Assessment of the Price Elasticity of Demand for Veterinary Services: A Case Study of the University of Zambia Veterinary Hospital

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Abstract

Introduction: Understanding the price elasticity of demand for a commodity is very important for developing a price policy that ensures financial viability in order to continue providing a service. The same is true for veterinary services whose economic nature has to be understood for practitioners to adjust prices for smooth income flows to the business. However, veterinary practitioners' prices often vary across practices without a clear understanding of the economic nature of animal healthcare or elasticity of demand for the services they provide. This study, therefore, aimed at assessing the price elasticity of demand for veterinary services using the University of Zambia Veterinary Clinic (UNZAVET) as a case study.

Materials and methods: To meet this objective, historical five-year data (2014-2018) were collected from the clinics' medical and financial records. The data were then entered and analysed using both Microsoft Excel and IBM SPSS Version 20. The price elasticity of demand was calculated using an end-point method. The association between inflation rate and revenue was estimated using Simple Linear Regression Analysis.

Results: Overall, the results showed that most of the services offered at UNZAVET were relatively inelastic (<1). Demand for the services gradually declined while total revenue was steadily increased due to the overall increase in prices. There was no significant statistical association (p=0.35) between annual revenue and inflation rate, nevertheless, a unit increase in inflation reduced the clinic's income by K29,815.81 per annum.

Conclusion and Recommendations: The study concluded that prices for veterinary services traded in a monopolistic competition market, with mostly inelastic commodities. The study recommended that Veterinarians should consider inflation and price elasticity of demand for each animal health commodity before changing prices. Veterinary practitioners must know that within their practice, there are some veterinary services that if prices of vaccinations were raised, consumers will still buy the same amount and

practitioners will make more money. Similarly, there are other services such as castrations and sprays which if practitioners lowered their prices; consumers would buy more hence increasing their income on such services.

Key words: *Animal Health Economics, Animal Healthcare, Price Elasticity of Demand, Veterinary Services, Zambia*

Introduction

In Zambia, private veterinary services are relatively new and are still expanding. The pricing system is not constant across all veterinary services. However, the main primary provider of animal healthcare veterinary services in Zambia is still the Government through the Ministry Fisheries and Livestock, which owns the largest market share [1]. Government's primary role is the provision, financing and policing of animal health care equitably to ensure the growth of the livestock industry. The Government was the sole provider of animal health care until 1992 when services were partially privatised to allow the private sector to be a partner in improving access to animal healthcare to grow the livestock sector [1]. There have been good developments, especially in small animal practice, although these are in urban areas where people with buying power for animal healthcare are found. Large animal private practice has lagged behind because 85 per cent of the cattle are in the hands of traditional cattle farmers who live in rural areas that are barely accessible by road due to among other factors, poor infrastructure [1].

The recent past has seen an increase in the number of veterinary clinics, mainly along the line of rail in Zambia. Veterinary clinics are run in a monopolistic competition market structure. This is a market where veterinary clinics sell related commodities that do not have close substitutes such as clinics specialising in small animal medicine, equine medicine, wildlife medicine etc. Additionally, individual practices set their own prices irrespective of other practices. Therefore, changes in the price of one commodity do not affect others. The veterinary clinics in Zambia each provide veterinary services but with some form of specialisation such as equine medicine, food animal medicine, poultry or companion animal medicine, wildlife medicine. Thus prices for animal healthcare vary from one practitioner to another, and these variations seem not to be based on understanding the economic nature of the animal healthcare commodities and their price elasticity of demand.

Price elasticity of demand is useful in the analysis of how changes in the market prices or quantities that are consumed will affect each other. It can be described as a ratio of two percentages, the change in quantities consumed that will result from a change in price or vice-versa [2]. A commodity is said to be elastic if elasticity is greater than one, inelastic if less than one and unit elastic if equal to one. This is a reliable measure that can be applied in making decisions about pricing [3]. The price elasticity of demand is the percentage change in quantity demanded (Q) divided by the percentage change in price (P) [4].

As mentioned above, price elasticity of demand indicates the degree of responsiveness of the quantity demanded

of a good to the change in its price, holding other factors such as consumer's income constant [2].

However, a gap exists in that most veterinarians increase prices without using the price elasticity of demand and other factors like consumer population, consumer income, inflation rate. This case study, therefore, assessed the price elasticity of demand for animal healthcare commodities of goods and services provided by the University of Zambia Veterinary Clinic.

MATERIALS AND METHODS

Case Study

The study was conducted at the University of Zambia, School of Veterinary Medicine Veterinary Clinic that is located in Lusaka in the capital city of Zambia. The Veterinary Clinic was established in 1986 with the cooperation of the Government of Japan. The clinic is housed in the School of Veterinary Medicine in the Department of Clinical Studies. It provides consultations, referrals and 24-hour emergency veterinary services, and care for animals such as horses, cattle, sheep, goats, pigs, dogs, cats, fowls, wildlife and exotic pets. The clinic also offers mobile house calls and ambulatory services to livestock farms. The clinic has a clinical teaching laboratory where the clinical samples are examined. Services include haematology, faecal sample analysis, cytology, urinalysis and skin scrapping analysis. Thus the clinic provides consultancy, diagnostic and referral services to both the public and private practitioners. It is equipped to conduct daily consultations on both first line and second opinion and referral cases. The surgical unit provides soft tissue and orthopaedic surgeries, dental procedures,

radiography, ultrasonography, equine and canine endoscopy. The medical unit provides both individual and herd management consultations and treatment. The clinic also provides routine preventive veterinary advice and care such as vaccinations, deworming and neutering (spays and castrations. Admission facilities are available for very sick animals and limited boarding facilities for healthy pets and farm animals.

Since the clinic operates as part of the School of Veterinary Medicine, the human resource is comprised of academic staff members, who are trained in various specialities; House surgeons, who are graduate veterinarians undergoing additional training to advance their clinical skills and practice; veterinary technicians and support staff, who perform tests and nursing care, and keep the animals' environment clean, provide feed and water to in-patients.

Due to its central location, a wide variety of services are provided, large clientele base, the referral nature of the clinic and specialised human resource, makes the University of Zambia veterinary clinic the ideal facility for estimating the demand elasticity of veterinary services offered in Zambia using a trends analysis case study design.

Data Collection

A checklist was used to collect time-series historical data from 2014 to 2018 from the clinics' medical and financial records (receipts for the services offered). Yearly data on types or profiles of services provided, price change over time and annual revenue over time were collected. Figures of the annual rate of inflation were

obtained from Government Economic Outlook reports (https://www.statista.com/statistics/457704/inflation-rate-in-zambia/).

Data Management and Analysis

The collected time-series yearly data was entered and established in Microsoft Excel spreadsheet. Analysis was done using both Microsoft Excel and IBM SPSS version 20. The Elasticity of Demand (E_D) was estimated using the price elasticity of demand, which is a ratio of the percentage change in the quantity demanded of animal health care commodities to a given percentage change in price [5,6]. The price elasticity of demand was then calculated using the mid-point method using a formula in Equation 1.

$$Elasticity = \frac{(Q_2 - Q_1)/\frac{1}{2}(Q_2 + Q_1)}{(P_2 - P_1)/\frac{1}{2}(P_1 + P_2)}$$

Simple Linear Regression Analysis was conducted to measure the association between inflation and the total revenue of health care commodities.

Ethical Considerations

Ethical issues that involve the use of secondary data include those that may cause harm to individuals' privacy and therefore, consent is required [7]. Consent and approval was obtained from the Registrar of the University of Zambia and the University of Zambia Biomedical Research Ethics Committee (UNZABREC), protocol number 20190720001 for the use of the clinic's financial records and all guidelines were followed accordingly. The investigations involved the tabulation of the services only received

by individuals and summation for that respective year was made. The personal details of individuals who had purchased the service were not necessary for this study, and hence their privacy was maintained.

RESULTS

The spectrum of small (companion) animal veterinary services that were offered by the University of Zambia veterinary clinic at the time of this study are indicated in Table 1.

Table 1:

Small animal veterinary services
(i) Dog Vaccinations: mainly against Rabies, Canine Distemper, Adenovirus type 1, Adenovirus Type 2, Parainfluenza, and Parvovirus) diseases
(ii) Cat vaccinations: feline rhinotracheitis virus, calicivirus, and panleukopenia virus.
(iii) Deworming,
(iv) Dipping,
(v) Surgical procedures: tail-docking, castrations and spays (Hysterectomy and ovariohysterectomy)
(vi) Treatments,
(vii) General consultations, and admissions.

Felocell® 3 is a cocktail vaccine for felines, which protects against three diseases (feline rhinotracheitis virus, calicivirus, and panleukopenia virus). Vanguard is a cocktail vaccine for canids, which protects against five diseases (canine distemper, canine

adenovirus type 1, canine adenovirus type 2, canine parainfluenza, and canine parvovirus).

The Elasticity of Demand for Key Small Animal Veterinary Services

The elasticity of demand for some of the basic services offered by the University of Zambia Veterinary Clinic ranged from undefined (UD) for services such as tail docking to a value of 2.9, as shown in Table 1. The vaccination services namely: Rabies, Vanguard, Felocell ®, deworming and dipping all had elasticity values less than 1, indicating   that they were inelastic. In 2016 both rabies vaccination and canine parvovirus (CPV) had an elasticity value of 1, which means they were unit elastic. CPV, castration and spays had elasticity values of greater than 1, indicating that they were elastic.

Table 1: Price Elasticity of Demand for Key Small Animal Veterinary Services

between 2014 and 2018 while dog tail docking's demand has been continuously declining since 2014 (Figure 1).
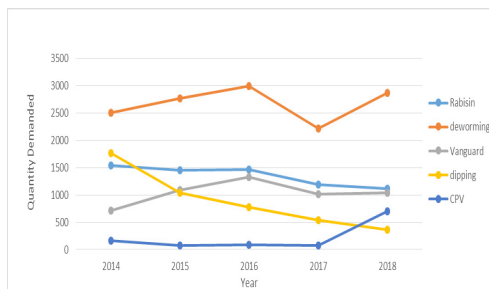

Figure 1: Change in quantity demanded over time for dog tail docking, castration, and spays, and felocell from the year 2014 to 2018

Figure 2 indicates that the quantity demanded for deworming services had been increasing from 2014 until 2016 when it started declining; the quantity demanded started increasing after 2017. The demand for dipping has been decreasing from 2014 to 2018.

Year	Rabies Vaccination	CPV	Vanguard	Felocell	Deworming	Castration	Spays	Dipping	Tail docking
2015	UD	UD	UD	0.89	UD	1.96	2.99	UD	UD
2016	1.00	1.00	0.43	0.52	UD	UD	UD	UD	UD
2017	UD	UD	UD	UD	UD	1.46	2.33	UD	UD
2018	0.09	2.94	0.03	0.34	0.39	1.03	1.46	0.38	UD

Trends of the Essential Veterinary Services with Regards to Changes in Demand with Time

The quantity demanded for Felocell ® was almost reasonably constant with a drop occurring in 2014 and a sharp rise in 2018, (Figure 1). Dog spays and castrations have had their demand changing every year with both increases and decreases occurring

The quantity demanded for Rabies vaccination had been relatively constant from 2014 to 2016 after which it started declining. Quantity demanded for Vanguard vaccination had been raising from 2014 but begun declining from 2016 and has continued to decline. CPV had a reasonably constant demand with an increase observed between 2017 and 2018.
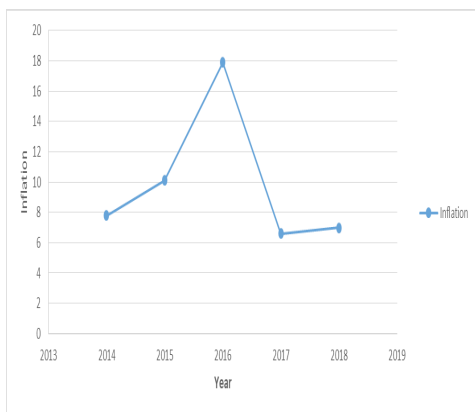
Figure 2: The change in the trends in quantity demanded for Rabies vaccinations, deworming, Vanguard, dipping and CPV changes in demand from 2014 to 2018

Inflation and revenue

There was a general increase in revenue over the stated years. However, an overall decline in revenue occurred in 2016 (Table for revenue not included as the authors were not allowed to display financial information to the public). This decline correlates with the high inflation rate recorded in that year, as shown in Figure 3.
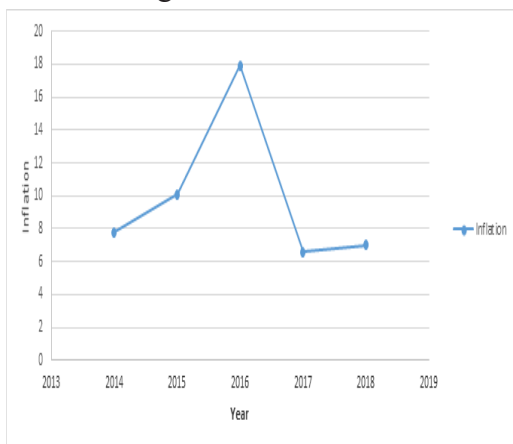

Figure 3: The national average inflation rate for Zambia from 2014-2018

Table 2 below indicates that there was no statistical association between inflation and annual revenue (p= 0.35). However, a unit increase in inflation reduced revenue by K29, 815.81 (US$ 2000) per annum.

Table 2: Results of simple linear regression showing association between revenue and inflation

Coefficients						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1021419.94	278040.21		3.67	0.07
	Inflation	-29815.81	24504.31	-0.65	-1.22	0.35
a. Dependent Variable: revenue						

DISCUSSION

The main aim of the study was to estimate the price elasticity of demand for veterinary services and measure the association between annual revenue and inflation rate at the University of Zambia Veterinary Clinic. The findings revealed that small animal (cats and dogs) vaccinations (Vanguard, Rabies, Felocell®), dipping and deworming had a relatively inelastic demand. Despite all vaccinations having an inelastic demand as shown in Table 1, Rabies vaccination was more elastic than Vanguard, which is given much earlier in life to puppies. This implies that according to the results consumers consider Vanguard more necessary than Rabies vaccination even though Vanguard has generally overall lesser quantities than Rabies vaccination. This difference in quantity

may be attributed to the fact that Rabies vaccination is cheaper than Vanguard, and consumers then face a trade-off. To either pay for a vaccination that is mandatory through the control of dogs Act (Rabies vaccination) or pay for one that is not and costs more. Rabies vaccination has a lesser opportunity cost, hence a higher demand.

Canine Parvovirus (CPV) is the only vaccination that was elastic, with a value of 2.94 per cent. This means that for every 1 per cent increase or decrease in price, there was a 2.94 per cent reduction or increase in demand respectively. This is because it has a close substitute, which is Vanguard vaccination. This may due to a common undocumented practice by veterinarians in Zambia to administer Vanguard vaccination at six weeks and CPV at four weeks, most individuals get their puppies at the age of six to eight weeks, when puppies get weaned, and by that time it would be too late to administer CPV, hence the low demand. Cross price elasticity compares how a change in the price of one involves the change in another product and is used for substitutes. Though Vanguard can somewhat substitute CPV vaccination, cross-price elasticity may not be applicable in this case since it has been shown that consumer trade-off is not based on price [8].

The findings also revealed that castrations, spays and CPV had a relatively elastic demand, an indication that these animal health services are more of luxuries in nature. A study by Kemp [9] showed that consumers consider a service more luxurious if it is more of a desire than to relieve discomfort. Therefore, castration and spay might be regarded as luxuries among pet owners and this might be the reason why these services had an elastic demand.

Felocell® is a vaccine that is given to healthy cats at 12 weeks of age or older. Cats of this age receive two doses administered 3 to 4 weeks apart after which they receive annual revaccination with a single dose. This vaccine had an inelastic demand despite the least quantities demanded. This is generally due to the undocumented belief among most Zambians that cats do not need vaccinations, and hence they are never taken to the veterinarians unless they are either sick or injured.

Tail docking is a surgical procedure that involves the amputation of all or part of the coccygeal vertebra of an animal [10]. This is mainly done in dogs for breed cosmetic purposes and cultural practices. Although tail docking is a service that had a constant price; the quantity demanded for this service demonstrated a gradual reduction. While the present study could not establish the causes for the decline in quantity demand for the procedure, there are a number of reasons that can be attributed to this observation. Due to the effects and so much pain that tail docking causes on puppies, its practice has been previously questioned and is considered unjustified [11].

In November 1987, the European Convention for the Protection of Pet Animals was opened for signature such that by 1992 it had been enforced that all surgical procedures that would not cure pets but modify them were prohibited. Since then, many Veterinary Associations and Animal Welfare Organisations have been advocating for it to be banned.

With this backlash on the procedure, a number of veterinarians have been reluctant to offer this service although this could not be established in this study as reason for the decline in demand for tail docking.

Deworming was not only inelastic but also had the highest quantity demanded. Pet owners are most likely to deworm their pets due to the inexpensive nature of the service.

The rates of neutering are different from place to place and this can be explained by the vast differences in culture and the general attitude people will have towards neutering their pets. There are also owners of indoor pets who believe it is unnecessary to neuter their pets [12]. Mckay *et al.* [13] state that participants of certain studies believe that pets have the right not to be sterilised. Their study also showed that male owners feel that neutering might affect the masculinity and sexuality of the pet. With regard to the present study, both castrations and spays had an elastic response. With demand increasing more in the recent years which we speculate was due to the increased awareness and demand for population control. As opinions remain vast on neutering, it would explain the varying changes in the demand.

Statistically, there was no significant association between revenue and inflation. However, a unit increase in inflation reduced annual revenue by ZMW 29,815.81 per annum.

Inflation is responsible for causing firms to become liable to the costs of changing their prices [14]. Buckle and Carson [15] demonstrated that firstly, inflation probably increases the probability of a price increase and secondly, prices tend to decrease as the demand decreases. Inflation increases the cost of living; hence it increases the price at which a service is offered as was seen in this study. Therefore, inflation leads to consumers not having enough disposable income to take their animals to the veterinarian and eventually affects revenue.

In 2016, inflation was highest and there was a change in the price of the services provided at the clinic. However, despite the decrease in demand of quantity for most services in 2016, the clinic did not decrease the prices probably due to the fact that the decrease in demand did not reduce the total revenue, which actually had been increasing steadily. This trend could be attributed firstly, to the increase in the prices of services, which had doubled between 2014 and 2018. The increase in price of services could have led to a reduction in quantities demanded. Moreover, because most of the services had an inelastic demand, increases in prices tended to correlate with an increase in revenue for the clinic.

Like any other retrospective study, the main limitation was the lack of records due to the manual type of filing system, that some of the records were misplaced. The study was initially planned to cover a ten-year period but due to the misplacement of some records, we opted to reduce it to the most recent five years. Neil and Holcomb [16] equally agrees that literature on the elasticity of demand for veterinary services is sparse and

so is data for estimating it due to poor record-keeping of quantities of services supplied, consumer and price changes over the years. Some of the information for this study was obtained from receipts, which are kept at the Central Administration Office. It took some time for permission to be obtained for access to the receipts hence delaying data collection. Only services provided in this study had data available while other services like consultations, treatments, admissions and boarding did not have data. However, this did not affect the quality of study as the available data still provided the required information for calculating price elasticity of demand and the association between revenue and inflation. Further studies should build on this work by increasing the number of clinics.

Conclusions and Recommendations

Most animal healthcare services offered at UNZA veterinary clinic during the period under review were found to be inelastic, which implies that consumers considered these services a necessity despite the increase in price. Vaccinations were more inelastic while minor surgeries such as tail docking, castration and spays were elastic. It is now evident on which services the veterinary practitioners could reasonably adjust prices without losing the consumers. The national inflation rate must be considered when adjusting prices as this can affect the quantities demanded for both elastic and inelastic services.

Veterinarians who own their practice need to know how to raise revenue to cover rising costs but should realize that it may be a mistake to raise all prices without considering their elasticity of demand. In particular, owners of practices should know which of the services they provide are ones that, in the words of the convenience store chain founder, "if you raise their price, animal owners will still buy pretty much the same amount, so they will make more money" and which are ones that "if you lower their price, animal owners will buy so much more than you will make more money" [17]. Johnson and Kilkenny [17] further state that, "knowing the price elasticity of demand for the things they sell benefits all business people, including veterinarians".

The results cannot be generalised since this was a case study involving only one veterinary clinic. However, it provides a methodology and platform for a bigger study with a larger sample size.

ACKNOWLEDGEMENT

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