



Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

**Faculty of Veterinary Medicine
and Animal Science**
Department of Clinical Sciences

Rabies Awareness, Incidence and Vaccination Coverage in Lilongwe, Malawi

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*Uppsala
2014*

Degree Project 30 credits within the Veterinary Medicine Programme

*ISSN 1652-8697
Examensarbete 2014:56*

Rabies Awareness, Incidence and Vaccination Coverage in Lilongwe, Malawi

Förekomst och medvetenhet om rabies samt vaccinationstäckning i Lilongwe, Malawi

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Degree Project in Veterinary Medicine

Credits: 30 hec

Level: Second cycle, A2E

Course code: EX0736

Place of publication: Uppsala

Year of publication: 2014

Number of part of series: Examensarbete 2014:56

ISSN: 1652-8697

Online publication: <http://stud.epsilon.slu.se>

Key words: rabies, awareness, dogs, dog bite, vaccination, Lilongwe, Malawi, Africa

Nyckelord: rabies, hundar, vaccination, hundbett, medvetenhet, Lilongwe, Malawi, Afrika

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SUMMARY

Rabies kills about 55 000 people every year and more than 90% of infected humans are considered getting the disease from dog-bites. To control the disease and eventually eliminate human rabies, the most efficient and economic method is to keep the dog population vaccinated. The objective of this thesis was to evaluate the situation of canine rabies in two urban areas in Lilongwe, Malawi, where canine rabies is enzootic. In each area 200 household-interviews were conducted in September and October 2013. Focal points were awareness of the disease, human incidence as well as vaccination coverage in the dog population. Furthermore an animal organization had vaccinated dogs in one of the areas in their community clinic, but not in the other area. A comparison in vaccination coverage was made between the areas to evaluate the impact of the work of the community clinic.

In total 98% had heard of rabies and 88% would seek medical care if bitten by a dog in order to get treatment against rabies. Hereby awareness of rabies must be considered high. The standard treatment regimen to prevent rabies after dog-bite in Lilongwe is five doses of vaccine, which also is the recommendation by the World Health Organization (WHO), but in average bitten people got only 3.7 doses. The reason is likely to be lack of vaccine doses.

Both areas had together vaccination coverage of 59% which is quite high when considering that it was only about a month left to the annual vaccination campaign at the time of the study. The human incidence of rabies in Lilongwe seems to be much higher than the annual officially reported number, which was estimated based on number of dog-bitten persons in the included areas in the study. Other studies have previously shown a correlation between number of dog-bites and number of human deaths in rabies. The vaccination coverage turned out to be higher in the area where the community clinic had not been based. Although the community clinic had not achieved especially high yearly coverage and it might not have contributed enough to make a difference.

SAMMANFATTNING

Omkring 55 000 människor dör årligen i rabies världen över och mer än 90 % av fallen anses bli smittade genom hundbett. För att minska och så småningom eliminera förekomsten hos humanbefolkningen anses den mest effektiva och ekonomiska metoden vara att hålla hundpopulationen kontinuerligt vaccinerad. Syftet med den här studien var att utvärdera rabiessituationen i två stadsdelar i Lilongwe, Malawi, där rabies förekommer enzootiskt. I varje stadsdel utfördes 200 hushållsintervjuer mellan september och oktober 2013 med avseende på medvetenhet om rabies, sjukdomsincidens hos humanbefolkningen samt andel vaccinerade hundar. En djurorganisation hade vaccinerat hundar gratis i den ena stadsdelen i sin ambulerande verksamhet, men inte varit verksam i den andra. För att få en uppfattning om effekten av deras arbete jämfördes andelen vaccinerade hundar också mellan stadsdelarna.

Totalt sett hade 98 % hört talas om rabies och 88 % sade att de skulle söka sjukvård om de blev bitna av en hund för att få förebyggande behandling mot rabies. Medvetenheten om rabies måste således anses vara hög. Av de hundbitna som sökte sjukvård fick genomsnittet färre vaccindoser i behandling mot rabies än vad som rekommenderas av Världshälsoorganisationen (WHO). WHO:s rekommenderade behandlingsregim var också den som angavs vara standard av ansvarig distriktsläkare i "Lilongwe District". Anledningen till att den regimen inte följs helt är sannolikt på brist på vaccin.

I båda stadsdelarna sammantaget var 59 % av hundarna vaccinerade, vilket måste anses som relativt högt med tanke på att det bara var cirka en månad kvar till den årliga vaccinationskampanjen. Incidensen av rabies hos humanbefolkningen i Lilongwe verkar vara mycket högre än vad som rapporteras årligen, uppskattat utifrån andelen hundbitna människor i de båda stadsdelarna. Andra studier har tidigare visat på samband mellan antal hundbitna människor och antal människor som dött i rabies. Andelen vaccinerade hundar var högre i den stadsdel där organisationen ej bedrivit sin verksamhet, dock så var den andel hundar som vaccinerats årligen i genomsnitt inte så hög och hade troligen inte haft effekt nog att göra någon skillnad.

ABBREVIATIONS

- CNS: Central Nervous System
- DHO: District Health Office
- EHPI: Essential Health Package Indicators
- GDP: Gross Domestic Product
- GIS: Geographical Information System
- HIV: Human Immunodeficiency Virus
- LDA: Lilongwe District Agricultural Office
- LSPCA: Lilongwe Society for Protection and Care of Animals
- PEP: Post-Exposure Prophylaxis

ACKNOWLEDGEMENTS

I would like to thank following persons:

Ulf Emanuelson, my supervisor, Cecilia Wolff, my examiner, as well as Nils Fall at SLU (Swedish University of Agricultural Sciences) for all their help, time and enthusiasm. Elisabeth Persson for introducing the idea and support as well as Elina Åsbjer for providing contact with LSPCA and giving information about Malawi.

D.V.M. Richard Ssuna, Program Director at LSPCA, Eric Mitembo, Project Assistant at LSPCA, Edson Chiweta, LSPCA, for all their help and kind reception. Also Sophie Widdowson and Nicole Cooke at the LSPCA as well as the rest of the LSPCA staff which made mine and my fellow students stay in Lilongwe very nice.

Patrick Saini, Veterinary Officer at Lilongwe District of Animal Health and Livestock Department, Mwawi Mwale, District Health Officer in Lilongwe District, Jorex Kantokoma, Assistant Public Health Officer at the City Council in Lilongwe, Gilson Njunga, Officer in Charge at Central Veterinary Laboratory in Lilongwe, and Precious Pzimhiri, Chief Technical Officer, at Central Veterinary Laboratory in Lilongwe. Thank you for sharing your knowledge and information in a very kind way.

Finally I send my greetings to SIDA for the scholarship which made it possible to perform this survey and all others that have contributed with assistance or encouragement in some way.

TABLE OF CONTENT

| | |
|---|----|
| Introduction | 1 |
| Aim of Study | 1 |
| Review..... | 1 |
| Rabies | 1 |
| Rabies in the world; a remaining problem | 2 |
| Economical burden of rabies..... | 3 |
| Prevention of human rabies..... | 3 |
| Eliminating rabies | 4 |
| Dog population demographic in Africa..... | 6 |
| Surveillance / Monitoring rabies | 6 |
| Malawi..... | 7 |
| Rabies in Lilongwe District..... | 8 |
| Lilongwe Society for Protection and Care of Animals (LSPCA) | 8 |
| Materials and Methods | 9 |
| Study area and sampling process | 9 |
| Questionnaire | 9 |
| Interviews with authorities and other professionals connected to rabies | 10 |
| Results | 10 |
| Human and dog demographics | 10 |
| Awareness of rabies | 11 |
| Authority view on rabies in Lilongwe..... | 12 |
| Medical system for handling rabies in Lilongwe | 13 |
| Dog bite incidents in Lilongwe | 13 |
| Response to dog-bite and treatment at medical centers | 13 |
| Vaccination coverage | 15 |
| Reasons to death among dogs and number of dogs tested for rabies..... | 16 |
| Discussion | 17 |
| Conclusions | 21 |
| References | 22 |
| Non published material | 24 |

Appendix 1 25

INTRODUCTION

Each year 55 000 people in the world die from rabies, which means one decease each 10 minutes. The majority of deaths occur in Africa and Asia, and about 24 000 human deaths are estimated to occur in Africa each year (Knobel et al., 2005). In more than 90% of all human rabies cases, the virus has been transmitted through contact with an infected dog (Lembo et al., 2010). The World Health Organization (WHO, 2013) means that the most cost-effective way to prevent rabies in people is to eliminate the disease in the dog population through vaccination. Canine rabies has been successfully eradicated from some places on Earth and it does exist methods, which are both efficient and economically achievable, for eliminating it for good from places where it is now endemic (Franka et al., 2013; WHO, 2010). Lembo et al. (2010) also confirm in their report that eliminating human rabies through vaccination of the dog population is applicable in most of Africa. Still rabies remains a problem, causing both a high annual human death rate and an economic burden to health systems of already poor nations.

In the southeastern African country Malawi rabies is endemic. National reports tell that rabies is “a notifiable disease in Malawi” (Mallewa et al., 2007) and that rabies kills more than 200 Malawians per year and probably more, since this number only represent the reported cases (Chenjezi, 2013). The Malawian organization “Lilongwe Society for Protection and Care of Animals” (LSPCA) has been operating in Lilongwe, the capital city of Malawi, since 2008. One of their main missions is to vaccinate the dog population in Lilongwe against rabies to prevent rabies in the human population. The aimed target is to keep 70-80 % of the dog population vaccinated. No evaluation of the achieved vaccination coverage has been done since the start of their work, neither any evaluation to see if the vaccinations have given any impact on the human or canine rabies incidence in Lilongwe (Interview with R. Ssuna, 2013). For the organization to plan their continuing work, an evaluation of the vaccination coverage as well as the impact on the human incidence of rabies should be done.

AIM OF STUDY

The aim of this study was to evaluate the situation of canine rabies in two urban areas in Lilongwe, Malawi. Main focus was vaccination coverage in the dog population, awareness of the disease and human incidence of rabies. Furthermore the vaccination coverage in an area where dogs have been vaccinated for free by the LSPCA in their community clinic was compared with another area where the community clinic has not been based.

REVIEW

Rabies

Rabies is a viral, zoonotic disease that can affect most warm-blooded species. It is mainly transmitted to humans through contact with infected animals, primarily by bites, scratches or other contact with saliva. The causing agent is a negative stranded RNA-virus, a Lyssavirus, and the outcome is almost certainly lethal. To infect the virus has to come in contact with non-intact skin or mucosal surfaces, because it is not able to penetrate intact skin. At the site

of infection the virus replicates or goes directly into the peripheral nervous system for retrograde transport along the nerve fibers to the CNS. The virus is estimated to travel around 15-100 mm per day. Major clinical symptoms are shown first when the virus has reached the CNS and the incubation time consequently depends on the site of infection (the distance the virus has to migrate). The amount of virus transmitted is another factor affecting the incubation time which is normally between two weeks and six months (WHO, 2004).

During the migration of the virus it also affects adjacent non-nervous tissue and the salivary gland is one example of importance. About 14 days before clinical symptoms are shown the salivary glands are affected and the virus is excreted in saliva. At this time transmission of virus can occur through saliva (bites). In the central nervous system the virus causes a progressive and fatal encephalomyelitis (WHO, 2004).

Initial symptoms are often fever and pain at the site of infection. Out of shown symptoms the disease can be divided into two categories; furious and paralytic rabies. Furious rabies includes more dramatic symptoms such as hyperactivity, behavioral changes and hyper excitability which finally end in death because of cardio-respiratory failure. Paralytic rabies is dominated by paralysis due to peripheral nerve dysfunction, starting at the site of infection slowly progressing to the rest of the body (WHO, 2004). Regarding to WHO (2013) 30% of human cases of rabies are shown as paralytic and this kind of rabies is more often misdiagnosed. Both forms terminate in death within one to five days after onset of neurological symptoms (WHO, 2004).

Rabies in the world; a remaining problem

WHO declares that there is a high level of underreporting when it comes to human rabies, which results in underestimated costs of the disease and consequently a lower national priority of the disease than it actually requires (WHO, 2004). Lack of awareness and knowledge of rabies and the risks that contact with rabid dogs include, contribute to people not seeking medical care when exposed to the disease and consequently they die undiagnosed at home and these cases do not get reported. Furthermore the long incubation period and the diffuse symptoms make the disease hard to suspect and diagnose, which also might contribute to its underreporting. According to The Africa Rabies Expert Bureau (AfroREB) (2008) many people in Africa do not know about the disease and even if they are aware of it they might live in rural areas, too far away from medical centers that can provide anti-rabies treatment for being able to get help. At medical centers few clinical cases actually get laboratory confirmed, which is necessary for a certain diagnosis and it is also common that the local centers do not report cases (confirmed and clinical) to central authorities. Knobel et al. (2005) predicted the number of human deaths in rabies to 55 000 per year which means that only 3% of human rabies deaths get recorded in central health recording systems. When studying only Africa the predicted number means that human deaths in rabies are about 160 times underreported in Africa (Knobel et al., 2005).

According to the WHO (2004) “more than 99% of all human rabies deaths occur in the developing world”. This adds both social and economic difficulties in fighting the disease. In their fact sheet from 2013, WHO states that poor people and people living in rural areas are most at risk of getting rabies. Living in a rural area in a developing country often means long distances to get access to medical care and it is not for granted that human vaccines and immunoglobulin against rabies are available or accessible even at the medical centers. Poor people are also at a higher risk dying in rabies since they might not be able to afford post-exposure prophylaxis (PEP). The cost for PEP is about 40 US dollars in Africa, where the average daily income is about 1–2 US dollars per person (WHO, 2013). The most common route of infection is transmission from dogs and the WHO estimates that in more than 99% of all human cases, the rabies virus has been transmitted from dogs. Children (aged under 15) turn out to be more at risk since they tend to have closer contact with dogs and according to the WHO (2004) children represent 50% of the human rabies cases in canine rabies endemic areas.

Rabies is considered being a neglected disease (Schneider et al., 2011) and the high proportion (99%) occurring in the developing world does probably contribute to the neglect. Other zoonotic diseases as Severe Acute Respiratory Syndrome (SARS) and avian flu cause much fewer human death cases per year than rabies (average number of deaths in SARS is 774 people per year and 79 per year in avian flu) but gets much more international attention (WHO, 2004).

Economical burden of rabies

Economic factors contribute to making human rabies still being a problem. Human PEP is very expensive which means high governmental costs. On household level costs arise when family members have to travel to seek medical care multiple times, when they lose income due to sickness and also due to medical fees (Lembo, 2010). Shortages of PEP in medical centers are furthermore not uncommon in Africa (Hampson, 2008). In 2005 Knobel et al. made a quantitative evaluation of the burden of rabies in Africa and Asia. Their estimation of the annual cost of rabies in Africa reached 20.5 million US dollars.

Prevention of human rabies

Vaccines against rabies in humans exist in both pre-exposure and PEP forms. The recommendation given by WHO (2004) is that pre-exposure prophylaxis should be given to people at high risk, for example rabies laboratory employees, veterinarians and also people living in high risk regions (preferably children under age of 15). Pre-exposure protection requires three doses of vaccine and serological testing every six months to evaluate if revaccination is required.

Post-exposure treatment shall include local cleaning of the wound with soap and water (as soon as possible), rabies vaccination (using a vaccine accepted by the WHO) and also treatment with rabies immunoglobulin if indicated (WHO, 2013). The regimen of post

exposure prophylaxis depends on the kind of contact with the rabid animal and the WHO (2013) divides the regimen into three categories:

Categories of contact and recommended post-exposure prophylaxis (PEP)

| Categories of contact with suspect rabid animal | PEP measures |
|--|---|
| Category I – touching or feeding animals, licks on intact skin | None |
| Category II – nibbling of uncovered skin, minor scratches or abrasions without bleeding | Immediate vaccination and local treatment of the wound |
| Category III – single or multiple transdermal bites or scratches, licks on broken skin; contamination of mucous membrane with saliva from licks, contacts with bats. | Immediate vaccination and administration of rabies immunoglobulin; local treatment of the wound |

The WHO (2004) accentuates the vaccination history of the involved animal as a factor important to evaluate when deciding if vaccination and administration of immunoglobulin are necessary or not. Although the WHO also point out that a certificate of rabies vaccination do not guarantee that the animal is not rabid. If the biting animal “is a potential rabies vector in a rabies-endemic region, initiation of post-exposure prophylaxis should never await the results of laboratory examination, nor should the responsible animal be observed for signs of rabies prior to starting post-exposure prophylaxis” (WHO, 2004).

Two types of human vaccines are available with different administration routes; intramuscular and intradermal, and there are also different schedules for the number of doses and the interval between doses (WHO, 2004).

If the biting animal is a dog or a cat the WHO (2004) recommends keeping it in quarantine under observation for 10 days. If it still does not show any symptoms of rabies 10 days later rabies can be excluded and PEP can be discontinued.

Eliminating rabies

The WHO (2013) states that “Rabies is a vaccine-preventable disease. The most cost-effective strategy for preventing rabies in people is by eliminating rabies in dogs through vaccination”. Also Lembo et al. (2010) concludes that control of canine rabies through mass vaccination of domestic dogs is possible in most of Africa. In Zimbabwe veterinary services were disrupted for seven years during the war and the dog population did not get vaccinated against rabies during this time. Consequently canine rabies got widespread and a marked increase in human deaths due to rabies occurred (Lawrence et al., 1980).

Canine rabies has been brought under control in several parts of South and Central America and in Asia, which also has decreased the level of human rabies. In Thailand a five-year program to prevent human deaths from rabies was conducted between 1996 and 2001. It included increased accessibility of human vaccine, educational interventions to increase

awareness, mass vaccination of the domestic dogs as well as monitoring and castrating the dog population. Also the documentation of PEP, the follow-ups of treated patients and the cooperation between different involved authorities (human health, agricultural and educational sector) were intensified. The approach turned out to be successful: “No deaths occurred during the last three years of the program, which indicated that the program was successful” (Kamoltham, 2003)

In Latin America the member countries made a political resolution in 1983 about eradication of human rabies transmitted from dogs by year 2005. Within this period the number of human and canine rabies cases was reduced by approximately 90%. This proves that rabies “can be controlled with effective action” (Schneider et al, 2007).

Lembo et al. (2010) give four common arguments to why rabies has not yet been brought under control in Africa:

- The national priority of the disease is often low due to low awareness of the real rabies affliction.
- Epidemiological restrictions, such as “uncertainties about the required levels of vaccination coverage and the possibility of sustained cycles of infection in wildlife”.
- Functional restrictions, as for example lack of knowledge of the actual size of the dog population when planning vaccination campaigns.
- Limited resources for performing surveillance and control methods.

The role of wildlife in persisting rabies has been discussed widely. Lembo et al. (2008) report from the Serengeti ecosystem (Tanzania) that rabies occurs only sporadically in wildlife and that wild carnivore only act as reservoirs and as “non-maintenance populations”. Domestic dogs are considered the only essential population for keeping rabies persistent.

To eliminate rabies in a dog population a certain proportion of the population (P_{crit} ; critical proportion) has to be vaccinated. The threshold level can be calculated based on the basic reproductive number (R_0 ; the average number of secondary infected cases initiated by one infected individual in a fully susceptible population). Keeping the vaccinated proportion of the population above the critical threshold will lead to elimination (Lembo et al., 2008). Hampson et al. (2009) made analyses of R_0 which predicted that relatively low vaccination coverage was enough for eliminating rabies, about ~20-45 % coverage would be enough. This is likely to be true since data from historical outbreaks from around the world, as well as more current data from Tanzania, show that R_0 in domestic canine populations is most often rather low, between 1.0 and 2.0. Although the authors also accentuate that other studies have found significant variations in what level of vaccination coverage that is required for controlling the disease. Mentioned authors related these variations mainly to dog demographics with the explanation that a high dog turn-over rate (high birth and death rates) causes a rapid decline in vaccination coverage since the number of immunized animals then quickly get exchanged with non vaccinated individuals. Their final conclusion about what level of vaccination

coverage to aim for, was a coverage of 60% in each annual vaccination campaign, this considering areas with high dog turnover rates. Rural Tanzania was used as example in their study. Hampson et al. (2009) say finally that not many control attempts carried out in Africa has reached vaccination coverage of 60 % and that this contributes to why rabies is a remaining problem. The WHO (2004) recommends vaccination coverage of 70% to control rabies, in areas with endemic canine rabies. When planning vaccination campaigns it is hence crucial to have an idea of the size of the dog population.

Dog population demographic in Africa

A few studies have been done in Africa regarding size of dog populations in different areas. In the urban area Iringa in Tanzania the dog:human ratio was estimated to 1:14 which was about six times larger than estimated by town records (Gsell et al., 2012). They also concluded that “dog densities in urban areas are generally much higher than in rural areas”. Average age of the dog population in Iringa was 2.23 years, and life-expectancy 2.76 years for both sexes. The growth rate of the dog population was 10% per annum. In 2005 Knobel et al. reported a dog:human ratio in Africa at 1:21.2 in urban areas and 1:7.4 in rural.

Surveillance and monitoring of rabies

Effective surveillance arrangements are essential when eliminating infectious diseases like rabies. It helps in detecting and reporting new outbreaks at an early point which enable an early response. A well-organized reporting system also gives accurate information about the burden of the disease and resources for eliminating can consequently be calculated. Surveillance is also crucial to evaluate the effect of intervention programs; to achieve data of the progress and to assess the cost-effectiveness (WHO, 2004).

Townsend et al. (2012) discuss the importance of surveillance quality when aiming for eliminating rabies and they mean that if the disease incidence is low, random sampling is not enough as surveillance strategy for detecting the disease. According to Townsend et al. control programs should include surveillance sufficient enough to detect at least 5% of all rabies cases in an area, to be able to eliminate the disease. Another significant factor that is mentioned is also avoidance of a “patchy coverage” when vaccinating dog populations. Aiming for a geographically uniform vaccinated dog population with no areas left unvaccinated is important since a patchy coverage might cause persisting disease due to “unvaccinated pockets”. Mentioned authors finally conclude that contraceptive vaccination of the dog population followed by two years of continuous monitoring and vaccination should guarantee elimination from an isolated area, where new introductions of the disease will not appear.

WHO suggests three cornerstones in rabies prevention in dogs; epidemiological surveillance, mass vaccination and dog population control. They emphasize the importance of community participation to achieve this, which declare that knowledge about rabies among common people is of great importance (WHO, 2004). Partners for Rabies Prevention (2010) also point out that it is essential with surveillance of rabies-occurrence when performing a rabies

prevention program, and if it is not performed it should be introduced. The reasons for this are both to increase the awareness of the disease, which also improves the national priority, and to be able to evaluate the impact of the program (Partners for Rabies Prevention, 2010).

In developing countries rabies is often under-reported, often due to lack of a reliable reporting system. In addition, data regarding the number of dogs is not always available. Another complicating factor is that the only way to confirm a rabies diagnosis in an animal is to analyze samples of brain tissue, which requires euthanasia of the animal. Furthermore, this can only be done after the animal have developed symptoms and become rabid (Centers for Disease Control and Prevention, 2011). With this in mind Partners for Rabies Prevention (2010) gives examples of how to measure rabies prevalence and incidence in other ways. Questionnaire surveys can be used to get information of human and animal rabies cases as well as dog bite injuries. It can also be used for getting information about the local knowledge of rabies and how it is transmitted. Data from hospitals about animal-bites injuries and number of post prophylaxis doses administered are also useful. In addition, comparisons of the number of vaccine doses administered to dogs with the total number of dogs in the country/area can be done. To obtain information about the total number of dogs, indirect methods of calculating the number of households and estimating the number of dogs typically belonging to a household have been proven to work before, for instance by Knobel et al (2008).

Malawi

The Republic of Malawi is a small nation in southeastern Africa and one of the poorest countries in the world (Regeringskansliet, 2013). According to the Human Development Index ranking list from 2013, Malawi is number 170 of 186 countries and belongs to the group of low human development (UNDP, 2013). The population in Malawi was estimated to 15 380 888 people in 2011 and the population density is one of the highest in Africa (158 inhabitants/km²) according to “Landguiden” (2013). A high birth rate keeps the population growth at a high level, even though mortality has increased the last few years - mainly due to poverty, under nourishing and HIV (human immunodeficiency virus). Life expectancy at birth is 54 years and two thirds of the population is under the age of 20. Of the population, 50% is considered to live in “extreme poverty” (which is defined as living of maximum 1 US dollar per day). The poverty is worst at the countryside, where nine of ten Malawians are living (Landguiden, 2013).

Agriculture is the driving force in the national economy and represents a third of the GDP (gross domestic product) and constituted almost all incomes from export in 2010. About 85% of the population is working within the agricultural sector, mainly as self-sustaining small-scale farmers. The reliance of agriculture makes the country especially sensitive against natural disasters and the nation has repeated times been seriously affected of drought and flooding. In 2009, 96.9% of the children in Malawi started school. Although a large amount of the children do not fulfill the education. Only 73.7% of the population is considered to be

able to read and write. The cost for health care in Malawi was 17 US dollars per person in 2007 (Landguiden, 2013).

Rabies in Lilongwe District

Mallewa et al. (2007) conclude that “rabies is a notifiable disease in Malawi”, and especially “an important cause of death among children”. In their study, children with CNS symptoms were evaluated for rabies (post-mortem examination, typical clinical manifestations and contact with rabid dog/history of dog bite were used for setting the diagnosis). One of their findings was that 11% of deaths that were considered caused by cerebral malaria actually were deaths due to rabies. This accords well with results in studies made by Knobel et al. (2008) and Cleaveland et al. (2002a), where the authors show that rabies in Africa is hugely underreported. Except from misdiagnosing, Mallewa et al. consider flaws in the national reporting system for the disease as a reason to why rabies seems less common than it probably is.

In 2012 Depani et al. from Queen Elisabeth Central Hospital in Blantyre in Malawi reported a two times increased incidence of rabies in children presented to the hospital during a three month period. According to Depani et al. the most likely reasons to the increase were “inadequate supply of anti-rabies vaccine and inadequate dog-control measures”. The authors opine that the rise in incidence is of “significant concern”, especially since the recorded number is likely to be heavily under-reported and the incidence thus is expected to be much higher. As solution the authors point out introduction of mass dog vaccination campaigns as one important step to prevent rabies in Malawi. Depani et al. also say that within Malawi rabies vaccine is often not available at local medical centers or “very hard to access”. Rabies immunoglobulin is not available at all. This results in dog-bitten people not getting PEP treatment at all or inadequate amount of doses.

In an evaluation of livestock diseases in Malawi made by Edelsten in 1995 the average number of confirmed rabies cases in animals throughout the country was 186 per year. Of those 83% occurred in dogs, which means 154 cases in dogs per year. Although Edelsten also point out that this number represents “an unknown factor of the real figure”. Edelsten describes a dog survey from 1993 in Lilongwe District where one dog per 3.8 people was recorded in rural areas and one dog per 3.4 people in urban areas. With the human population at this time being 8.5 millions with the majority living in rural areas the incidence rate of rabies in dogs turned out to be about 10 cases per 100 000 dog-years.

Lilongwe Society for Protection and Care of Animals (LSPCA)

The Malawian organization “Lilongwe Society for Protection and Care of Animals” (LSPCA) was started in 2008 by individuals concerned about animal welfare in Lilongwe. One of the main tasks of the organization is to keep the dog population in Lilongwe district vaccinated against rabies with the aim to keep the level of rabies in the human population as low as possible. The goal is to keep 70-80 % of the dog population vaccinated against rabies in line with guidelines from the WHO (Ssuna, 2013, pers. comm.).

The LSPCA has since 2009 had one vaccination campaign against rabies every year. Some years the City Council has subsidized the vaccinations and it has been free for the dog owners to vaccinate their dogs. Other years the owners have had to pay, this year (2013) it was for free. LSPCA also vaccinates dogs for free twice a week in their community clinic. The community clinic is mobile and location is switched every now and then. During 2013 the clinic has been run twice a week, earlier just once a week. “Defensor 3” (Zoetis Ltd) or “Rabisin” (Merial Animal Health Ltd) are the vaccines used. For “Rabisin” yearly revaccination is required and for “Defensor 3” one booster dose is required one year after the primary dose and later revaccination every third year is necessary. The LSPCA promotes vaccination of all dogs every year. The size of the dog population in Lilongwe is not known and no evaluation of the vaccination coverage has been done so far (Ssuna, 2013, pers. comm.).

MATERIALS AND METHODS

Study area and sampling process

Between the 12th of September and the 11th of October 2013 household interviews were conducted in two areas (25 and 23) in Lilongwe City. Both areas were urban and had similar socioeconomic status according to local inhabitants (Mitembo, 2013, pers. comm.). The organization has vaccinated dogs in both area 25 and 23 during their annual vaccination campaigns. In area 25 the LSPCA has also been vaccinating dogs against rabies in their community clinic once to twice a week between October 2011 and March 2013. The community clinic has never been based in area 23. In 2012 the annual vaccination campaign was conducted in the very beginning of September, slightly more than a year before this survey was performed.

A total of 200 households were interviewed in each area and households were selected as randomly as possible. No updated city maps existed; instead maps from Google were used together with GIS (geographic information systems) to point out the borders of the different city areas. Clusters of different households were picked for interviews and these were as even scattered in the areas as possible, with respect to geographical location.

Questionnaire

A questionnaire was developed for interviews with households to gain relevant information about vaccination coverage, people’s awareness of rabies, people’s tendency to seek medical help when bitten by a dog etcetera. To develop the questionnaire people at the LSPCA with knowledge of the local area and people as well as epidemiologists were consulted. Also literature research was done for similar surveys based on questionnaires or interviews. Before the interviews got started five households got interviewed just to test the interview formulary. These households were located in another part of the city (not in area 25 or 23) and the interviews were not included in the survey. When interviewing one or several household members did respond to the questions for the household as an entity. The interview questions

are attached, see appendix 1. Question number 2a and 2b have not been evaluated and are not included in the presentation.

Both households with and without dogs were included, to be able to estimate the dog population and the dog:human ratio. Questions were asked in Chichewa (the native language) by an interpreter, translated to English and noted in the questionnaire by a Swedish veterinary student. Two different interpreters were involved in translation and also two Swedish veterinary students. If the respondent spoke good English and accepted to get interviewed in English, one of the veterinary students conducted the interview. The interpreter introduced the survey by shortly telling the respondent about the LSPCA and that a survey about dogs was conducted right now. Rabies was not mentioned in the introduction of the survey, except in 10-15 interviews in area 25 due to a misunderstanding. Data were entered into Microsoft Excel for analysis. In cases where two factors were compared, chi-square test was used to test if achieved discrepancies were statistical significant.

Interviews with authorities and other professionals connected to rabies

Furthermore an interview was made with the Veterinary Officer at Lilongwe District of Animal Health and Livestock Department (LDA) to get to know more of the view on rabies within the agricultural authority and to take part of their records of number of dog-bitten persons. The District Health Officer (DHO) in Lilongwe was interviewed to get the health authority view on rabies and to get access to their records of the annual number of people treated against rabies as well as records of human deaths in rabies. Also staff at the Central Veterinary Laboratory in Lilongwe got interviewed to find out more about how many dogs that get tested for rabies every year. At last the Program Director at LSPCA got interviewed to get better insight in the organization. From the LSPCA records from their vaccination campaigns in 2012 and 2013 as well as from their community clinic regarding the number of vaccinated dogs were collected, to be able to estimate the achieved vaccination coverage.

RESULTS

Human and dog demographics

The interviewed households included 2 298 people and 190 dogs, which mean a dog:human ratio at 1:12.0 for the areas together. Of all the 400 households 28% had at least one dog. In the dog population 25% of the dogs were puppies (below the age of six months).

Area 25 itself had a dog:human ratio at 1:9.7 and area 23 at 1:15.8. The difference is statistically significant at $p=0.05$. According to the City Council area 25 had 64 650 inhabitants and area 23 had 45 779 in 2008, which is the last time the number of inhabitants was recorded in the different areas (Kantokoma, 2013, pers. comm.). Extrapolating the dog:human ratios to the entire areas give an estimated total number of 6 690 and 2 900 dogs in area 25 and 23, respectively.

The Lilongwe District of Animal Health and Livestock Department estimate the dog population in Lilongwe District to 44 170 dogs and that there are around 300 cases of rabies in dogs every year (Saini, 2013, pers. comm.).

Awareness of rabies

Ninety-eight percent of all respondents had heard of rabies, 96% in area 25 and 100% in area 23. The difference between the areas is significant at $p=0.05$. When the respondents were asked to tell what they knew about rabies 89% could tell that rabies is a disease while 11% said that they had just heard the name “rabies” but did not know more about it. Furthermore 71% mentioned it can get transmitted from dogs to humans and 36% that the disease is fatal (Figure 1).

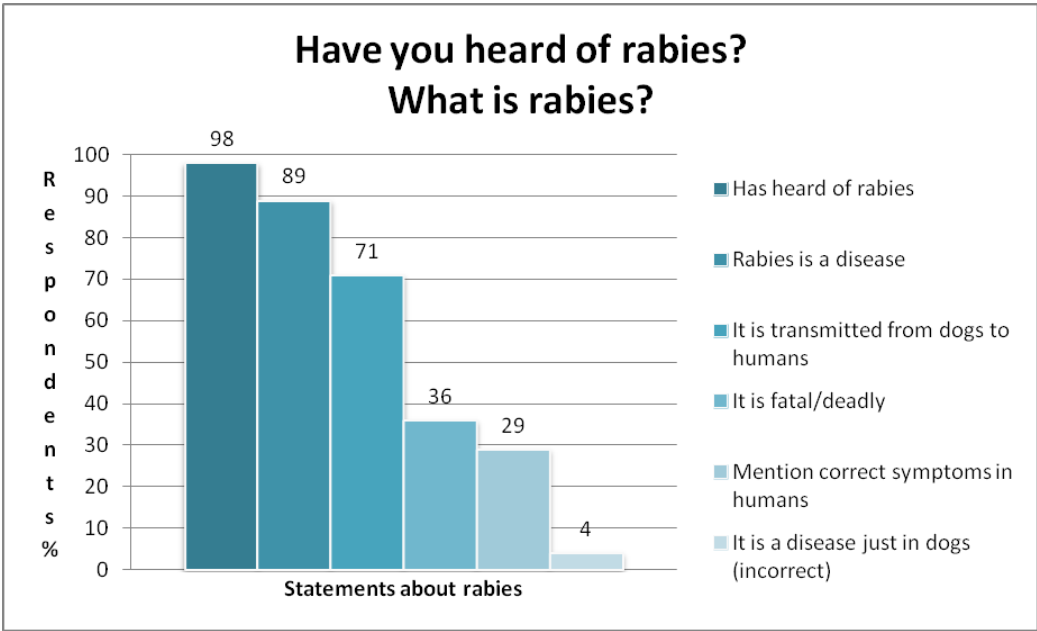


Figure 1. Knowledge of rabies among 2 298 people in area 25 and 23, Lilongwe City.

Of the respondents that had heard of rabies 18% considered it being a problem in their living area, with no significant difference between the areas ($p\leq 0.05$).

Of the respondents, 99% would seek medical care if bitten by a dog and 88% reported “to get treatment against rabies” as a reason to seek medical care if bitten. Of the people giving other reasons to seek medical care most common were to get the wound cleaned and/or dressed, to get vaccinated against tetanus or to get painkillers (Figure 2).

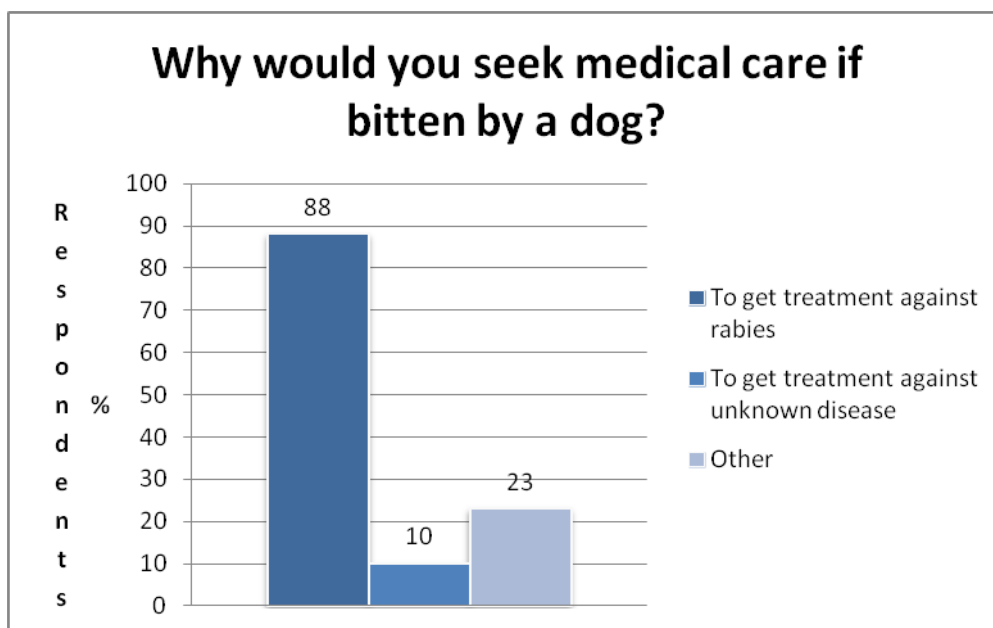


Figure 2. Reasons to why 2 298 people seek medical care when bitten by a dog.

Just 3 of 400 respondents said they would not seek medical care if bitten by a dog. One respondent had a religion that did forbid her to seek medical care, another thought medical care was too expensive and the third respondent just did not want to go to the medical centre.

Authority view on rabies in Lilongwe

According to The District Health Officer (DHO) in Lilongwe, Mr Mwale, awareness of rabies is very good within Lilongwe District. Mr Mwale means that “Everybody knows about it”. Regarding the tendency to seek medical care Mr Mwale says that people’s tendency to seek help is higher if it is an unknown stray dog and not so high if the person knows the dog.

Regarding the authority view on the disease Mr Mwales opinion is that rabies is serious mainly since it is a deadly disease and not since it causes high death numbers. The actual number of deaths in rabies in the district is not known, but in terms of treatment around 200 people got treated against rabies in 2012, although all of the treated persons might not have belonged to Lilongwe District. If another district runs out of vaccines their patients can be sent to Lilongwe for treatment and also if Lilongwe district runs out of vaccines people from there are sent elsewhere. When asked about the real death numbers and if it is likely to be a high or low level of unreported cases, Mr Mwale says that he believes there are many unreported cases. Although Mr Mwale says rabies is not included on his top ten list, based on the EHPI (Essential Health Package Indicators) (Mwale, 2013, pers. comm.). Essential Health Packages is a way to prioritize which medical services that should be available in a low income country with limited resources. The EHPI are the indicators that the priority list in the EHP is based on (WHO, 2008). In 2013 (September) two people has died in rabies so far and in 2011 five people died of the disease in Lilongwe District, of the reported cases (personal communication, P. Saini, 2013).

People bitten by a dog get treatment against rabies in accordance with the criteria of the WHO. This means five doses of post-exposure vaccine. Pre-exposure vaccinations are generally not given, just for some high-risk groups as for example veterinarians. Mr Mwale means it is too expensive to provide pre-exposure vaccination and if the dog population would be vaccinated properly it would not be necessary. The cost of one post-vaccination dose is about 20 US dollars, which means 100 US dollars for the treatment of one person (Mwale, 2013, pers. comm.).

The Veterinary Officer at Lilongwe District of Animal Health and Livestock Department (LDA), Mr Saini, consider rabies being a problem especially since it is a controllable disease that still kills a lot of people every year. For Lilongwe District Mr Saini thinks rabies is mainly a problem in rural and peri-urban areas. The cost of one dose of dog vaccine against rabies is 350 Malawian Kwacha (about 0.8 US dollars) (Saini, 2013, pers. comm.).

Medical system for handling rabies in Lilongwe

When a person in Malawi gets bitten by a dog the person is at first directed to the local veterinarian department, where the veterinarians investigate if the dog is vaccinated against rabies. If no vaccination certificate can prove that the dog is vaccinated, the bitten person gets a referral to hospital for treatment. At the hospital the wound get inspected and the criteria of the WHO are used for deciding if anti-rabies treatment will be given or not (Mwale and Saini, 2013, pers. comm.).

If the dog is not vaccinated, it is put under observation for ten days. If it is alive without symptoms of rabies after ten days it is considered not rabid. If it dies or shows rabid symptoms, specimens from it (the brain) are sent to laboratory for confirming the diagnosis. If the dog is already dead and buried LDA tries to dig it up to be able to send specimens to lab. LDA also tries to find out if there are more people who have become bitten by that particular dog (Saini, 2013, pers. comm.).

Dog bite incidents in Lilongwe

In 2012, 2 992 people came to the LDA because of dog-bites. According to National Statistical Office, Lilongwe District had 1 230 834 inhabitants in 2008 (National Statistical Office, 2008), this gives an annual bite incidence of 243 cases per 100 000 people. The number of dog-bites is slightly higher than previous years, for 2008, 2010 and 2011 the average annual number was 2 774. Records were missing for 2009. For 2013, 1 973 bites were recorded until the end of September. That is 219 bites per month which is a lower monthly number than previously years (249 bites per month for 2012 and 231 as average bites per month for 2008, 2010 and 2011).

Response to dog-bite and treatment at medical centers

Among 2 298 people covered in the study 51 cases of dog bites occurred during the last year and 44 households of 400 (11%) had had someone bitten by a dog during the last year. It means that 2.2% of the human population got bitten by a dog in one year, which is 2 230

cases per 100 000 people per year. Between area 25 and 23 it was no statistical significant difference in proportion of dog bitten persons during the last year ($p \leq 0.05$).

Of all dog bite cases 76% did seek medical care. In 8 of the 12 cases where the bitten person did not seek medical care the skin did not get penetrated or “it was just a scratch”. In 6 of the mentioned 12 cases of dog bites the dog was not vaccinated against rabies or not known if vaccinated and in 2 of these 6 cases the skin had been penetrated.

If the dog was not vaccinated or if the vaccination status was unknown, 86% of the bitten people did seek medical help. If the bitten person got her/his skin penetrated 58% did seek medical care (Figure 3).

In 80% the bitten person knew the dog. When comparing the tendency to seek medical care between people bitten by a known dog compared to an unknown there was no statistical significant difference ($p = 0.05$). Of the people that had been bitten by a dog they knew, 73% did seek medical care compared to 90% of the people bitten by an unknown dog (Figure 3).

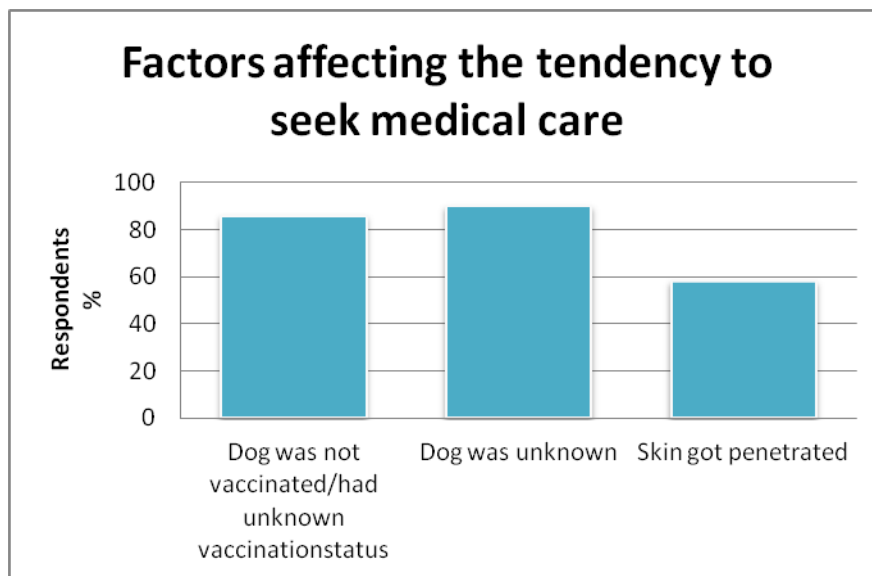


Figure 3. Different factors that made 2 298 people in area 25 and 23 more or less prone to seek medical care when bitten by a dog.

Of the 51 dog-bite cases just two persons reported complications secondary to the bite; one person had had a few days of fever and the other one had gotten bitten in a finger and the finger was still not alright. Of the 51 dogs that did bite, eight dogs were killed, no measures was taken to 31 of the dogs and with the other 12 the respondents did not know what happened.

Of the bitten people seeking medical care 14 people of 39 (36%) got vaccinated against rabies and 11 people (28%) got one or several injections but did not know what kind. Twelve respondents (31%) did not get any injections and two respondents (5%) did not know if the bitten person got any injections or not (Figure 4). Of the people that got bitten by an

unvaccinated dog or a dog with an unknown status of vaccination and did seek medical help, 58% knew that they got vaccinated against rabies at the medical centre and 84% could tell that they got some kind of injection.

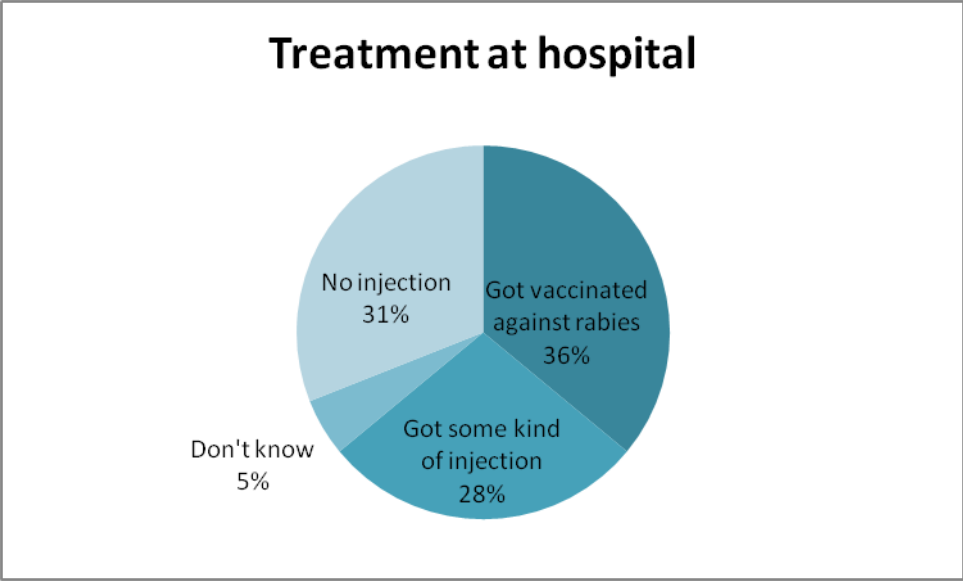


Figure 4. Proportion of kind of treatment among 39 people that did seek medical care when bitten by a dog.

Of the people that got both bitten by a non vaccinated dog (or not known if vaccinated) and that got their skin penetrated 64% got anti-rabies treatment and 82% got some kind of injection. Among the people receiving anti-rabies treatment after a dog-bite the average number of injections was 3.7. Two respondents reported lack of vaccines in hospital or that the hospital had ran out of vaccines as a reason to why not getting more injections or not getting any treatment.

Vaccination coverage

Of 190 dogs in the two areas 108 were vaccinated against rabies and of those 48% had been vaccinated during the last year. However, 47 of the dogs were pups and 2 of the dogs had been too young at the time the vaccination team was vaccinating in the area. The respondents were also not sure if 6 dogs (all pups) were vaccinated or not. Excluding these gives final vaccination coverage in the adult dog population of 59% for both areas.

Area 25 had vaccination coverage of 50% in the adult dog population, including only dogs that had been vaccinated during the last year. In area 23, 69% of the adult dogs had been vaccinated during the last year. The difference in coverage is statistically significant ($p \leq 0.05$). Including all adult dogs that have been vaccinated some time during their lives, it gives vaccination coverage of 58% in area 25 and 86% in area 23. The difference is statistically significant ($p \leq 0.05$).

In area 23 a higher proportion of the dog owners had paid for the vaccinations of their dogs than in area 25 (38%). The difference is statistically significant ($p \leq 0.05$). In area 23 none of the vaccinations were said to be made by LSPCA but 70% of the dogs in the area were vaccinated by the Government (Figure 5). Also in area 25 the Government was the main vaccinating actor, but had only done 38% of the dogs.

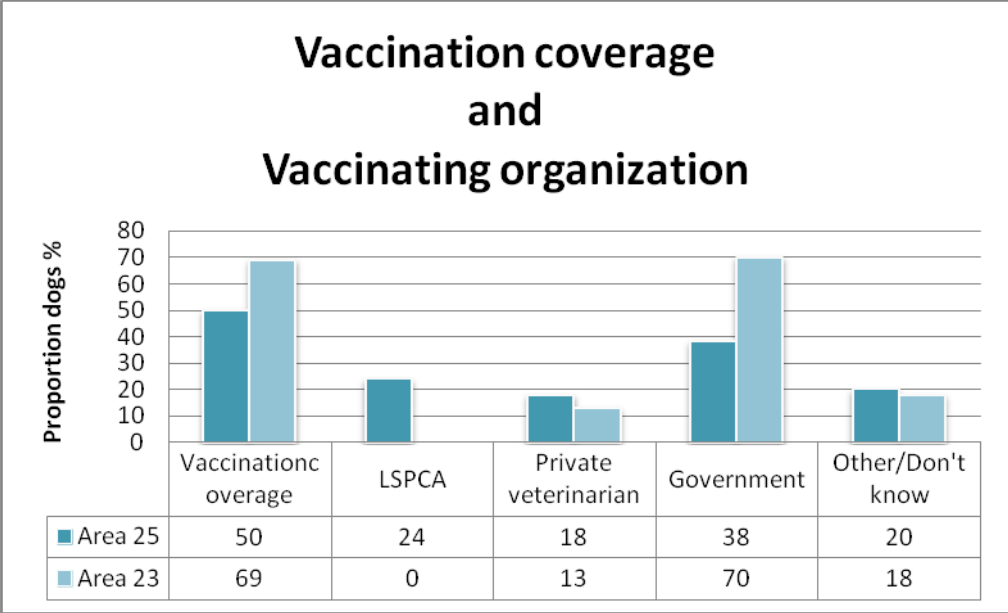


Figure 5. Vaccination coverage among 190 dogs and different actors that have been vaccinating in area 25 and 23.

From the first of September 2012 (about a year ago from the start of this survey) the LSPCA vaccinated 256 dogs in area 25 in their community clinic. Their last day of vaccinating in area 25 was the last of March, which includes seven months during the last year. During this period 3.8% of the dog population got vaccinated. It means that in average 0.5% of the population got vaccinated in a month and consequently there was annual vaccination coverage of 6.2%. During the annual vaccination campaign for 2013, 1 483 dogs got vaccinated against rabies in area 25 and 1 221 dogs in area 23. The campaign was conducted during ten days in end of October and beginning of November 2013 (after this survey was made). The vaccination numbers mean that coverage of 22% was achieved in area 25 and 42% in area 23. In 2012 the annual vaccination campaign was conducted in the very beginning of September (slightly more than a year before the start of this survey) and during that one just 152 dogs got vaccinated in area 25 and 592 in area 23. Poor publicity was considered as the reason to the low number in 2012 (Ssuna, 2013, pers. comm.)

Reasons to death among dogs and number of dogs tested for rabies

In total the households had had 143 dogs that died during the last year. The most common reason for death was “killed by other people/poisoned” and only six dogs died because of age. Four dogs died or were killed due to suspected rabies but the diagnosis was not confirmed by

laboratory analysis. Counting the number of alive adult dogs and the number of dogs that had died during the previous year gives an annual mortality of 49%.

In 2011, 14 dogs from Lilongwe District got tested for rabies in Central Veterinary Laboratory. Of these seven turned out to be positive. In 2012 nine dogs were tested and all of them were positive (Njunga and Pzimhiri, 2013, pers. comm.).

DISCUSSION

Vaccination coverage of 59% means that more than half of the dog population in area 25 and 23 is vaccinated against rabies. In area 25, where the LSPCA has been vaccinating dogs in their community clinic as well as in their annual vaccination campaign, the vaccination coverage is 50%. It is less than 70% that is the recommended vaccination coverage of the WHO (2004), to control canine rabies. However, Hampson et al. (2009) mean that boosting vaccination coverage to 60% once a year is enough to eliminate rabies, for areas with high dog turnover rates. This survey was done just a month before the start of the next annual vaccination campaign and having a coverage of more than 50% at this time must be considered quite good. Based on these details it seems possible and even likely to reach coverage of at least 60% during the following, annual campaign.

The statistics from the vaccination campaign together with the estimation of the dog population size achieved from this survey, showed that the campaign only reached coverage of 22% in area 25 and 42% in area 23. This is rather low but the fact that the total vaccination coverage achieved in this survey was 59% indicates that other vaccinating actors are likely to be involved as well and together a good coverage is acquired. Hampson et al. (2009) also mentioned in their study that coverage of ~20-45% had been enough to control rabies in other studies from around the world. It should also be kept in mind that the size of the dog population was estimated and that the size of the human population (which was used for estimating the dog population size) was from 2010 and consequently a bit old. Furthermore the number of dogs without owner is not known and if this group of dogs is large the true vaccination coverage is lower. The achieved vaccination coverage of 42% in area 23 in the vaccinating campaign was higher than in area 25. It is likely easier to reach higher coverage in a smaller area (area 25 is geographically bigger than area 23) since it is easier to spread publicity about the event.

If the vaccination coverage of 59% in area 23 and 25 is valid for entire Lilongwe the general vaccination coverage for the city is good. However, to make an extrapolation like that more information should be obtained of factors that can affect the vaccination coverage. For example how the socioeconomic status differs in the city and if the way to keep dogs differs in different city areas.

This survey indicates that vaccination campaigns are likely to have bigger impact on vaccination coverage than the work of community clinics, seen to the fact that the vaccination coverage achieved by the community clinic in a year was very low compared to the result in the campaign 2013. By itself the community clinic gave vaccination coverage of only 6.2% in

a year. Still the castrations of dogs made by the community clinics keeps the dog population stable (if enough dogs get castrated) which is beneficial also for keeping high vaccination coverage for a longer time. In a steady dog population with a low dog turnover rate, it takes longer time for the vaccinated individuals to get exchanged for non-immunized dogs than otherwise. To fight rabies both vaccination campaigns and dog population control should be included, but it would be interesting to investigate further if it is beneficial to spend more money on vaccination campaigns than on running community clinics.

Vaccination coverage was significantly higher in area 23 (where the LSPCA has not had their community clinic) than in area 25, which may have different explanations. The areas are supposed to be similar seen to socioeconomic factors according to local contacts. When performing the interviews both areas also seemed very similar in appearance. Although 65% of the dog-owners in area 23 had paid for getting their dogs vaccinated compared to just 38% in area 25 which might be due to a better economic situation in area 23 than in area 25 – or that it has been a free option (provided by the LSPCA) in area 25. Awareness of rabies was somewhat higher in area 23 too, which might increase the interest in getting the dogs vaccinated. Furthermore only 3.8% of the dogs in area 25 had been vaccinated in the community clinic during the last year and 6.2% in average every year which is a quite low proportion and it might not be big enough to make any difference in the total vaccination coverage. One further possible explanation to the difference between the areas is that the vaccination coverage in area 23 was much higher from the beginning than in area 25 and that the difference today is smaller than originally.

Eleven percent of the households in area 25 and 23 had someone bitten by a dog in the last year. This incidence is similar to the one in KwaZulu where canine rabies also is endemic. In KwaZulu 12% of 1 992 households had someone bitten by a dog in the last year (Hergert, 2013). In Lilongwe, this survey showed that 2.2% of the population in area 25 and 23 got bitten by a dog during one year. Extrapolating these numbers to entire Lilongwe City gives an annual bite incidence of 2 220 cases per 100 000 people (with 16 000 dog bites occurring in total per year). That is nine times more than 243 bites per 100 000 people and year, which was recorded by the LDA for entire Lilongwe *District*. Cleaveland et al. (2002a) predicted human rabies deaths on the basis of dog bites in Tanzania. In their surveillance they found a mean yearly bite incidence of 103.9 cases per 100 000 people and predicted an annual incidence of 4.9 deaths in rabies per 100 000. According to the result in this survey, Lilongwe City has a much higher incidence of dog bites than Tanzania. Also Lilongwe District has a higher bite-incidence than Tanzania, considering the national bite statistics from the LDA. It might not be representative to compare Lilongwe City with an entire nation (Tanzania) but comparing Lilongwe District and Tanzania should be more equivalent. The annual bite incidence indicates together with the correlation between number of dog-bites and human deaths in rabies (from the mentioned survey by Cleaveland et al.) that the annual incidence of human deaths in the disease is much higher in Lilongwe than the reported number. The reported number of human deaths in rabies was five cases in 2011 and two cases for the first nine months in 2013 for Lilongwe District (Saini, 2013, pers. comm.). In 2013 Chenjezi

reported that 200 Malawians and probably more than that die of rabies every year. Only 8% of the population in Malawi live in Lilongwe District and accordingly the national death incidence is likely to be higher than 200 (National Statistical Office, 2008; Landguiden, 2013).

Using the same relationship between dog-bite incidence and incidence of human deaths in rabies as in Tanzania, it indicates an annual incidence of 105 human deaths in rabies per 100 000 in Lilongwe City (with records from this survey). Extrapolating the relationship to entire Lilongwe District, it gives an indication of 11 deaths per 100 000 (using national bite statistics). Although as already mentioned, it should be kept in mind that these numbers are estimations and extrapolations and consequently the reliability is not very high - but the indication of that the human death incidence in rabies is higher than reported is still steadfast.

Awareness of rabies is high within both area 23 and 25. In total 98% of the respondents affirmed that they had heard of rabies and 71% could tell that it is a disease that can get transmitted from dogs to humans. It indicates a high awareness of rabies in Lilongwe City, but there is still space for improvements. Some of the people, who stated that they had heard of rabies, had probably not in reality but perhaps they did not want to appear untaught. That 71% could tell that rabies is a disease that can get transmitted from dogs is probably a more reliable number. The results accord quite well with the opinion of the District Health Doctor in Lilongwe who means that “everybody knows about rabies” and that at least more than 75% of the human population knows that it is a disease and can tell how it is transmitted. The fact that 88% of the respondents stated that they would seek medical care if bitten by a dog in order to get treatment against rabies also indicates a high awareness. When comparing these statistics with studies from other African countries where the awareness of rabies also has been investigated similar results are proved. For example in KwaZulu in South Africa, 88% of the urban citizens had heard of rabies. In KwaZulu the source of knowledge to rabies was studied as well. The Government Veterinary Services was recorded as the main source (Hergert, 2013). It would be interesting to investigate the source of knowledge to rabies also in Lilongwe.

Of the people bitten by dogs (51 cases) 76% did seek medical care. If the dog that did bite was not vaccinated against rabies or not known if vaccinated the tendency to seek medical help was higher; 86%. It was no statistical significant difference in tendency to seek medical help if the dog that did bite was known to the bitten person or not.

Of the people that got bitten by an unvaccinated dog or a dog with an unknown vaccination status 84% knew they got some kind of injection/-s when seeking medical care. When excluding the respondents that did not know if the bitten person in their household got any injections or not, 11% of the people bitten by an unvaccinated dog or a dog with unknown vaccination status did not get anti-rabies treatment. Two respondents said that the hospital had ran out of anti-rabies vaccine and this is likely to be the main reason to why this group of bitten people did not get treatment. Of the people that knew they got anti-rabies treatment at the medical centre the average number of anti-rabies vaccine was 3.7 doses. The criteria of the

WHO for post-exposure treatment are five doses and this is the treatment regimen that Mr Mwale, the District Health Officer, says is followed in Lilongwe. Reasons to why the average number of treatments is lower than five is likely to be that the medical centers try to save doses to be able to treat more people. Depani et al. (2012) say that within Malawi rabies vaccine is often not available at local medical centers or “very hard to access”. Another explanation is that if the dog that did bite is put under observation and noted not rabid the treatment can be stopped and the person might then have received less than five doses.

Rabies has in general often a low national priority, which can be explained by the fact that it is estimated to account for only 1% of human deaths due to infectious disease (Meslin et al., 1994). However there is considered to be a very high level of underreported cases and that the true incidence is actually much higher (WHO, 2004). In Malawi the DHO means that the level of underreported rabies cases probably is high but he has not rabies included on his “top 10 list” of important diseases. Except from that rabies is likely to have a higher incidence than known, another factor making the disease worth a higher priority to prevent is the high cost of human treatment post to exposure (Bogel, 2002; Meslin, 1994). In Lilongwe the authorities are aware of rabies but is not highly prioritized and not considered as one of their majority disease problems.

The DHO in Lilongwe estimates the number of treated people per year in Lilongwe District to about 200 and says that the cost of one dose of vaccine is 20 US dollars (Mwale, 2013, pers. comm.). It means that the government has to pay 100 US dollars per treated person which in total gets 20 000 US dollars in treatment costs per year, and that is just the cost of the vaccinations. Furthermore there are costs for medical staff, wound cleaning and dressings, tetanus injections etcetera. The cost for health care in Malawi was 17 US dollars per person in 2007 (Landguiden, 2013). It means that the cost of PEP constitute 0.1% of the total cost of health care in Lilongwe District. Consequently rabies is likely not the disease that make up the biggest burden to the health system in the district but still the costs could be eliminated if rabies got eradicated from the area and it would relieve the budget for an already strained system. In comparison to the human PEP costs, the costs of vaccines for vaccinating the dog population in the district would be about 48 000 US dollars per year. It is more than the double cost compared to the costs of PEP but it also includes the advantage of preventing the cases that today never get treatment and die undiagnosed.

Area 25 and 23 had together a dog:human ratio at 1:12.0, which is similar to such ratios calculated in other surveys in sub-Saharan Africa. For example Iringa in Tanzania, an urban area just as area 25 and 23 in Lilongwe, had a dog:human ratio at 1:14.0 (Gsell, 2012). Extrapolating the dog:human ratio in area 25 and 23 to entire Lilongwe City gives a total dog population of 60 300 dogs, which is more than 44 170 dogs (which was the estimation of the dog population size made for the entire *district* by the LDA). Probably the situation in area 25 and 23 is not completely representative for entire Lilongwe but it still indicates that the dog population is likely to be higher than expected. The Veterinary Officer at the LDA estimates the number of dogs infected by rabies every year to about 300. The number of cases tested by

laboratory was although just 14 cases in 2011 and 11 in 2012, which is a very low proportion dogs.

In area 25, 38% of the dogs had been vaccinated by the government and 24% by the LSPCA. Although it is possible that some of the dogs that were said to have been vaccinated by the government actually got vaccinated by the LSPCA. Sometimes the respondent to the interview was not the same person who took the dogs to vaccination and consequently he/she might have guessed it was the government who vaccinated since it was for free. Also, since it was the City Council that subsidized the vaccinations, the government was involved in the vaccinations performed by the LSPCA as well and can be held as responsible. Furthermore very few of the responding households could show a vaccination certificate; either they did not know where they had it or someone else in the household (who was not around at the moment) took care of it. It means that proof for that the dogs were vaccinated were missing in most cases and that the achieved vaccination coverage is based on the statements of the respondents.

Of the respondents 99% said they would seek medical care if bitten by a dog and 88% mentioned “to get treatment against rabies” as the main reason to why they would seek medical care. However, of the people that had become bitten by a dog only 76% did seek medical care. It indicates that people not always act as they say they would do and it must be considered as a source of error when it comes to studies based on people’s statements, as this one is. Probably people are aware of the optimal way to act when it comes to for example rabies and dog bites but when a dog bite actually occur, life interferes and perhaps they have no car to get to hospital, they cannot stay away from work in order to get money to feed their family or something else.

A possible source of error is communicational misunderstandings during the interviews due to language, since English was not the native language either for the author of this thesis, the interpreters and rest of the staff at LSPCA or any of the interviewed authorities. Misunderstandings can for example have occurred when translating the household-interviews or when interviewing authorities. Although in all communication the attempt has been to be as clear and accurate as possible. Also having two interpreters can have resulted in some discrepancies in the information given to the people interviewed in the households.

CONCLUSIONS

The survey shows that the awareness of rabies in area 25 and 23 in Lilongwe is very good and that most people would seek medical care if bitten by a dog. Area 25 and 23 had together vaccination coverage of 59% which is less than 70% that is recommended by the WHO, but when considering that it was only a month left to the next annual vaccination campaign the coverage must be considered high.

Area 25 had lower vaccination coverage than area 23, although the LSPCA had had their community clinic based in area 25 while no free vaccinations had been provided by the organization in area 23. However, the vaccination coverage reached by the community clinic

was quite low and it has probably not contributed much in increasing the total coverage. Furthermore awareness about rabies was somewhat higher in area 23 which might make people more prone to vaccinate their dogs. It is also possible that the vaccination coverage was higher in area 23 from the start, compared to the situation in area 25.

Extrapolating the relative amount of dog bites in area 25 and 23 to entire Lilongwe show much higher frequency of dog bites than the national statistics from the LDA declares. Other studies show relationship between number of dog-bites and number of human deaths in rabies. When comparing the dog-bite incidence in Lilongwe to the incidence seen in a neighbor country, Lilongwe has a very high incidence which also indicates a much higher incidence of human deaths in Lilongwe than reported.

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Non published material

1. Eric Mitembo, Project Assistant at LSPCA, personal communication 13th of September 2013.
2. Gilson Njunga, Officer in Charge, and Precious Pzimhiri, Chief Technical Officer, at Central Veterinary Laboratory in Lilongwe, personal communication September 2013.
3. Jorex Kantokoma, Assistant Public Health Officer at the City Council in Lilongwe, personal communication September 2013.
4. Mwawi Mwale, District Health Officer in Lilongwe, interview 11th of September 2013.
5. Patrick Saini, Veterinary Officer at Lilongwe District of Animal Health and Livestock Department, interview 9th of September 2013.
6. Richard Ssuna, Program Director at LSPCA, interview 11th of September 2013.

APPENDIX 1

Interview questions for households with dogs

1.
 - a. Date?
 - b. Interviewer?
 - c. Area?
 - d. Block?
 - e. House number?
2.
 - a. Gender of respondent?
 - b. Head of household?
 - c. How many people are members of the household?
3.
 - a. How many dog/-s belong to the household?
 - b. How many are adult dogs versus puppies (younger than six months)?
4.
 - a. Have you had any dog/-s that died during the last year?
If yes:
 - b. How many?
 - c. Why did it/them die?
5.
 - a. Did anyone in the household get bitten by a dog during the last year?
If yes:
 - b. How many cases of dog bites happened?
 - c. Did the skin get penetrated?
 - d. Did that person seek medical care?
If yes:
 - i. What kind of injections did the person get?
 - ii. How many anti-rabies vaccinations did the bitten person get?
 - e. What happened to the person that was bitten afterwards?
 - f. Was the dog that bit vaccinated against rabies before the incident?
If yes:
 - i. How did you get to know that?
 - g. What happened to the dog afterwards?
 - h. Did you know the dog?
6.
 - a. Would you seek medical care if bitten by a dog?
If yes:
 - b. Why would you seek medical care?
If no:
 - c. Why would you not seek medical care?
- 7.

- a. Are your dogs vaccinated against rabies?
If yes:
- b. Why?
- c. Can we see the certificate? / Which year did each of the dogs get the last vaccination?
- d. Who did the vaccination? Did you have to pay?
If no:
- e. Why not?

8.

- a. Have you heard of rabies before?
If yes:
- b. What do you know of rabies?
- c. Do you consider rabies being a problem in your living-area?

Interview questions for households without dogs

As above but question number three and seven were excluded.