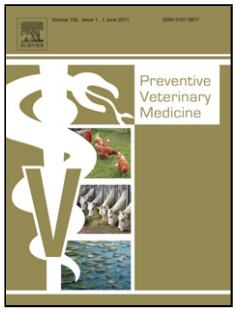

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Participatory appraisal of the impact of Epizootic Lympangitis in Ethiopia

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Abstract

Epizootic Lymphangitis (EZL) is reported to have a significant impact upon livelihoods within resource-poor settings. This study used a participatory approach to explore peoples' experiences of EZL and examine the perceived impact of disease, owner knowledge and understanding of EZL, lay management of disease and, attitudes and strategies towards disease prevention.

Focus-group discussions were held with 358 cart-horse owners and drivers recruited from 7 towns attended by SPANA (Society for the protection of animals abroad) mobile veterinary clinics and 2 unexposed towns where no SPANA clinics were available. Focus group discussions explored four main research questions: 1) Is EZL recognised by animal owners, and is this considered an important disease in equids? 2) What factors do animal owners associate with the development of disease? 3) What happens to an animal with clinical disease and how does this impact upon the owner/community? 4) Are measures taken to reduce disease occurrence? These key areas were

explored using photographs, disease ranking, matrices and open discussion. Data were analysed using descriptive statistics and thematic analysis.

The results are presented thematically and include; recognition and descriptions of EZL, treatment strategies used, disease priorities and ranking, impact of disease, disease transmission and attitudes and approaches to disease prevention.

EZL was widely recognised and ranked highly as an important disease of equids. However, there was uncertainty around identifying early cases of EZL, and this could impact upon the timing of initiating treatment and separating potentially infectious animals. People had varying knowledge of effective methods for disease prevention and reported particular difficulties with isolating infected animals.

The impact of EZL was multi-dimensional and encompassed effects upon the horse, the individual owner and the wider society. Working equids provide a vital utility and source of income to many people in resource-poor settings. Often, infection with EZL resulted in a reduction in working ability which had a direct impact upon the livelihoods of owners and their dependent family members. EZL also impacted upon the welfare of the horse as sick animals continued to be worked and, in advanced cases, horses were abandoned due to ineffective or unavailable treatment.

This study conceptualises the importance of EZL due to the effects of the disease on the horse and its impact upon human livelihoods. Epizootic Lymphangitis is a neglected disease that requires further investigation in order to develop practical and sustainable disease control strategies within endemic regions.

Keywords

Epizootic Lymphangitis, working equids, participatory research, qualitative analysis, disease prevention, resource-poor settings.

Highlights

- Epizootic Lymphangitis (EZL), a neglected equine disease, impacts human livelihoods.
- Conducted a participatory study of horse owners' experiences of EZL in Ethiopia.
- Identified uncertainty around early recognition and control of EZL.
- Practical and sustainable disease control strategies required in endemic regions.

Participatory appraisal of the impact of Epizootic lymphangitis in Ethiopia

1. Introduction

Epizootic lymphangitis (EZL) is often considered an historic equine disease, following slaughter and eradication programmes in a number of European countries (Pallin, 1904, Refai and Loot, 1970). Previous reports located the disease within European, African and Asian countries including: Iraq (Al-Ani et al., 1998); Egypt (Refai and Loot, 1970, Gabal et al., 1983, Selim et al., 1985); Sudan (Bennett, 1931, Awad, 1960, Hamid and Yousif 2001); Central African Republic (Herve et al., 1994); Nigeria (Addo, 1980); Italy (Plunkett 1949); Russia (Noskoav 1960); UK and Ireland (Pallin, 1904); Japan (Tokishiga, 1896); China (Zhang et al., 1986) andIndia (Singh, 1965). Little is known of the current spatial distribution of disease as surveillance and reporting is limited. OIE disease distribution maps suggest that EZL is restricted to Ethiopia, Senegal and South Africa (OIE WAHID maps, 2005); however, current clinical cases are also evident in Chad and the Gambia (personal communication and authors' own experiences). Therefore, EZL continues to be a major problem in socio-economically deprived areas of Africa, such as Ethiopia, where the disease has been reported to affect around one in four equids in some regions (Ameni and Siyoum, 2002, Ameni and Terefe, 2004, Asfaw et al., 2012).

Epizootic lymphangitis is caused by the dimorphic fungal pathogen *Histoplasma capsulatum var. farciminosum* (HCF) and is characterised by multi-focal pyo-granulomatous sub-cutaneous nodules that disseminate via the lymphatic system. The clinical presentation varies and has been described as occurring in four forms; ocular, cutaneous, respiratory, and asymptomatic carriers (Al-Ani, 1999). Mixed clinical presentations can occur and may reflect different stages of disease progression. Chronic disease results in progressive lameness and severe debilitation which may be a result of multi-systemic involvement (Singh et al., 1965). The respiratory form is characterised by pyo-granulomatous lesions within the nasal mucosa that can extend throughout the respiratory tract to the lung parenchyma (Singh et al., 1965, Fawi, 1971, Al-Ani, 1999). Few studies have examined the

equine immune response to *Histoplasma* and the extent and duration of immunity to natural infection, the presence of asymptomatic carriers and response to experimental vaccination are yet to be fully ascertained (Noskoav, 1960, Gabal and Khalifa, 1983, Solimen et al., 1984, Gabal and Mohammed, 1985, Solimen et al., 1985, Zhang et al., 1986, Ameni et al., 2006).

Little evidence is available to describe risk factors for EZL, such as factors favouring persistence of the organism within the environment (Gabal and Hennager 1982), the routes of transmission (Singh, 1965a and 1966) and potential vectors (Singh, 1965a). Previous cross-sectional studies have reported an association with altitude and average annual temperature (Ameni, 2006) and both ticks and flies have been implicated as mechanical vectors (e.g. *Musca* and *Stomxys* species, Singh, 1965a, *Amblyoma* and *Boophilus* ticks, Ameni and Terefe, 2004) although evidence for this is weak. While these studies provide a valuable basis for understanding the biology of HCF, there remain many unanswered questions of the disease ecology, epidemiology and pathogenesis. Recommendations for control are largely based upon slaughter of infected animals (OIE http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.05.04_EPIZ_LYMPHANGITIS.pdf). However, most currently known endemic regions are resource-poor and mass slaughter is not a practicable option mainly due to the reliance upon equids to support livelihoods, lack of funds to compensate owners and little infrastructure to implement such campaigns. Therefore, research is needed to examine the drivers promoting maintenance of endemicity within these regions and to develop infection control strategies.

Epizootic lymphangitis is reported to have a significant impact upon livelihoods within resource poor settings (Jones, 2006, Aklilu and Zerfu, 2010). In a study investigating the economics of the cart-horse industry in Ethiopia, Aklilu and Zerfu, (2010) reported that losses to the owner due to morbidity of a horse with EZL resulted in more than a 50% reduction in daily earnings. In Ethiopia, where EZL is endemic and human-animal interdependency is integral to livelihoods (Admassu and

Shiferaw, 2011), consultation with horse owners could provide insights into the way the disease is managed.

This study used a mixed methods approach incorporating participatory research and qualitative inquiry. This combination of methods was adopted as they are a readily adaptable and inclusive methodology to gauge the knowledge, opinions and experiences of large groups of people whilst alleviating the need for questionnaire based studies and thereby do not exclude those with low-levels of literacy or numeracy. The study aimed to describe experiences of EZL among horse owners in Ethiopia and examine the impact, owner knowledge and understanding of EZL, lay management of disease and attitudes towards and strategies for disease prevention.

2. Materials and Methods

2.1 Focus group discussions

Focus groups were conducted to address four main research questions: 1) to what extent Is EZL recognised by animal owners and do people consider it to be an important disease in their equids? This was explored quantitatively with a participatory ranking exercise and qualitatively through discussions. 2) What factors do animal owner's associate with the development of EZL? This included a qualitative inquiry of the owner's recognition of clinical signs and disease progression. 3) What happens to an animal with clinical disease and how does this impact upon the owner/community? The effect of the disease on the working ability of the animal was assessed semi-quantitatively using pair-wise matrices alongside group discussion 4) Are measures taken to attempt to reduce disease occurrence? This included an exploration of knowledge and attitudes towards disease prevention.

The focus group discussions were with cart-horse owners and drivers recruited from those attending SPANA (https://spana.org/) mobile veterinary clinics. (SPANA is a UK based charitable non-governmental organisation (NGO) working in low-income countries around the world providing free

130 veterinary treatment, community development and training). Participants were selected from 7
131 SPANA clinic sites and 2 towns with no previous access to SPANA clinics (classed as unexposed
132 towns, see figure 1). All towns were purposefully selected based upon logistical accessibility and
133 were situated within the North, East and West Shewa and Arsi regions of Ethiopia. The nine towns
134 varied topographically and included highland, mid-highland and lowland regions. The discussions
135 were conducted in Amharic or Afan Oromo (dependent upon the preferences of the participants)
136 and facilitated by the first author and an Ethiopian animal health professional (either AZ or KM) who
137 acted as co-facilitator and translator. All facilitators were trained in the participatory exercises used
138 and were careful not to introduce ideas to the group by only using open and non-leading questions
139 to facilitate discussion.

140 Due to the broad aims of the study, four separate formats were used for the focus group discussions
141 (A,B,C and D, Table 1), designed to explore the four main research questions. All four focus group
142 formats were used at each of the nine study sites. The focus group formats were rotated within
143 each visit in order that people waiting to receive treatments would not discuss the content with the
144 previous group. At the end of the focus group sessions, participants were given an educational talk
145 about EZL that described methods for reducing the spread of infection (an example leaflet is
146 available, supplementary material item 1).

147 Data collection was carried out over five weeks between July and August 2007. Participants were
148 eligible for inclusion if they were either taxi-cart drivers renting the horses or horse owners. All
149 participants were invited to take part in the research and were briefed of the research objectives
150 and researchers affiliations. Voluntary verbal informed consent was sought from all participants, and
151 their decision to take part in discussions (or otherwise) did not affect the availability of free
152 treatment from the SPANA clinic which was available for any animal attending the clinic. Discussions
153 were semi-structured and used a variety of participatory methodologies such as disease ranking,
154 pair-wise matrices and photographs (Catley et al., 2012, Mariner and Roeder 2003). In focus group

format A, EZL was not introduced by the researchers and began with a general exercise to identify and rank diseases of horses. Disease ranking and pair-wise matrices were completed on flip-charts. Photographs showing horses with varying presentations of cutaneous EZL were used to stimulate discussion within focus group formats B, C and D (figure 2). Hand written notes and observations were made and discussions were recorded using a handheld digital Dictaphone.

2.2 Descriptive statistical analysis

Data from the disease rankings and pair-wise matrices were entered into Microsoft Excel software and descriptive statistics were generated using SPSS (IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.). A list of diseases that participants had volunteered (during focus group A) and considered to be of importance to working equid health was generated including frequency tables of how many groups named each disease and, group ranking data to show the perceived importance of the disease. The average ranking for each disease was produced using two methods (by summing the rank positions and dividing by the total number of groups identifying that disease and, summing the rank positions and dividing by the total number of groups participating in the exercise) along with a combined rank score. The latter was calculated by re-assigning the ranks with a score. For example, as seven was the highest number of diseases named by any group, the following scoring system was used to standardise between groups; the disease ranked 1st (i.e. most important) by a group was given a score of 7, the 2nd most important disease a score of 6 and so on. Subsequently, the total scores for each disease named by each group were added together to give a combined rank score. Disease ranking data were compared by topographical region and lists were generated demonstrating the ranking of diseases within highland, mid-highland and lowland groups.

2.3 Qualitative data analysis

Notes made during the focus groups were transcribed into Microsoft Word documents and analysed using thematic analysis (Braun and Clarke 2006). Themes were developed from the data using an

inductive approach to coding. This approach starts with the narrative textual data and codes data (or creates themes / categories) to condense raw textual data into a brief summary format (Thomas, 2006). The codes are data driven and the researcher does not use any pre-conceived hypotheses or framework within which to code the data (Braun and Clarke 2006). Codes that are generated are continuously compared with other portions of the data and as more data are analysed, the relationship between the codes may be further defined. In this way, codes may be organised to develop summaries that condense and describe the processes involved in the participants' experiences (as has been produced here within the figures presented) but are always based in the original data. NVivo 9 (QSR International) software was used to handle Microsoft Word files of the textual data and compare and contrast themes developed during the manual coding process. Thematic summaries including hierarchical codes and links between them were illustrated diagrammatically. Thematic saturation occurred when no further hierarchical themes emerged within the discussions (Green and Thorogood 2009). This was apparent during the focus group discussions where, as more focus groups were conducted, similar topics recurred. The research team continued to recruit participants for each of the focus group discussion formats until no new ideas were being generated within subsequent focus group discussions.

2.4 Ethics

This study was conducted in accordance with the research ethics requirements of the University of Liverpool at the time the study was conducted. Due to the nature of the study and the low risk posed to participants, formal approval from the Ethics Committee was not a requirement at the time of the study. This study was approved by SPANA UK and by staff members at the college of veterinary medicine and agriculture, Debre Zeit, Addis Ababa University. Horse owners/drivers were invited to take part in the study and informed of the reasons that the study was being performed and that their participation was entirely voluntary and they would be in no way disadvantaged if they did not wish to participate. Voluntary informed consent was taken verbally. All data were

anonymised and owners' contributions were kept confidential. At the end of the focus group discussions all groups were debriefed about the discussion and any questions were answered. Before ending the discussions, animal health advice and educational material were provided by SPANA team members to all participating owners.

3. Results

3.1 Participants

In total, 71 focus groups were conducted involving 358 participants. Among these, 22 groups participated in focus group format A, 19 groups in format B and 15 groups each for formats C and D. Each group comprised between 3 and 10 participants (median 5), the majority of participants were men (only 2 were women) and all were >18 years of age. Participants included; 205 (57.3%) cart-horse owners, 48 (13.4%) taxi-cart drivers who rented the horses, 27 (7.5%) who were both taxi-cart drivers and the owner of the horse, and 37 (10.3%) who owned either donkeys or saddle-horses (n= 41 missing data on role of the participant). The respondents had a range of experience of working with equids (median 4 years, range 0.25 – 40 years, lower and upper quartiles, 2 and 7 years among 308 participants).

3.2 Recognition and description of disease

Epizootic lymphangitis was referred to as 'Nidift' (Amharic) or 'Bitchée' (Afan Oromo) and was widely recognised with different forms of disease described based on peoples' views of severity of the infection and how the lesions were distributed on the body. Some horse owners likened EZL to 'Horse Aids' or 'Leprosy', based upon the effect on the horse and the visual appearance of the skin nodules.

> *"They [the horse] become like a leprosy patient. When [we] take horses infected with EZL to [non SPANA clinic] vet department they say there is no medicine."*

The disease was characterised by the appearance of skin 'wounds' with 'swellings' and discharge'. EZL skin 'wounds' occurred on different regions of the body, and went through cycles of developing, rupturing and expelling discharge before leaving an 'ulcer' giving the appearance of a 'skin wound'. Discharging swellings often emitted a "pungent smell". Disease progression was variable and could develop over weeks or months.

Different forms were identified by participants and characterized by the distribution of the 'skin wounds' and the speed by which they spread.

> *"There are 2 types of Nidift in this area, [in one] distribution is rapid and fast [and the other] distribution around the body is very slow and starts as small nodules in body and follows vessels and distributes over the whole body area."*

Participants also distinguished different forms based upon the patterns of the lesions on the animal. For example, some participants reported a 'straight line' pattern (e.g. with lesions spreading up the limbs). This was attributed to infection spreading along the 'vessels' (referring to blood or lymph vessels, a few participants described these as 'white vessels'). It was sometimes considered that this form of the disease was more treatable (or 'reversible') than the other observed presentation of disease, where lesions were distributed randomly around the body. As well as being more difficult (or sometimes impossible) to treat, this generalised form was considered more likely to be fatal.

There were conflicting reports of when the disease occurred with some participants suggesting they saw infections during the rainy seasons whereas others thought it more common during the dry season. For some, it was not possible to define a seasonal element as they saw disease throughout the year.

Among those groups asked to interpret images of clinical cases (focus group formats B, C and D), people generally expressed doubts about whether picture 'A' depicted EZL (figure 2). Other possible

explanations included; a tumour(e.g. sarcoid), tissue growth, wound or proudflesh. Some considered this photo to illustrate an advanced, irreversible stage of EZL, due to the presence of a large ulcer and beliefs that the blood vessels were damaged. In contrast, other participants thought this image illustrated a mild form, with the potential to resolve if the owner provided good management.

Picture 'B' was commonly identified as EZL and represented the straight line pattern that followed the vessels. This was considered not as severe as cases 'C' and 'D' although not illustrative of the earliest stage. It was observed that some signs of healing were present and that the animal could work at this stage.

Picture 'C' was commonly identified as EZL, although a couple of participants queried whether this horse also had an infection known as 'Chitto' described as a pruritic, parasitic skin condition. This picture was interpreted as a severe form of the disease where the lesions were scattered throughout the body and it was believed that this form was irreversible, highly transmissible and consequently animals were commonly abandoned. Some participants commented that the presence of whip sores and sores around the mouth would make it difficult for the animal to eat.

Picture 'D' was also identified as EZL (with a few participants suggesting the horse was additionally suffering from Chitto). This was considered to be the most severely infected animal being "at the fringe of death". This stage was believed to be untreatable and the only option would be to abandon the horse (as one participant expressed,"even the Hyenas do not want to eat this animal"). Some people also believed that this horse was a danger to the owner's and other horses health, so people would not approach the animal.

3.3 Disease priorities and ranking

Epizootic lymphangitis was the most frequently identified disease of horses (among 17 out of 22 groups participating in focus group format A). Other diseases that were commonly identified were

foot abscesses / hoof problems (11 groups), a syndrome described as “cold stiffness” or ‘Bird’ (10 groups), colic (7 groups), respiratory disease (6 groups), African Horse sickness ‘chaffa’ or ‘tutti’ (5 groups), difficulty urinating (4 groups), bloat (3 groups), stomatitis (3 groups) and others. Epizootic lymphangitis was also ranked highly (Table 2) when considering both the average rank position and also the combined rank scores among all diseases. There was a notable difference in disease rankings by region. Groups in the highland areas (>2,100 msl) did not name EZL; in these areas respiratory problems and internal parasites were considered important (Table 3).

3.4 Disease transmission / initiation

The schematic in figure 3 summarises the hierarchical and key themes arising from discussion around the key question ‘do you have opinions on how an animal becomes infected with EZL?’ (focus group format B). Participants listed a range of possible sources of infection that could be grouped as either ‘direct’ or ‘indirect’ sources.

”If one horse at home is infected the other horse has a high probability – but [I] do not know mode of transmission.”

”Abandoned horses – when abandoned horses touch our horses – for example with their mouths it becomes distributed.”

Environmental factors were also identified as having a possible role and flies were often implicated in the spread of infection.

”If there is one horse affected by EZL and lots of flies in the area, flies go to infected lesions and take discharge to healthy horse and in this way they get infection.”

”There is a specific season for occurrence of Nidift in the area. In this season there is a high

fly population in the area…end of September biting flies bite their horses and they get infection."

There were various beliefs about how the infection developed, with some believing the disease developed spontaneously from 'within the horse' and others describing the disease as being transmissible. Knowledge of contributory factors was an important element underpinning these beliefs.

"It is a matter of chance we do not know which mechanism […] which is infected and which is not infected it is chance."

There were also contrasting views about which animals were susceptible to infection, with some participants believing that those in poor condition, or kept with poor hygiene (e.g. lack of owner cleaning sweat from the horse) were more likely than those in good body condition to contract the infection.

"Horses by their nature require a shower just like human beings but our economy does not allow us to give them every day. Because of this, they have certain wound and dirt on their body and create skin damage and so when we use harnessing materials by borrowing from the neighbour but the neighbour horse may have infection of Nidift so this may lead his horse in infection."

However, some people believed that horses in good body condition were at risk of infection due to the 'evil eye'.

"If the horse has very good body condition the eye power of individuals can cause infection"

Wounds were frequently described as being a significant factor contributing to the horse developing infection.

"He had a horse, the horse was poorly harnessed and had harness inflicted wounds and also

lesions around the inguinal region and the horse went over and contact infected horses and then lesions started in this wound region and therefore know EZL can transmit through contact with wounds."

3.5 Impact of disease on cart-horses and their owners

The impact of EZL reflected the inter-dependency between people and working horses in Ethiopia (figure 4). Equids were required to transport goods and people. Horses were commonly harnessed to a cart and provided a taxi-service to local people. The distance covered and the loads carried varied. Occasionally, horses were hired for use in wedding ceremonies. In the highland regions (e.g. Wenchi) horses were more frequently ridden as 'saddle horses' rather than being harnessed to a cart.

For the cart-horse owner, the income generated through providing a cart-horse service was often the sole means of supporting themselves and their family.

"I use horses to help myself and my old father and mother and my children and in second place I serve society by giving a transport service."

Therefore, the presence of disease interrupted the functionality of the working equid and reduced the quality of peoples' livelihoods.

"Since we based our life on this business, if we lose our horse / put one horse out of work our income reduces by half. Our income is expected to feed our family and our horse. So in the case of disease, this has a great effect on our income."

The income also funded basic care costs for the horse. Reduced working capacity of the horse due to disease compromised daily income and owners could struggle to buy feed for the animal leading to a secondary impact on the horse.

" Nidift is also a serious problem for our horses even if it does not cause sudden death. It reduces body weight and working ability and affects our income by feeding an inefficient horse."

"Nidift results in a horse that is totally out of work therefore, no daily earning and we require feed for this problem horse and therefore requires money in our pocket."

Additionally, loss of the animal through disease would leave the owner in a difficult financial situation.

"It is difficult to come back to the cart taxi business as may not be able to save to buy another horse. So it is important that the horse does not become infected with Nidift."

A spectrum of effects was described due to the chronic nature of disease. In the initial phases, there were reportedly minimal effects upon the horse or its ability to work, but with further development of disease, participants observed weakness, lethargy, inappetance and gradual emaciation.

The compounding problem of lameness was described as having a significant impact on the horse's capacity to work. As lameness progressed, people described how the horse was unable to pull the cart, the effect of this accumulated over a number of months (data generated from the pair-wise matrices examining the duration of impact of EZL on the ability to work are available in supplementary file 2). In response, owners reported that they worked the horse for as long as possible by reducing the distances travelled, the working hours or the loads carried. There were often mixed reactions among customers hiring the carts for taxi services. Some people chose not to ride on a cart pulled by an infected horse due to the unpleasant appearance of the animal, the pungent smell or the perception of it being inhumane to work these animals.

"Since the lesions are somewhat horrific, people do not like to sit on these horses and the owner is unwilling to use such nasty horses as lesions create a smelly discharge."

"Actually it is inhumane to use such infected horses to transport or carry goods within the village but other people are willing to use such animals for transport. Others find the pungent smell off putting and so are unwilling to use."

A significant impact on the horse resulted from abandonment in the advanced stages of the disease. Owners often felt they had no option other than to abandon the horse. Multiple reasons were cited including; the presence of extensive lesions around the body, behaviour changes in the horse making them unhandleable, the risk of disease spread from extensively infected animals, the inability of the horse to generate income due to severe debilitation and, subsequent lack of resources to care for the horse.

"Some horses become aggressive because the wound is painful and makes them unable to walk properly and finally we are forced to reject the horse because of this problem."

"Until the lesions have distributed to the whole of the body I can use the horse but once the horse is totally affected and smelly, I reject and make horse out of work."

3.6 Attitudes and approaches to disease prevention

The hierarchical themes and examples of sub-themes emerging from 15 focus group discussions about disease prevention (focus group format D) are illustrated in figure 5. The hierarchical themes are presented in a tiered fashion with participant attitudes to disease prevention as the overarching theme. It was notable that little discussion was generated about disease prevention within towns where SPANA clinics were not available.

Participants described a range of disease prevention strategies and these are represented as specific and non-specific strategies. Specific strategies were identified as those directed at preventing EZL, whereas non-specific strategies were aimed at improving general equine health. The most frequently described prevention strategy was washing the horse (especially when sweaty after work) as it was perceived that poor hygiene could lead to the development of EZL. Although flies were identified by owners as a source of EZL infection in horses (figure 3), there were mixed responses relating to measures to reduce fly nuisance. These included: laughing at the idea of attempting to prevent flies; washing the horse to remove sweat; keeping the horse inside after work; occasional

use of home-made fly repellents such as tincture iodine, engine grease or kerosene applied to the body of the horse or spread around the stable, or; only being concerned about flies if there was a wound present in which case the area around the wound had 'repellents' applied. Discussions often focused upon wound care and the prevention of wounds (figure 5). It was believed that the presence of wounds made the animal more susceptible to EZL through attracting flies.

"if healthy horse has a wound there are flies which bring discharge from affected horse and put [EZL infection] on wound of healthy horse easily in this way."

There were issues with implementation of some of the reported methods for disease prevention. These included practical difficulties with isolating infected horses as shared stabling and grazing was frequently the only option. Further, as infected animals continued to work, they would frequently come into contact with other horses at gari-cart stations and shared watering points.

"Actually try to prevent horses from infection but they are not successful – they try to wash horses daily and try to isolate the horse from infected animals but difficult to protect horses with Nidift as lots of horses with disease in the town. In station (gari-station) there are a number of horses that are working with disease and so cannot protect horse from infection".

In some regions, local authorities (e.g. the gari-cart associations) prevented the use of infected cart-horses and policed this by observing horses at gari-cart stations. However, this was acknowledged to be difficult to enforce as one of the key issues was deciding when the horse was considered to present an infection risk to others.

" at the very beginning it is difficult to differentiate for disease...and when [we (gari-cart association)] see discharge / ulcers / wounds on [the] body we immediately restrict horse from other cart-horses...but at the very beginning cannot differentiate easily."

Conflicting opinions on when a horse with EZL presented an infection risk to other animals complicated decisions to isolate or reduce contact with other animals. For example, some people believed that the horse was only infective when the nodules had erupted and that the disease did not transmit in the early stages. There were also social implications relating to separating horses infected with EZL.

> *"these infected horses are our friends' horses - he does not bring disease by his will, unexpected event on his horses, do not reject our friend when bring infected horse not humanly to tell them go away as they are friends so....unacceptable action."*

Significant barriers regarding the participants' perceptions of their ability to prevent disease were evident. These included; a lack of knowledge of effective strategies and, fatalistic attitudes to prevention, as it was sometimes perceived to be out of the owners control and occurred purely by chance.

> *"even if we do such things for horses we cannot totally protect our horses from EZL we have no information, where horses get EZL under these circumstances even if we give good care and management can also get EZL infection."*

Motivational factors that increased willingness to attempt to prevent disease were perceptions of the disease as an important issue and a desire for it not to occur in their animals. However, it was noted that any disease prevention strategy should be cost effective and easy to implement.

3.7 Treatment strategies used by owners

Alongside discussion of approaches to disease prevention, participants described how they currently attempted to treat disease in their equids. Aside from the potassium iodide treatment that was (and still is) freely available from the SPANA clinics, no treatment was readily available for EZL as many governmental veterinary clinics did not have the resources to provide suitable treatment. A number

444 of alternative treatment strategies were attempted by participants (Table 4) with varying success
445 dependent on the stage of the disease, and many of the traditional treatments were reported as
446 ineffective.

447

448 ## 4. Discussion

449 This study illustrates the important role EZL has within horse owners' lives in Ethiopia. In addition to
450 the important socio-economic impacts of EZL, this disease has far-reaching welfare implications,
451 attributable to difficulties in treating cases and the abandonment of horses. The findings highlight
452 the breadth and variety of knowledge of EZL among cart-horse owners and drivers. The information
453 presented here could contribute to the design of educational interventions to support owners in the
454 care of their horses and inform the design of epidemiological studies aimed at developing evidence-
455 based disease prevention strategies.

456 The majority of study participants accessed SPANA veterinary clinics and therefore the results may
457 not be directly applicable to other areas. The study attempted to address this by conducting focus
458 groups in 2 towns that SPANA clinics had not previously accessed and a further 2 towns where
459 SPANA clinics were a new venture at the time of the study (Shashamene and Hawassa). It was
460 apparent that there were some differences in the knowledge and perceptions of the participants in
461 the non-SPANA regions compared to the SPANA regions highlighted by themes arising from
462 discussions (figures 3 and 5). The methods presented here are useful tools for examining differences
463 in owner experience, knowledge and practices at a community level and have the potential to
464 inform extension programme development and assessment. There was also a gender bias as the
465 majority of people attending the clinics were men. Including the female perspective would be an
466 important area in which to extend this research as women's involvement with horses may include
467 different aspects of husbandry and women may have different approaches to decision making
468 around the care of the horse (Voices from women international report, Valette, 2014).

469 The participatory approach allowed the sociological context of this disease to be described. Within
470 veterinary research, the use of participatory research methodology is gathering momentum and is
471 generally accepted as useful for studying the social context of disease (Mariner and Roeder, 2003,
472 Catley et al.,2012) and has been adopted to study other equine health and disease issues (Okell et
473 al., 2013, Upjohn et al., 2014). Medical sciences have embraced health sociology as its potential is
474 recognised for the valuable insights into the lay constructs of disease (i.e. how an individual
475 understands and lives with illness). In their examination of how people understand illness, Conrad &
476 Barker (2010), identified three main premises; "some illnesses are embedded in cultural meaning; all
477 illnesses are socially constructed at the experiential level and; medical knowledge is not 'given' by
478 nature but is constructed and developed by individuals". The current findings illustrate how lay
479 understanding and societal perceptions of EZL, create a construct of EZL that impacts on how the
480 disease is managed and which preventive strategies may be adopted. For example, individuals'
481 knowledge and beliefs affected perceptions of when a horse could be infective and on a community
482 level, there was a general stigmatisation of horses with advanced disease where EZL was likened to
483 horse 'leprosy' and horses were avoided due to their pungent smell. However, these constructs were
484 complex as, although among some quarters EZL was stigmatised, others thought it poor social
485 etiquette to separate horses particularly if their owners were friends. Whilst demonstrating the
486 diversity of beliefs and knowledge, this information has the potential to support the development of
487 practical and contextually relevant educational programmes.
488

489 Epizootic lymphangitis was widely recognised by horse owners and identification was prompted by
490 several contributing factors including the distribution and appearance of lesions on the horse.
491 Perhaps most significant, in terms of educational initiatives, was the confusion of identifying early
492 cases of EZL, apparent from peoples' interpretations of the photographs and descriptions of the
493 development of the disease. Furthermore, there were differing perceptions among owners of when
494 a horse posed an infection threat to others. Early recognition and treatment seeking is key to

improving treatment outcomes and should be supported by confirmatory diagnostics given the potential for differential diagnoses (e.g. ulcerative lymphangitis, glanders, sporotrichosis etc.). Previous work conducted at the University of Addis Ababa, College of veterinary medicine and agriculture, Debre Zeit (Getachew, 2004 unpublished thesis) showed that intralesional treatment with tincture of iodine combined with oral dosing with potassium iodide was more successful when initiated in the early stages of disease and SPANA's ongoing educational initiatives have been targeted at alerting owners to monitor horses for signs of early disease and to seek appropriate treatment (See supplementary material). Implementation of preventive health strategies (such as cleaning harnesses, reducing traumatic wounds and reducing contact with infected animals etc.) may be key to reducing the spread of infection and more research is needed to inform these strategies.

Epizootic lymphangitis often ranked highly among mid-highland and lowland groups. This is in agreement with another study conducted within these regions (Stringer *et al.*, 2009). From discussions with cart-horse owners who identified EZL, the reason for this was due to the major impact on the working ability of the animal, the difficulty of treating the infection and ultimately, the loss of use of the horse. These concerns took priority over other conditions that may have been more frequently observed (for example, if measured with observational studies). This highlights the additional benefit of participatory techniques that allow the owner's viewpoint to be captured, and provide an additional angle to the understanding of the role of equine disease in peoples' lives. In the case of EZL, the impact on owner livelihood and ability to work contributed to the reason why owners' prioritised this disease. In contrast, Epizootic lymphangitis was not ranked as important within highland groups and this is consistent with previous cross-sectional studies reporting low to zero prevalence of EZL at higher altitudes (Ameni, 2006). Although the present study cannot reflect prevalence estimates for disease, perceptions of disease priorities from owners may provide a basis upon which to initiate further epidemiological investigation.

There were a wide variety of opinions on how the disease is initiated, some of which have been identified in previous epidemiological studies. For example, previous studies have reported a seasonal/climatic element (Endebu and Roger, 2003, Ameni, 2006) and implicated flies and ticks (Singh, 1965a, Ameni and Terefe, 2004) and these were both reported in the focus groups. However, there were a number of theories and conflicting opinions about how disease transmission occurs, further highlighting the need for research. This broad information suggests hypotheses that may be tested in population-based epidemiological studies to further quantify risk factors for the disease.

Respondents described a range of alternative 'treatment' strategies. The use of traditional or home-based therapies is widespread in Ethiopia and other parts of the world (Anon 2002, Swaleh, A. 1999, Gabanakgosi et al., 2012, Gebreyesus et al., 2014). Reasons for this may include; tradition, availability, cost, accessibility and beliefs in efficacy (Birhan et al., 2011, Scantlebury et al., 2013, Gebreyesus et al., 2014). Trends in the uptake of traditional medicines appear to be changing (Bussman et al., 2011) and it is evident that their use is "contextualised amidst factors such as social convention, economic constraints, perceptions of efficacy, or lack of access to appropriate advice" (Upjohn et al., 2014). Despite sparse scientific evidence supporting the use of some traditional therapies, these are often commonly accepted by horse owners. Without criticising such beliefs, there is concern that some of the treatments described here may have poor welfare implications for horses (e.g. topical application of battery acid and reports of cutting, ligating or firing lesions in the absence of anaesthesia). Although surgical excision of the lesions has been suggested to be successful (Plunkett, 1949), in situations where no veterinary personnel are available to perform such procedures and to provide appropriate analgesia and post-operative care, the welfare of the horse is undoubtedly compromised. Howeverthe use of these treatment strategies reflects peoples' concerns and attempts to eliminate EZL in order to offset the subsequent impact on both the horse and human livelihoods.

The discussions revealed that the impact of disease was multi-dimensional and included effects upon the horse, the individual owner and the wider society. Working equidae provide a vital utility and source of income to many people in resource-poor settings (Pritchard, 2010) and the reduced working ability resulting from infection with EZL had direct impacts upon the livelihoods of the owner and their dependent family members (including dependent younger and older generations). There were also welfare implications for the horse as people continued to work sick animals and the subsequent reduction of income made feeding and making adequate provisions for sick animals difficult. The ultimate outcome for advanced cases was the abandonment of the horse; this was fuelled by unwillingness within the community to hire these cart-horses, a lack of effective treatment, and a reduced ability to work leading owners to conclude they had no other option. Loss of the horse perpetuated the cycle of poverty as owners found it difficult to generate income to replace the horse to continue in the cart-horse business. Therefore, in order to tackle the burden of EZL within resource-poor communities, there remains the major challenge of addressing the structural causes of poverty that result in situations where people have little capacity or provisions available to improve equine health and welfare.

There was limited dialogue about disease prevention particularly among participants from towns not exposed to SPANA's education programme. As there were a variety of beliefs about the initiation of disease, preconceptions of disease risk and attitudes to disease prevention could have an important effect on how people receive preventive healthcare advice (Calnan and Johnson 1985, Davison et al., 1991, Frankel et al., 1991, Conrad and Barker 2010). For example, in the advanced stages of disease, people were less likely to hire the cart-horses due to their appearance and smell thus reducing the economic value of the animal. This may provide some motivation for owners to monitor their animals and adopt disease prevention strategies. Some participants lacked conviction that there were any effective control strategies available and perceived there was nothing they could do to prevent disease occurring within their horse. There were also challenges with isolating infected

571 animals including lack of space and facilities in which to isolate horses, shared harnessing and, as
572 they were required to work, continued circulation of infected horses within the cart-horse
573 population. Knowledge of these perceptions and challenges highlights areas for further research and
574 development.
575

576 ## 5. Conclusions

577 This study illustrates the importance of EZL due to the effects of the disease on the horse and its
578 impact upon human livelihoods. The participatory methods used provide context specific findings
579 detailing understanding, attitudes and beliefs about the disease and its impact within Ethiopia. This
580 information may contribute to the development of educational material and disease prevention
581 programmes.

582 Epizootic lymphangitis is a neglected disease that requires further investigation in order to develop
583 disease control methods within endemic regions. With further research, it is anticipated that
584 contextually relevant, practical, affordable and sustainable disease prevention strategies can be
585 developed.

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734 Figure Legends

735 Figure 1: Map illustrating locations of focus group discussions held at 7 SPANA mobile clinic sites and
736 2 non-SPANA accessing towns (unexposed towns).Figure 2: Photographs used in focus group formats
737 B, C and D. The images were selected to represent different stages of the cutaneous form of
738 Epizootic Lymphangitis in order of increasing severity.

739 Figure 3: Schematic representing hierarchical and key themes relating to participant reported
740 methods for the generation of disease.

741 Figure 4: Venn diagram representing the interconnection of hierarchical themes (and example sub-
742 themes) arising from qualitative thematic analysis of discussions about the impact of EZL on horses
743 and society.

744 Figure 5: Thematic summary of approaches to disease prevention. Themes that are underlined and
745 in bold indicate topics discussed by participants in regions with no previous access to SPANA clinic
746 (see figure 1).

747 Tables

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752 Table 1: Description of the four focus group formats (A,B,C and D) including participatory methods
753 used and key questions in the order they were discussed.

Recognition and knowledge of disease		Impact of EZL and approaches to disease prevention	
FOCUS GROUP A* n=22 groups	FOCUS GROUP B n=19 groups	FOCUS GROUP C n=15 groups	FOCUS GROUP D n=15 groups
List: Important disease of working equids (horse/mules/donkeys) in this region.	Photo identification: Do you see animals with this disease here? What is this disease known as locally? Are some animals more severely affected than others? How can you tell?	Key question: What are horses / mules and donkeys required to do? Can you describe their use?	Photo identification (as described in Group B).
Rank: these diseases in terms of perceived importance	Key question: Do you have opinions on how an animal becomes infected with this disease?	Photo identification (as described in Group B).	List: Do you know of any measures that may be used to prevent this disease?
Matrix: how do these diseases affect the animals' ability to work?		Matrix: Clinical signs associated with EZL and effect on ability of animal to work. Key question: How does this disease affect an animals' ability to work?	Key question: Do you take steps to attempt to prevent this disease occurring in your horse/mule/donkey?
Key question: Does EZL			

affect your income and lifestyle?			

*Within Focus group format A the researchers did not introduce the topic of EZL. For all other focus group formats, EZL was introduced with the aid of photographs to stimulate discussion (figure 2).

Table 2: Ranking of equine disease in order of perceived importance to participants. Summaries are given of the average rank for each disease along with the combined rank score. 19 groups completed this exercise as 3 groups did not agree on ranking.

Rank[1]	Disease	Number of groups that included disease in ranking #	Average rank score among groups that ranked this disease[2]	Highest rank, Lowest rank	Average rank score for this disease among all 19 groups[3]	Combined rank score[4]
1	Epizootic lymphangitis Nidift / Bitchee /	14	1.3	1,3	0.9	94
2	Musculoskeletal problem / Cold Stiffness / Bird	10	2.5	2,3	1.3	55

3	Foot abscess / hoof problem/Chug	9	3.0	2,4	1.4	45
4	Colic	6	3.3	1,5	1.1	28
5	Respiratory problem / Furro	4	2.0	2,3	0.4	24
6	African Horse Sickness / Chaffa/tutti	4	3.8	1,5	0.8	17
7	Stomatitis	3	3.0	2,4	0.5	15
8	Bloat	2	1.0	1,0	0.1	14
9	Difficulty urinating	3	3.7	3,4	0.6	13
10	Cough	3	4.0	2,6	0.6	12
11	Watery swelling lower limb	2	2.5	2,3	0.3	11
12	Inappetance / emaciation	2	3.5	2,5	0.4	9
13	Internal Parasites	1	1.0	1,0	0.1	7
14	Head and eye swelling / Chura dagif	1	3.0	0,3	0.2	5
15	Sweating / Inability to work	1	5.0	0,5	0.3	3
16	Diarrhoea	1	7.0	0,7	0.4	1

Ranks were generated during focus group discussion format A and arereported here only when ranking could be agreed upon by the group.

[1] The diseases are listed here in order of combined rank score.

[2] The average rank score was produced by summing the rank positions and dividing by the total number of groups that volunteered that disease.

[3] This column reports on the average rank when including all of the 19 groups that took part in the ranking exercise, i.e. including those that did not rank the disease as important.

[4] The combined rank score was calculated by re-assigning the ranks with a score with the disease ranked 1st given the highest score. Subsequently, the total scores for each disease named by each group were added together to give a combined rank score.

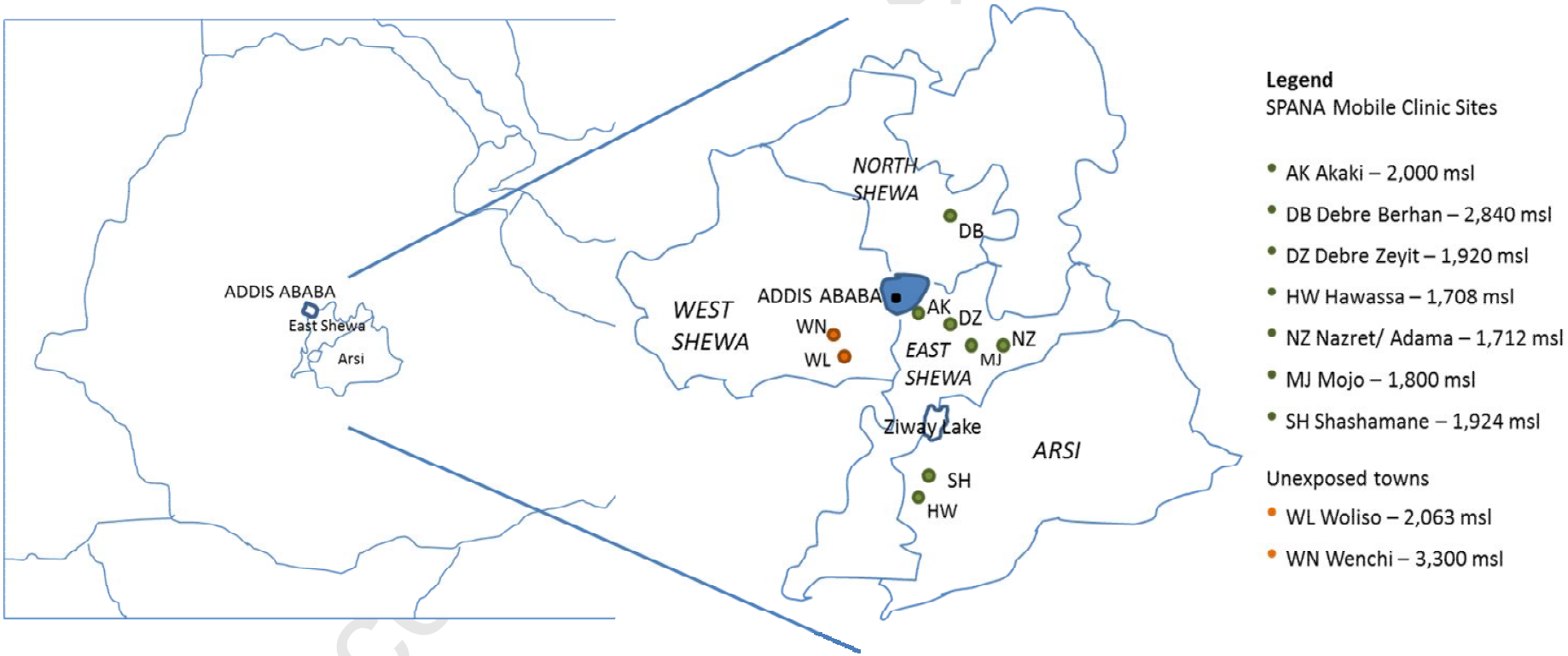
Table 3: Ranking of equine disease split by focus groups held within different altitude zones. The data display the number of groups that ranked the disease and the combined rank score for the disease. 19 groups participated in the disease ranking exercise, 3 groups could not agree on rank order.

Highlands >2100 msl (2 groups)			Mid Highlands >1800 - <2100 msl (9 groups)			Lowlands <1800 msl (5 groups)		
Disease	Number of groups ranked disease	Combined rank score	Disease	Number of groups ranked disease	Combined rank score	Disease	Number of groups ranked disease	Combined rank score
Respiratory problem	1	7	Nidift / Bitchee / EZL	9	60	Nidift / Bitchee / EZL	5	34
Internal Parasites	1	7	Cold stiffness / Bird	4	22	Cold stiffness / Bird	5	28
Foot abscess/hoof problems	1	6	Foot abscess / hoof problems	4	21	Foot abscess / hoof problems	4	18
Colic	1	6	Colic	4	18	African horse sickness / Chaffa / Tutti	4	17
Cold stiffness / Bird	1	5	Respiratory problems	3	17	Stomatitis	2	9
			Bloat	2	14	Inappetance	2	9
			Difficulty urinating	3	13	Cough	2	8
			Watery swelling	2	11	Colic	1	4
			Stomatitis	1	6	Sweating	1	3
			Chura dagif	1	5	Diarrhoea	1	1
			Cough	1	4			

Table 4: Traditional / home-based treatment methods that owners reported to have used to treat Epizootic Lymphangitis within the study region.

Topical treatments	Other treatments
Lemon and cement	Spiritual
Plant preparations	Firing lesions and surrounding areas including lymphatics
Wash horse	Take to highlands and wash daily in highland river water
Apply ash to lesions	Cut the lymphatic vessel to prevent spread of infection
Apply battery acid	Ligate the lesion
Applying hyena faeces	
Use washing detergent	

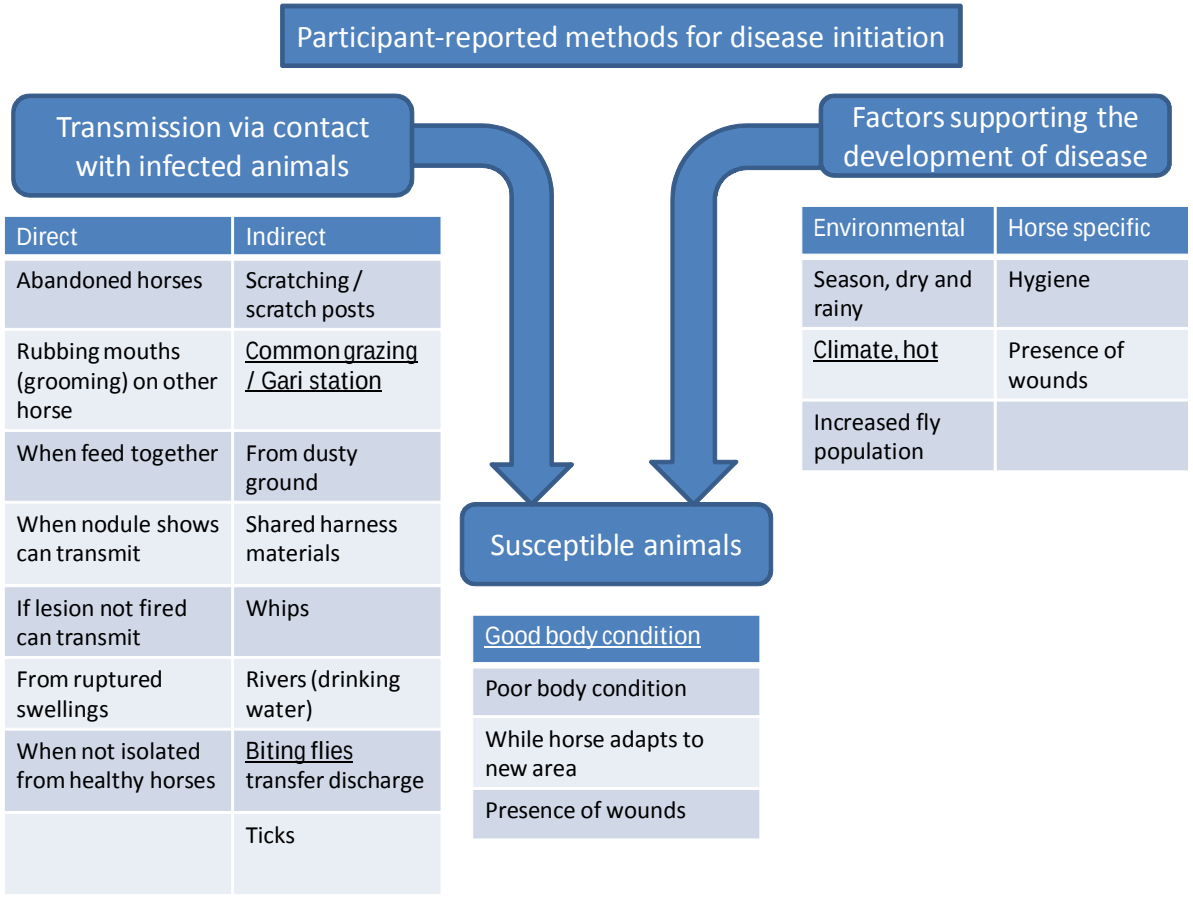
Figure 1: Map illustrating locations of focus group discussions held at 7 SPANA mobile clinic sites and 2 non-SPANA accessing towns (unexposed towns).



Highlands, temperate regions, >2100 msl Debre Berhan, Wenchi, Mid-Highlands, Subtropical regions, ≥1800 - <2100 msl included Akaki, Debre Zeyit, Shashamene, Woliso and Mojo, Lowlands, Sub-tropical to tropical climate, <1800 msl included Hawassa and Nazret/Adama.

Figure 2: Photographs used in focus group formats B, C and D. The images were selected to represent different stages of the cutaneous form of Epizootic Lymphangitis in order of increasing severity.

Figure 3: Schematic representing hierarchical and key themes relating to participant reported methods for the generation of disease.



Direct	Indirect
Abandoned horses	Scratching / scratch posts
Rubbing mouths (grooming) on other horse	Common grazing / Gari station
When feed together	From dusty ground
When nodule shows can transmit	Shared harness materials
If lesion not fired can transmit	Whips
From ruptured swellings	Rivers (drinking water)
When not isolated from healthy horses	Biting flies transfer discharge
	Ticks

Environmental	Horse specific
Season, dry and rainy	Hygiene
Climate, hot	Presence of wounds
Increased fly population	

Good body condition
Poor body condition
While horse adapts to new area
Presence of wounds

Themes that are underlined and in bold indicate topics discussed by participants in regions that had no previous access to SPANA clinic (see figure 1).

Figure 4: Venn diagram representing the interconnection of hierarchical themes (and example sub-themes) arising from qualitative thematic analysis of discussions about the impact of EZL on horses and society.

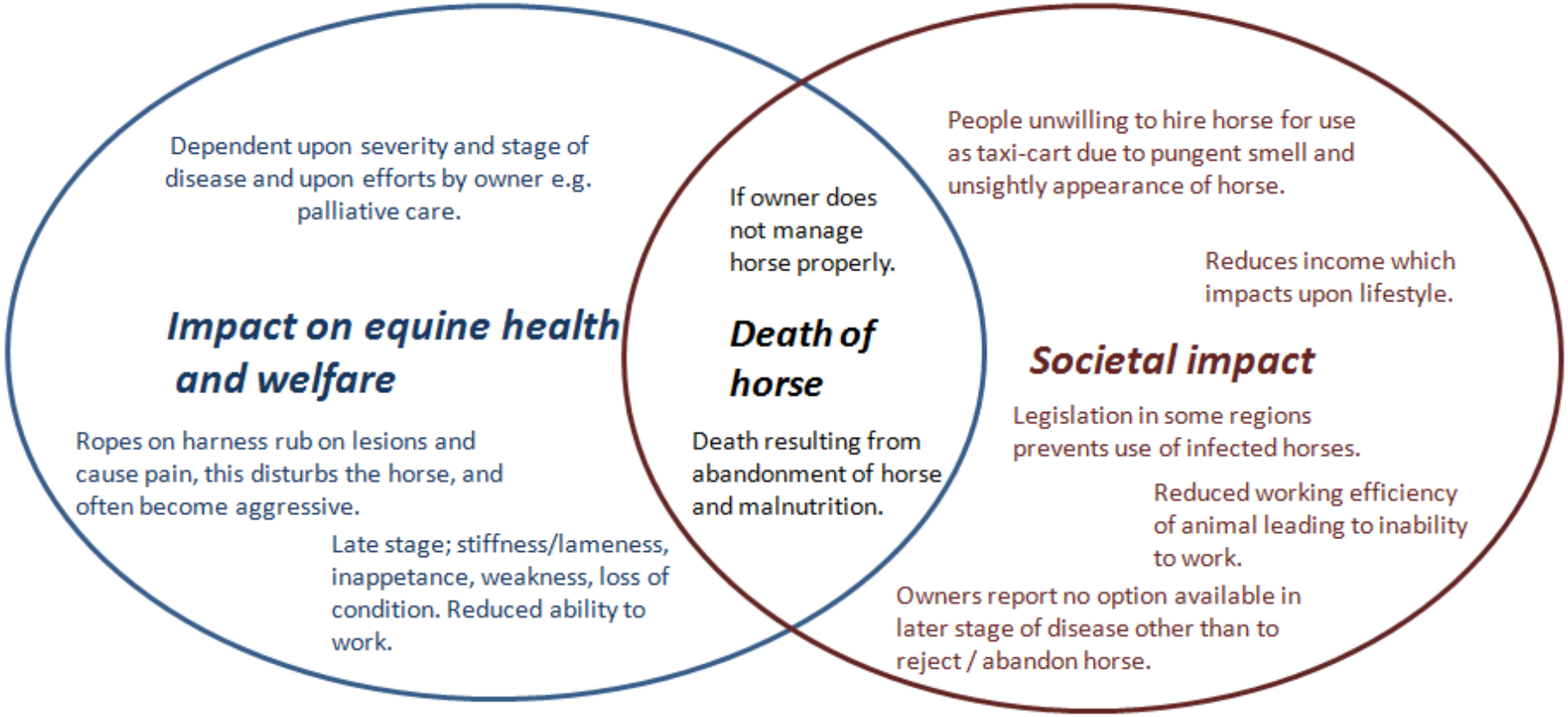
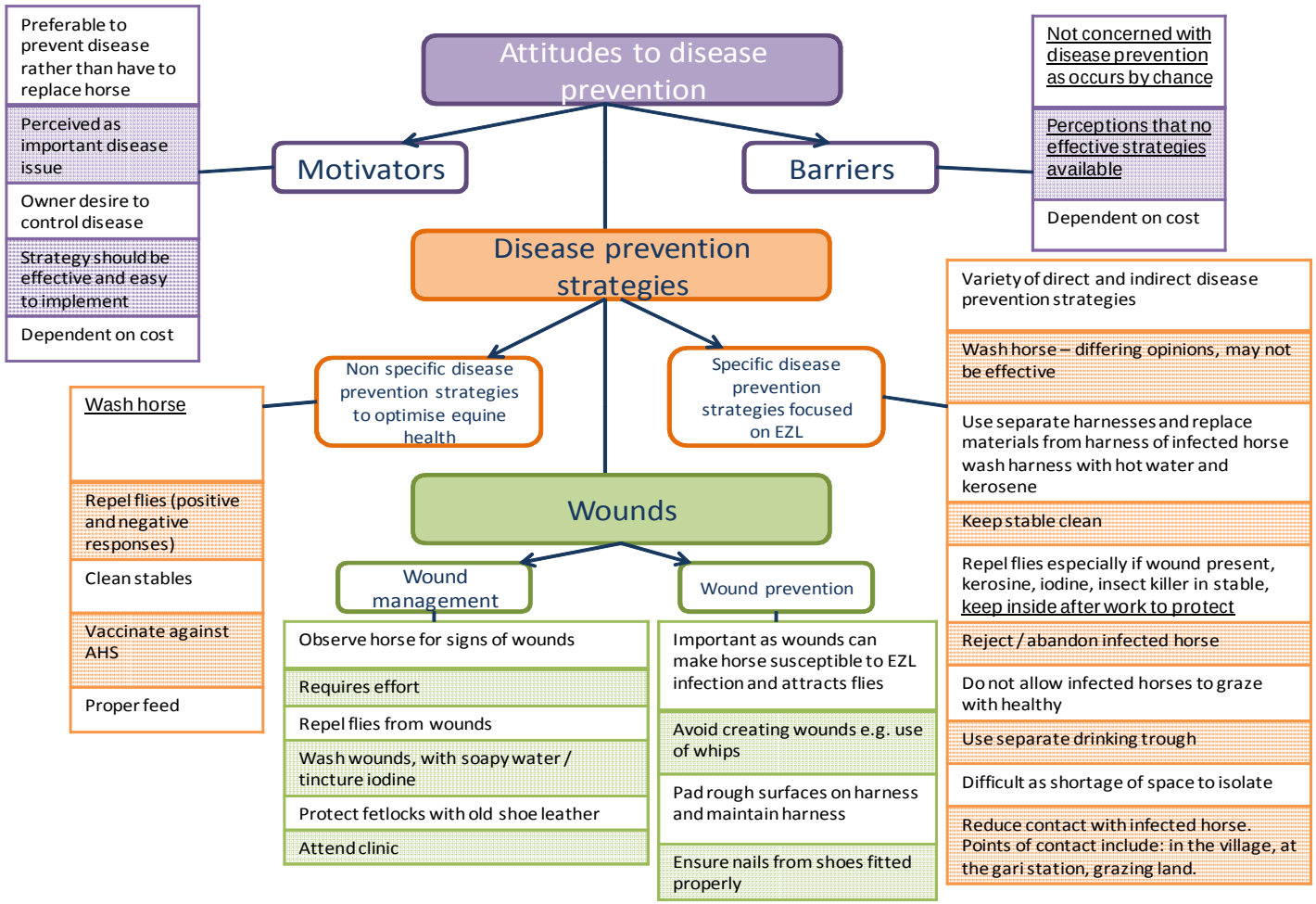


Figure 5: Thematic summary of approaches to disease prevention. Themes that are underlined and in bold indicate topics discussed by participants in regions with no previous access to SPANA clinic (see figure 1).



Footnote: Abbreviations: EZL = Epizootic lymphangitis, AHS = African horse sickness