not to conduct the study, the thought process in a team setting that went into planning and determining the data, research variables and logistics required to obtain the inputs was by far the most valuable learning element.

The opportunity to produce a recording of the team presentation was a great way for myself to see my presentation style and how I could learn from my teammates and others in the class. Something that I rarely have the opportunity to in a safe learning environment.

I find the data visualization oriented final project in W200 Python programming is partly complementary to this learning segment. In that project, actual data analysis is required whereas here, the focus is more on the design of the research process and properly framing the research questions given the chosen topic.

Teammate reflection from Matt Pribadi

It was an exciting thought process to go through the future of telemedicine and what it means for both humans and pets and it was a great segway between learning about research design and applying it to a real life project. What helped to make this project a success was great collaboration between team members and quick and constructive responses and feedback. Collaboration through an online setting is something that I was not used to doing completely, especially the combined Zoom recording, but everything turned out great.

Overall, the two final projects between W200 and W201 complemented each other since in one aspect, we understand the technical basis behind gathering the data. On the other hand we get to practice and understand thoughtful and creative presentation styles to engage the audience.⁹

Teammate reflection from Andy Tertzakian

This was a very enjoyable project overall. I thoroughly enjoyed thinking about a data science project which is far outside of my normal day-to-day work. Furthermore, it was a wonderful exercise in practising ideating, scoping, and actually planning a real-world project to answer a

relatively broad question. I can definitely see myself applying this sort of process to a project in my life in the near future.

On top of this, it was great to be able to work in a diverse team on refining these ideas. From discussing where to start, to recording our final presentation together, the collaboration I had with Frances and Matt was fantastic.

I caught myself referring back to concepts I have learned in W203 many times throughout this project, too. Whether it was considering appropriate sample sizes, or pondering the independent and identically distributed nature of our sampling strategy, I really enjoyed having all of these cross-course concepts come together.