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Veterinarians, Paraprofessionals, Farmers and the Quality of Clinical Veterinary Services: A role play experiment

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Abstract:
The study examines the interaction of farmers, veterinarians and paraprofessionals in provision of clinical veterinary services. It uses a role play experiment to examine how farmers and service providers interaction influences the quality and demand for clinical services. The game was played in four rounds and quality of clinical services was measured using scores in drug prescription for selected animal diseases in each round. Statistical tests were performed to test whether quality of services provided by paraprofessionals and veterinarians differ. Service provider learning curves were constructed to examine whether the quality of services provided by paraprofessionals improves as they continue to interact with veterinarians. Farmer's belief updating curves were also constructed to examine whether farmers change their beliefs about paraprofessionals on receiving information about quality of their services. A logistic regression model for binary panel data was estimated to determine factors that influence farmer decisions to change service providers. Results show that the quality of services offered by veterinarians are not significantly different from services offered by paraprofessional's trained in veterinary science. However, the quality of services offered by service providers who are not trained in veterinary medicine are significantly different from those offered by veterinary trained service providers. Continued interaction between paraprofessionals and veterinarians gradually leads to improvement in quality of clinical veterinary services among paraprofessionals with general agriculture and social science training but not with paraprofessionals with no formal training or education. Farmers do not easily to change their beliefs about paraprofessionals and this depends on gender of the farmer, previous outcome and livestock production system. The paper argues that the slow pace in which farmers update their beliefs about paraprofessionals limits paraprofessional's willingness and readiness to learn or consult with veterinarians. However, use of animal health medical cards would induce paraprofessionals to provide quality services and enable farmers to measure the quality of services thus improving quality clinical services in the long run.

Key words: *Belief updating, Lemon Market, and Role play game, Learning curves and Farmers Belief Updating Curves*

1. Introduction:

This paper is concerned with measuring and assessing the quality of clinical veterinary services. The existence of veterinarians and paraprofessionals of varying skills and training is a major problem in animal health markets (Ly 2003; D K Leonard et al. 1999). Qualified veterinarians have to compete with not only less qualified and unqualified practitioners but also their qualified colleagues in general agriculture who have both crop and livestock training and are involved in providing the same service but of heterogeneous quality (Boden 1996). Livestock farmers who have no skill and training in veterinary science cannot perfectly measure or determine the quality of services being offered by these service providers. Ilukor & Birner (2012) describe the inability of a farmer to assess the quality veterinary services as "measurability problem". The measurability problem creates motivation problems such that, a farmer is not willing to pay a premium fee for the service. As a result, service providers that provide high quality services are forced to accept low pays since they cannot convince the farmer that their services are of high quality (Ly 2003). However, in the real world set up, service providers interact repeatedly with farmers and if farmers fail to differentiate the quality of the service, high quality service providers are displaced or nudged off the market since the institution that are required to ensure quality for veterinary services in developing countries are missing or weak (David K Leonard 2000). Akerlof (1970) describes this interface between quality heterogeneity and asymmetric information resulting to the disappearance of a market with quality goods and services as "lemon market".

As argued by Ly (2003), a lemon market has occurred in animal health markets in most developing countries. In Kenya, even in productive areas, the veterinary paraprofessionals have dominated the animal health markets (Oruko & Ndung'u 2009). In Uganda, Koma (2000) found out that it is very difficult for private veterinarians to break-even because farmers are not willing to pay a veterinarians a premium for the service that can offered by the paraprofessionals at lower cost thus leaving the paraprofessionals to dominate the market. The dominance of the veterinary paraprofessionals in the provision veterinarian services although useful in reducing costs and increasing access has been criticized on grounds that this has resulted in a decline in the quality of veterinary services (Cooper et al. 2003; Mugunieri et al. 2004). To improve the quality of clinical veterinary services, there are increased calls for an improved relationship between veterinarians and paraprofessionals (Schneider 2011). Ahuja (2004) argue that because of high measurability in clinical services, professional veterinary staffs are better placed to provide clinical services and reduce economic and health related risks in both humans and animals. However, since veterinarians are few, difficult to retain and motivate, cooperation between paraprofessionals and veterinarians is the appropriate approach to improving quality of clinical veterinary services (Ilukor & Birner 2012).

Economic literature on the provision of animal health services emphasizes that if farmers had information about the quality of service offered, they would be able to update their beliefs and more readily seek services of veterinarians who offer quality services. Belief updating (belief change) is the operation of changing the old belief to take in to account new

information (Lang 2007). By seeking quality services, paraprofessionals or low quality service providers would strive to consult with veterinarians in order to maintain and build their reputation. The information externalities described here has not been recognized and analyzed in animal health literature. Information externality in context of animal health is concern with how information about the quality of the service of particular service provider affects demand for services of other service providers. An information externality exists in animal health market when livestock farmers rely on information generated from experience of other farmers and themselves in dealing with different service providers. An information externality can result to increase or decline of the demand of services of particular service provider (Nakamura 1993; Hendricks & Kovenock 1989). Bolton & Ockenfels (2005) and Morgan & Sefton (2001) contend that information externalities influence beliefs and decisions and consequently the value of reputation building, price, quality and demand for products or services. However, in the context of clinical veterinary services, this will depend on how farmers update their beliefs and whether service providers value their reputation (Schmidt 1993). Cole (1989) argues that belief updating in light of new information is extremely difficult because of lack mental model to combine different factors. In other words, even if farmers receive information they may fail to punish poor quality service providers, and the quality of the services may not improve. In this study, a role play game was used to assess the influence of information on farmers' beliefs about service providers and quality of clinical services. In particular the study aimed at answering the following questions: Does the quality of services provided by paraprofessionals differ with that provided by the veterinarians? Does quality improve in long run as paraprofessionals and veterinarians interact? Do farmers update their beliefs about service providers? And what factors influence farmer belief updating?

A role play game was chosen because it captures the complexities without losing reality (G. E. Bolton 2002). Role plays are able to capture information externalities generated through social interaction and learning accurately. Green (2002) compared game theory, role playing and unaided judgement in assessing decision making in conflict situations and found out that 37% of the game theorists, 28% of the unaided assessments and 64% of the role play games assessment were correct. Armstrong (2001) also compared role playing and unaided expert opinions and found out that role playing predicted correctly 56% of 146 predictions compared to 16% of 172 predictions of unaided expert opinions. Consequently, they both concluded that role play games are most accurate and consistent methods of assessment and decision forecasting. Schelling (2011) argues that role play games are a useful tool for predicting and assessing outcomes that are latent in the problem and complex in nature. Since veterinary service delivery is complex in nature (Bossche et al. 2004), role play games are the appropriate tools for assessing the influence of information externality on farmers behaviour and quality of veterinary services. The paper proceeds as follows: section two covers materials and methods. Section three presents the results and section four discussions and conclusion.

2. Materials and Methods

Design of the game: The experimental data used in this paper were collected at two different districts in Uganda (A and B). District A is found in a pastoral production system and district B in an intensive livestock production systems. Subjects were recruited from each district. The subjects included the farmers, paraprofessionals and veterinarians. They were informed that they were to participate in a role play game and they would be paid for their participation. Upon arrival farmers were told that their pay-off would depend on the outcome of the transaction and their ability to negotiate with service providers. Their initial endowment was set at six thousand Uganda shillings (US$2) which three times the daily wage for unskilled labour. If the outcome is good a farmer would be paid a fee covering the difference between what a service provider charges and the initial endowment. A good out is one where the animal is cured (right drug is prescribed). If the outcome is bad, a farmer receives nothing. Service providers on the hand were informed that their earning would depend on their reputation with farmers and professional fee charged. Their reputation was measured by the number of farmers who seeked their services. Service providers were also told that they can refer a service to other service providers if they wish and should give the reason for referring. The cost of transport and drugs were considered as dead weight costs because neither a farmer nor service provider takes that fee home and hence not included in the game.

A total of 51 farmers were recruited to participate in the experiment, 26 in the pastoral livestock production system (10 female and 16 male) and 25 from the intensive livestock production system (12 female and 13 male). In each production system, two veterinarians, and five paraprofessionals were recruited to participate in the game. In district A (pastoral area), veterinarians are difficult to come by because there are no trained veterinarians from these areas and professionals from non-pastoral ethnic groups are often reluctant to work in pastoral areas because of harsh climate, and poor infrastructure (Hassan 2003). Subsequently, two government animal health assistants with diploma training in veterinary medicine were asked to act as veterinarians. We later tested their performance in terms of disease diagnosis and drug prescription with veterinarians in district B and found that there is no statistically significant difference in their scores. Therefore, this did not affect the analysis of the results. Paraprofessionals on the other hand had different trainings. In the pastoral system, two of the paraprofessionals had a diploma in social science with three month training in animal health and the other three had either primary or no education with three month training in animal health. Meanwhile, three paraprofessionals in the intensive production system had a certificate in general agriculture, and two had a diploma in general agriculture. In the intensive system, the three livestock diseases that were identified as the most common diseases were East Cost Fever, Anaplasmosis, and Tryponamiasis. In the pastoral systems two more diseases were added, namely, Heart Water and Red Water.

The game proceeded as follows: Farmers were given an animal medical card with the name of the disease written on it both in the local language (Pokot and Luganda) and in English. Farmers were asked to choose any service provider of his or her choice. Every farmer who participated in game knew at least one veterinarians and one professional. The service provider chosen had to perform a clinical diagnosis of the disease and prescribe the drugs. They also had to agree on costs of treatment with a farmer. The costs were broken down in to the professional fee, drug cost and transport fee. All this information was written in the animal medical card. Two of the paraprofessionals in the pastoral areas who did not

know how to write and read in English were assisted by hired University students with no veterinary training. They were instructed to write only what the paraprofessionals told them to write. The cards were later handed back to the farmers who presented the cards to the researcher. The researcher would then assign the outcomes based on drug prescription. Outcomes were categorized as good and bad. A good outcome is one where the animal is cured while a bad outcome is one that arises from a poor response (wrong drug is prescribed). The outcome of the case was assigned as good if the service provider prescribed drug(s) that would cure the that particular disease and bad if the prescribed drug was not a drug that would cure the disease see table 1 below. The game was played in four rounds and at the beginning of each round, the farmers received a new medical card. Also at the end of each round, both farmers and service providers received information about the outcomes, and their pay-offs were paid to each to each of them. After the game, subjects were invited to participate in the reflection session and for drinks and food.

Analysis of data: To analyse the effect of information externalities on the demand and quality of clinical veterinary services, the degree of accuracy in clinical diagnosis and prescription were used as indicators of quality. After every round, subjects would consult or share their outcomes with others. The scores for every round were computed and analysed. To measure the level of accuracy in disease diagnosis and drug prescription, a marking scheme was designed by consulting the practicing veterinarians, the Merck Veterinary manual[1] and the OIE technical disease cards[2]. The cardinal signs for each disease was given a score of one mark and later transformed in to percentages. In the case of drug prescription, scores were awarded based on the drugs prescribed by the service providers. As shown in table 1 below, If service provider prescribed one of the main drugs then he was given a score of 8 or 9 and a score of 2 or 1 for all the supplementary drugs depending on the disease and the pass mark could be set at 80%.

Table 1: Clinical Signs and Drugs for specific Animal Diseases

Disease	Clinical signs	Main drug(s)	Scores	Supplementary drugs	Scores
ECF	High temperature of about 40^0C, swollen lymph nodes, increased breathing loss of appetite, nosal discharge, loss	Butarex, Parvexion, Clexion and	8	multivitamins and oxy-tetracycline	2

[1] The Merck Veterinary manual for veterinary professionals http://www.merckmanuals.com/vet/index.html

[2] OIE technical disease cards http://www.oie.int/animal-health-in-the-world/technical-disease-cards/

	of appetite, cough, white discharge in the eyes	Aflexion			
Anaplasmoisis	High temperature (41^0C), severe constipation, loss of appetite, loss of body weight, increased breathing and dry mouth	Imisol	8	salts, multivitamins and oxy-tetracycline	2
Tryponamiasis	High temperature, stunning hair, loss of body weight, lacrimation (crying), blood discharge from the ears or skin, mucus discharge and brown urine.	Suriname, Diminazene and Ethidium	9	oxy-tetracycline	1
Heart Water	Turning in circles, grinding of the teeth, sensitiveness to touch, nosal discharge and high temperature	Oxy tetracycline	9	Multivitamins	1
Red Water	Reddish urine, high temperature, loss of appetite, laboured breathing and weight loss	Imisol, Diminazene and Berenil	9	Multivitamins	1

The data from the role play were entered into a data base and analysed as follows: Scatter diagrams were used to analyse quality of clinical diagnosis and drug prescription for each diseases. Learning curves were constructed to examine whether quality improves with experience or as paraprofessionals interact with veterinarians. Learning curves are used in clinical medicine to measure quality and they occur when improvement in an activity results from acquisition of information or knowledge from prior experience (Waldman et al. 2003). Hopper et al. (2007) argue that a steep learning curve implies that skills are acquired rapidly because the procedure is simple. In this particular case, a steep slope would mean service providers are consulting or learning from each other to build and maintain their reputation. Farmer's belief updating curves were also constructed to examine whether farmers update their beliefs or change their beliefs about type of service providers. The slope of the slope of the curve measures the level of belief change or updating. Service providers were categorized by field of training and in to veterinarians and paraprofessionals. The mean scores in drug prescription for each category in each round were computed and plotted on a Cartesian axis in order to construct the learning curves. Also, the total number of farmers seeking services from the different categories of service providers in each round was computed and the results were used to construct farmer's belief updating curves.

Non parametric statistics were used to perform statistical tests because the Shapiro-Wilk test for normality and the Doornik-Hansen test for multivariate normality showed that the data violated normality assumption. This is not surprising because behavioural data always violates the normality assumption (Mayo 1958). Since the normality assumption was

violated, the parametric tests were considered to be less powerful than the non-parametric tests because they do not assume normality (Sawilowsky 1990). A panel logit model with random-coefficient that allows for unobserved heterogeneity in farmers belief updating in each round was estimated to determine factors that influence farmers belief updating. In the model belief updating is measured as a farmers decision to change to another service provider other than the previous service provider.

3. Results and Discussion

Analysis of service quality by disease

In the materials and methods section, it was noted that animal health assistants with a diploma in veterinary science were asked to act as veterinarians in pastoral areas. Therefore, it was imperative to test whether there is a significant difference in the quality of their services (clinical diagnosis and drug prescription). A Kruskal-Wallis and Kolmogorov-Smirnov non parametric test for equality was performed and results revealed that no statistical evidence exists to suggest that the scores of government health assistants in the pastoral areas in clinical diagnosis and prescription are different from the score of veterinarians ($p<0.05$). The mean scores of clinical diagnosis and drug prescription for government animal health assistants were 58% and 98% respectively. The scores for clinical diagnosis and drug prescription for veterinarians were 53% and 99% respectively. Consequently, in this paper veterinarians include veterinarians and government animal health assistants trained in veterinary science, or more precisely service providers with veterinary science training. Paraprofessionals included those with a diploma and a certificate in agriculture, social science and community animal health workers (CAHWs).

Figure1 is a scatter diagram for the overall scores in clinical diagnosis and drug prescription. Results show that veterinarians score in drug prescription was always close to one hundred per cent but in clinical diagnosis, sometimes the veterinarians scored below 50%. Paraprofessionals on the other hand recorded high heterogeneity both in clinical diagnosis and drug prescription. This could be a result of high variation in type of paraprofessional. The Kolmogorov-Smirnov two sample non parametric test was performed to test whether there is a statistically significant difference between veterinarians and paraprofessionals in both clinical diagnosis and drug prescription. Results showed that there was a statistically significant difference between paraprofessionals and veterinarians in drug prescription but not clinical diagnosis. Consequently, discussion of the results will mainly focus on drug prescription as a measure of quality of the service.

Figure 2 to 6 are scatter diagrams for clinical diagnosis and prescription for each disease. Results show that there is major problem in drug prescription by paraprofessionals especially in the treatment of ECF and Anaplasmoisis see figure 2 and 3 below. Six of the cases in ECF had score of below 80% in drug prescription and four of which are from the intensive production system and two from the pastoral communities. Three cases were from the same service provider who had a diploma in crop science. The problem with this particular service provider was that he was a general lack of interest in consulting with other service providers.

He kept on prescribing Oxytetracycline's, multivitamins and Imisol. In the pastoral area all the two cases were from a service provider with no education and the cases were recorded in round one and two. His problem too was low propensity to consult with veterinarian and which can be attributed to having no education. The prescription offered in both cases was only Oxytetracycline's.

Anaplasmoisis also had thirteen cases with a score of below 80% in drug prescription and six of cases were from the intensive systems and seven from the pastoral communities. Unlike the case of ECF where these cases were from specific paraprofessionals, Anaplasmoisis cases were distributed over different paraprofessionals in both production systems. In the intensive system these prescriptions were mainly multivitamins, Oxytetracycline's Butarex Suriname, and Diminazene. In the pastoral areas the prescriptions were mainly Oxytetracycline's, multivitamin, one litre and half litre of the cooking oil and OMO washing detergent. This sounded strange but both service providers and farmers argued using cooking oil and washing detergent yields good outcomes. In the case of Tryponamiasis, there were five cases where the score of below 80% in drug prescription and all of them were from pastoral system. Two of cases were from on service provider trained in social science and three from those with no education. The drugs prescribed were Berenil and oxytetracycline. Red Water and Heart Water had three cases each that recorded score below 80%. All the cases are from paraprofessionals with no education and the prescription for all the diseases six cases was pen-strep. The Kruskal-Wallis test was also used to test whether drug prescription varies with diseases and between paraprofessional and veterinarian. Results showed that there is evidence to support that drug prescription varies with disease and between paraprofessionals and veterinarians ($p<0.05$).

Fig. 1 The scatter diagram for Veterinarian and Paraprofessional scores in diagnoisis and prescription

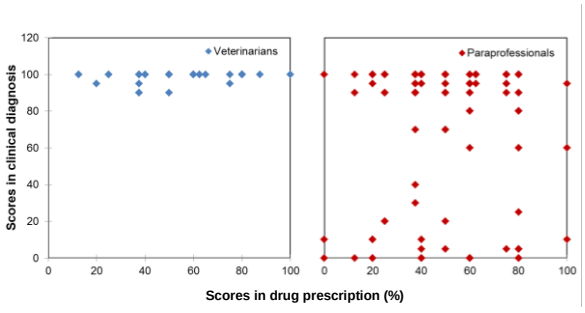


Fig. 2 Veterinarian and Paraprofessional scores in the treatment of East Coast Fever

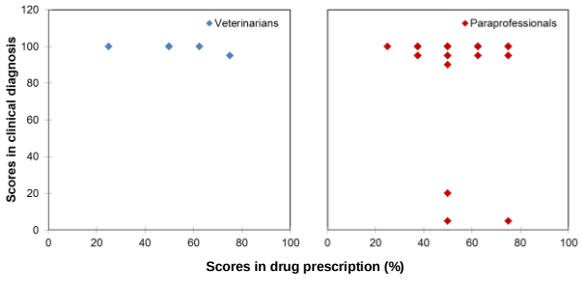


Fig. 3 Veterinarian and Paraprofessional scores in the treatment of Anaplasmosis

Fig. 4 Veterinarian and Paraprofessional scores in the treatment of Tryponomiasis

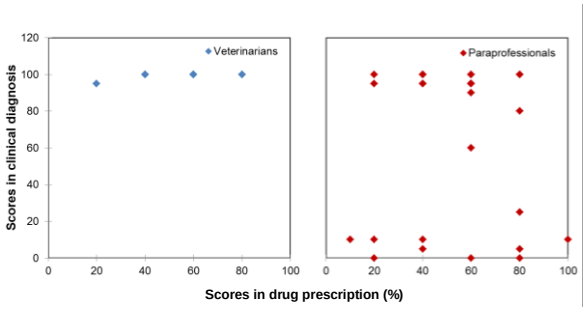


Fig. 5 Veterinarian and Paraprofessional scores in the treatment of Heart Water

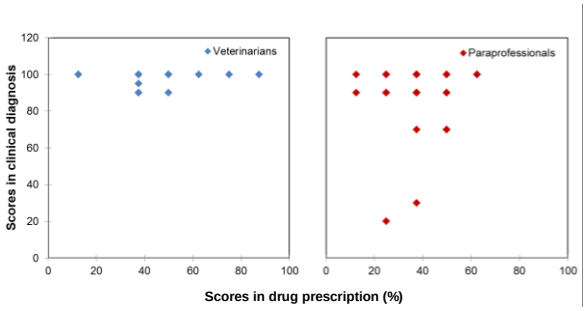
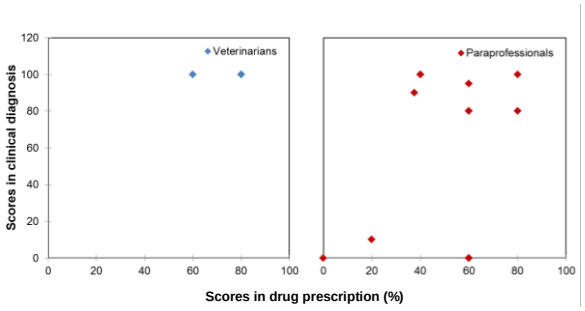
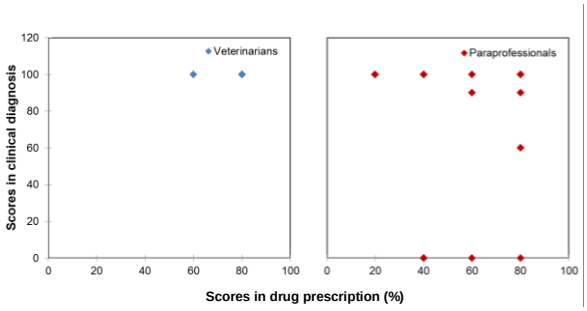


Fig. 6 Veterinarian and Paraprofessional scores in the treatment of Red Water





Information externality and Quality of Clinical Services

To test whether there is a statistically significant difference between the scores of veterinarians and paraprofessionals in drug prescription and in clinical diagnosis, the Kolmogorov-Smirnov test was performed. Results showed that there is statistically significant evidence that paraprofessional and veterinarians scores in drug prescription differ but not in clinical diagnosis ($p<0.05$). The mean scores attained by paraprofessionals in clinical diagnosis and drug prescription were 50% and 72% respectively. Veterinarians on the other hand had a mean score of 99% in drug prescription and 56% in clinical diagnosis. The scores of clinical diagnosis were low because service providers were not keen on listing all the clinical signs. Since scores of clinical diagnosis were not statistically significant between paraprofessionals and veterinarians, drug prescription was considered as measure of quality. The Kruskal-Wallis test was performed to test whether there is a significant difference in drug prescription by field of training, and between production system and rounds. Results revealed that there was a significant evidence to show that the mean scores of drug diagnosis differ by field of training and production system ($p<0.01$). However, only scores of drug prescription in round one and four had a significant difference ($p<0.05$). This is could be attributed to fact that farmers taking a long time to change their beliefs about the paraprofessionals and thus, paraprofessionals have fewer incentive to learn or consult. In addition, paraprofessionals noted that consulting with veterinarians increases the likelihood or risks of losing clients. This is mainly the case because farmers would lose confidence in them and veterinarians would use that as an opportunity to discredit them in front of the clients.

The learning curves were constructed by plotting the averages scores in each round as in figure 11-13 below. Figure 11 shows the learning curves of paraprofessionals and veterinarians. The veterinarian curve shows that veterinarians are operating at maximum with an average score of 99% in drug diagnosis. Paraprofessionals on the hand had a score below 80% pass mark. In round one, the average score of paraprofessionals in drug prescription was 60% and 75% in round two. The 15% increase can be associated with the desire to build reputation and save face in front of the farmers. As a result paraprofessionals consulted with veterinarians after receiving the outcomes in round one. In round three, the average score fell from 75 to 74. Although this may not be a significant decline, Hopper et al. (2007) describe this drop as a temporal deterioration in performance as result of lapses and over confidence. In this particular a case, it could have happened as a result of both confidence and desire to demonstrate competence. As noted above, the paraprofessionals did not want show famers that they do not have skills and competence because consulting veterinarians would increase the risk of losing clients to veterinarians. However, the poor performance (outcomes) in round three forced them to consult with the veterinarians to save face in front of the clients, resulting in an increase in the average score to 88%.

Figure 12 shows learning curves of service providers by field of training. The learning curves for service provides trained in veterinary science shows that they operate at maximum as expected. The scores of service providers with a social science background were 71, 91, 90 and 88 in round one to four respectively. The scores represent an asymptotic curve as shown in figure 12 while paraprofessionals with agricultural training had a slow but gradually increasing learning curve with scores of 74, 79, 82, and 94 in round one to four respectively. These curves suggest that social science paraprofessionals are more ready to learn than paraprofessionals with agricultural training (Stepanov et al. 2010). In other words, social sciences paraprofessionals easily consult veterinarians but attain optimum level lower that of veterinarians. The paraprofessionals with agricultural background on the other hand have a potential but this depend on how farmers update their beliefs about paraprofessionals. As present in upcoming sub-section, farmers changed services providers but were not updating their beliefs about paraprofessionals. The learning curves of paraprofessionals with no formal education took the shape of a sigmoid curve. In round one the score was 24%, 45% in round two and 33% and 77% in round four. The poor performance in round one to three can be explained in terms inability to consult with veterinarians and improved performance in round four can be explained by loss of farmers and need for reputation building. The learning curves in figure 13 show that the quality of clinical veterinary services pastoral system is lower than that of the intensive system. The learning curve of intensive system is gradually increasing curve while that of the pastoral system takes the sigmoidal shape.

The asymptotic curve of paraprofessionals with social science background implies that they consult with veterinarians and thus they acquire skills more rapidly (Hopper et al. 2007) than agricultural and informally trained paraprofessionals. However, the gradual learning curve suggests that paraprofessionals with agricultural training gradually consult with veterinarians for fear of losing their clients to veterinarians. During interaction with paraprofessionals after the game, they noted that they are sceptical to consult with

veterinarians because they use their weakness to tarnish their reputation and image before their clients. The sigmoidal curve of pastoral system suggests that interaction between paraprofessionals and veterinarians can lead to improved service delivery but there is need for continuous training especially for service providers with no formal training. The gradual curve of intensive livestock system indicates that interaction between paraprofessionals and veterinarians can gradually lead to increased service quality as long as farmers are able to update their beliefs about service providers. The use of the animal health cards is one way to assess the quality services provided by service providers. Most farmers in the game expressed their excitement with the use of the animal health cards as tool to make service providers accountable. They noted that "this card can do a lot in saving animals because the records are kept and service providers can be held accountable for their services". Paraprofessionals on the other hand raised fears of losing the market and the possibility of being sued if the animal dies.

Fig. 11 Learning curves by type of the service provider

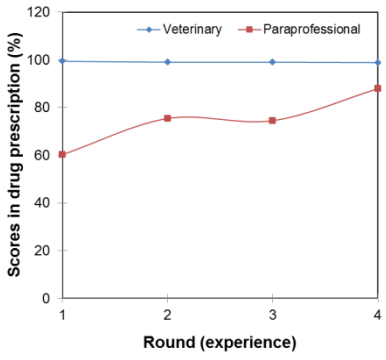


Fig. 12 Learning curves by field of training of service providers

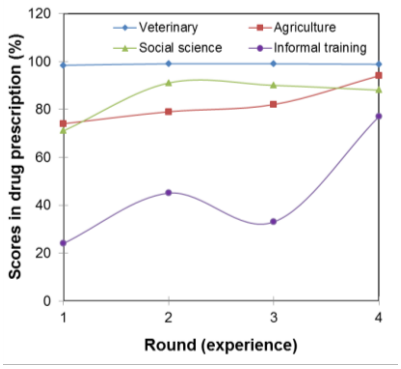
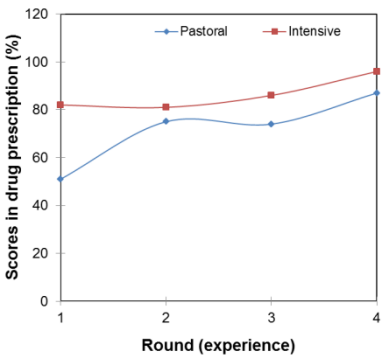


Fig. 13 Learning curves by livestock production system



Demand for clinical services

To measure the effect of information on demand, demand for services of the veterinary and paraprofessionals was measured in each round and farmer's belief updating curves were constructed to assess whether farmers update their beliefs about different types of service providers. Figure 7 and 8 presents the farmer's belief updating curves for veterinarians and paraprofessionals services in the intensive and pastoral system respectively. The curve shows that in the intensive system, farmers do not easily update their beliefs about paraprofessionals. The belief updating curves were perfectly inelastic even with experience in interaction up to round three. In round four, the demand for veterinary paraprofessional services declined while that of veterinarians increased. In the pastoral systems, the demand for veterinarian's services gradually increased and that of paraprofessionals gradually decreased. This suggests that livestock farmers in pastoral areas update their beliefs about their service providers much faster than farmers in the intensive system ($p<0.001$). This could be attributed to the fact that scores of veterinarians and paraprofessionals are significantly different in the pastoral system ($p<0.05$) but not in the intensive system ($p<0.05$).

Figure 9 shows results the farmer's belief updating curves for service providers by field of training. Service providers with agricultural training were found only in the intensive livestock system while those with no formal training and with social science training were found in the pastoral livestock production system. The farmer's belief updating curves for social science and agriculturally trained service providers were inelastic between round one and three and the decline was recorded in round four. Their scores were not significantly different at $p<0.05$ but significantly different at $p<0.1$. The farmer's belief updating curve for veterinary trained service providers gradually increased while that of non-trained service providers gradually declined. The gradual increase in demand of service from service providers who are trained in veterinary science can be associated with gradual decline in demand from informally trained service providers. However, decline in demand for social science and agricultural trained service providers can associate to increase demand for services of veterinary trained service providers since the demand for informal trained service providers remained constant up to round three.

A panel logit random effects model was estimated to determine the factors that influence the likelihood for a farmer to changing to another service provider. The results are reported in table1 below. They show that there is a significant evidence to indicate that the previous pay-off of farmers which is determined by outcome and fee charged by paraprofessional, as well as production system and gender of the farmer influence the farmer's decision to change to another service provider (see results in Model 1). Lower welfare gains from the transaction and being female reduces the likelihood of changing the service providers. However, farmers in the intensive production system are more likely to change the service providers but most of the change was from paraprofessional to paraprofessional at least up to round four. In Model 2 we dropped the variable for livestock production systems and included education. The results show that an educated farmer is more likely to change service providers than an uneducated farmer. In Model 3 the variable for farmers payoff is replaced with the outcome of the previous transaction which dummy variable with one being bad outcome and zero otherwise. Results revealed that the outcome of the previous transaction influences the farmer's decision to change services providers, while the level of the fees charged by service providers does not. The likelihood that farmers change service provider were predicted or estimated using Stata post estimation commands and the results showed that farmers are more likely to change to veterinarians than to the paraprofessionals, as shown in figure 10.

Fig. 7 Farmers Belief Updating Curves about Service Provider in the Intensive Production System

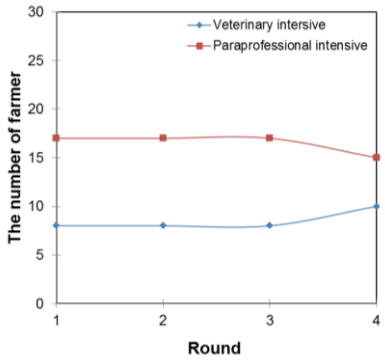


Fig. 8 Farmers Belief Updating Curves about Service Provider in the Pastoral Production System

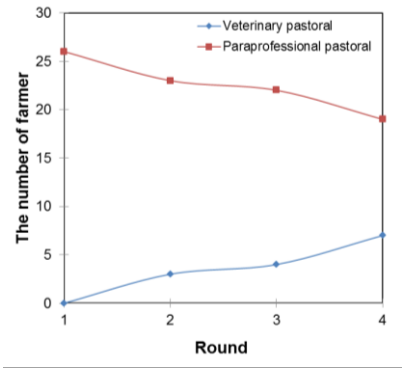


Fig. 9 Farmers Belief Updating Curves about Service Provider of Different Fields of Training

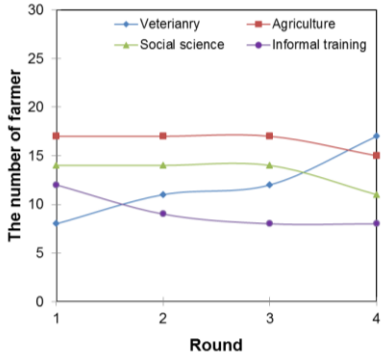


Fig. 10 The service providers that farmers were likely to change too

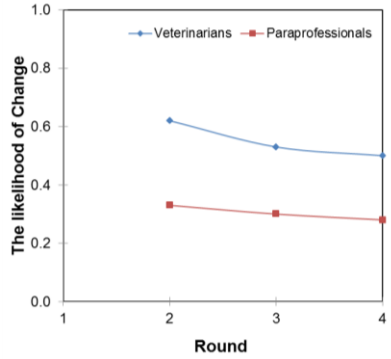


Table 1: Random effects panel Logit model results for farmer's decision to change service providers

Variable	Model 1	Model 2	Model 3
Female farmers	-0.891*	-0.401	-.838*
Farmers pay-off from previous transaction (consumer surplus)	-1.489***	-0.784*	
Fees charged in previous transaction	-0.217	-0.015	0.253
Intensive livestock production systems	2.249***		1.597***
Farmers with education		0.949*	
Previous outcomes			1.122**
N	142	142	139
Wald chi2(4)	22.61***	10.8*	18.93***
Standardized beta coefficients * p<0.05, ** p<0.01, *** p<0.001			

Discussion and implications for clinical veterinary service delivery

The objective of this study was to examine whether and how information about performance influences farmers' beliefs about service providers and the quality of clinical services. The results show that the quality of services as measured in role play game that are offered by veterinarians is not significantly different from services offered by paraprofessionals trained in veterinary science. However, the quality of services provided by paraprofessionals who are not trained in veterinary science is significantly lower than those provided by service providers trained in veterinary science. This indicates that on-the-job training does not substitute formal education in veterinary science. Within the classification of non-veterinary science training, paraprofessionals with no formal education or training provide a significantly poorer quality services than paraprofessionals with agricultural or social science training. Even with continued paraprofessional and veterinarian interaction, the quality of veterinary services offered by non-trained veterinarians failed to reach 80% accuracy for drug prescription. Disease diagnosis and drug prescription was particularly a problem in for paraprofessionals who were not trained in veterinary science when handling cases of Anaplasmoisis.

This results contradict findings by Peeling & S. Holden (2004), Oakeley et al. (2001) and Admassu et al. (2005) which show that paraprofessional were providing quality services. For example, Oakeley et al. (2001) used a random survey of veterinary service providers including included Community Animal Health Workers (CAHWs), the on job trained service providers to examine the level of drug diagnoses among different service providers. Their results shown that, 85% of the diagnoses made by CAHWs were accurate and appropriate. Curran & MacLehose (2002) attributes these to poor research design and they argued that such conclusion that state paraprofessionals provide quality services need to be confirmed by well-designed studies. The other reasons could be that these studies may have been conduct during or at end of the project implementation thus, the results may not be a true reflection of reality on the ground since most of CAHWs systems have fail to perform at end of the projects (Riviere-Cinnamond & Eregae 2003). In addition, most the studies that assess quality of clinical veterinary services do not considered information externalities and behaviour of farmers and service providers in making animal health management decisions in real life. Chilonda & Van Huylenbroeck (2001) argues that the study of the behaviour and decision-making processes of farmers, service providers and their interactions in different livestock production systems provides is important in developing policy options for the successful delivery of quality veterinary services to small-scale farmers.

In a role play game, a tool that has been tested to be accurate and consistent methods of assessment and decision forecasting (Armstrong 2001a; Dionnet et al. 2007), farmers decisions and behaviours were examined. The results show that while paraprofessional services were found to be of low quality compared with veterinarians, farmers changed their beliefs about paraprofessionals rather slowly, thus providing few incentives for paraprofessionals to provide quality services. The slow pace in which farmers were updating their beliefs about service providers could be because of strong social relations or ties with particular service providers especially in pastoral areas (Conant 1965) so they go to service

providers they know and the fact that farmers know that even if you treat the animal, sometimes it will still die so they give service provider room for improvement. In addition, most farmers in pastoral areas are used to self-treating and bad outcomes could not easily affect or influence their beliefs about a service provider thus providing insufficient incentives for paraprofessionals to provide quality services. However, the interaction between veterinarians and paraprofessionals in long the run could result in improved quality of clinical veterinary services as long as farmers are able to "punish" service providers who provide poor quality services by turning to better performing service providers. The fee charge of the previous transaction was found not to influence farmers believe change and this consistent with finding by Ahuja, et al. (2003) and Ahuja, McConnell, et al. (2003) who found out that rural farmers in India are willing to pay clinical animal health services. Infact Leonard (2000) argues that the issues is not that farmers are poor and unable to afford veterinary services but rather that farmers have failed to distinguish qualifications of different services providers and the quality of services they offer.

The use of animal health cards or animal medical cards has a strong potential as a tool to enable farmers to distinguish and measure quality of clinical veterinary services. The tool is useful in providing proper record keeping and monitoring of antimicrobial agents use in animals. Farmers can use exercise books and service provides could be asked to write their diagnosis and prescription in these books. France's national society of veterinary technical groups (SNGTV), the technical veterinary organization responsible for developing and promoting the expertise of private veterinarians involved in France's livestock production have developed a software for registering the prescriptions of veterinarians to monitor prescription and use of antimicrobial agents (Brard 2013). The software is called VETELEVAGE and it acts as animal medical card or register shared by both a service provider and a farmer. A service provider records intervention and prescription and a farmer records intervention and management practices performed daily[3]. This software application performs better than the use of an exercise book because records are kept on line and can easily be accessed by a farmer and a service provider. However, this only possible in developed countries where farmers have computers and the network connections. The exercise books could work in developing countries and can easily be adapted by farmers because they often use medical card when they visit hospitals and medical clinics. Finally, the limited number of participants involved in the game makes the results not to be representative but since real farmers and service providers participated in the game, the results can be considered to be valid and representative.

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[3] http://www.oie.int/eng/A_AMR2013/Presentations/S4_3_ChristopherBrard.pdf

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