A COMPARATIVE STUDY ON THE CAPACITY OF HEALTH WORKERS AND HEALTH CENTRES TO DIAGNOSE HUMAN AFRICAN TRYPANOSOMIASIS IN TSETSE INFESTED CHAMA AND MAMBWE DISTRICTS OF EASTERN ZAMBIA

By

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DELCARATION

I, **Gloria M. Mulenga**, do here by declare that: “This Dissertation is my original work and has not been presented for a degree in any other university and that all sources that I have quoted have been acknowledged by means of complete references.”

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CERTIFICATE OF APPROVAL

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ABSTRACT

This study was carried out to investigate and compare the levels of knowledge on Human African Trypanosomiasis (HAT), disease awareness among health personnel and factors affecting the diagnostic capacity of HAT in tsetse infested Chama and Mambwe districts of Eastern Zambia. Structured questionnaires were used to collect information from 110 health personnel drawn from 23 rural health centres (RHCs). Both districts reported low staffing levels for experienced laboratory personnel (7.7% for Chama and 12.2% for Mambwe). According to the survey, about 67.3% and 42.9% of the interviewed staff in Chama (n=52) and Mambwe (n=49), respectively, reported to carry out further investigations on patients that tested malaria negative (P =0.027). More staff from Chama district reported to have encountered HAT compared to Mambwe (P =0.000). About 88.5% (n=52) of the interviewed staff from Chama district were aware about the possible occurrences of HAT in their district (responses included abnormal sleep, headache, body pains, lymph node enlargement and microscopy) while the level of awareness in Mambwe district was 77.6% (n=49). The overall responses on the availability of basic laboratory tools for HAT diagnosis (including giemsa staining solution and microscopes) indicated that there was no significant difference (P>0.05) between the two districts although 43 suspected HAT cases were reported and 8 cases confirmed in Chama district between 2003 and 2013 while only one confirmed case was reported in Mambwe district during the same period. Both districts reported low collaboration with private sectors and low support from both government and private departments regarding the management of HAT compared to support received for malaria, HIV/AIDS and TB (P =0.007). In conclusion, health personnel from Chama and Mambwe districts had the potential to diagnose HAT but lacked sufficient support from both the government and private sectors to diagnose the disease.

DEDICATION

I dedicate this study to all the people who died from HAT and were not able to get medical attention because they did not know the cause of their illness or they lived in places where access to treatment was difficult.

This also goes to all survivors of HAT for their actions taken to seek treatment and all individuals who have dedicated their lives towards the fight of this disease and other neglected tropical diseases which have continued to take the lives of many innocent individuals.

To all, I say “Don’t give up! Let us keep the candle burning towards the fight and control of the so called neglected diseases”

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LIST OF ACRONYMS

AAT	African Animal Trypanosomiasis
AIDS	Acquired Immune Deficiency Syndrome
CATT	Card Agglutination Test for Trypanosomiasis
CNS	Central Nervous System
CSF	Cerebrospinal Fluid
CSO	Central Statistics Office
DNA	Deoxyribonucleic Acid
ELISA	Enzyme-Linked Immune Sorbent Assay
FAO	Food and Agriculture Organization
GRZ	The Government of the Republic of Zambia
HAT	Human African Trypanosomiasis
HIV	Human immune-deficiency Virus
IAEA	International Atomic Energy Agency
LAMP	Loop-Mediated Isothermal Amplification
MOH	Ministry of Health
NTDs	Neglected Tropical Diseases
PAAT	Programme Against Trypanosomiasis
PATTEC	Pan African Tsetse and Trypanosomosis Campaign
PCR	Polymerase Chain Reaction
QBC	Quantitative Buffy Coat

RHC	Rural Health Centre
SIT	Sterile Insect Technique
UN	United Nations
WHO	World Health Organization

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CHAPTER 1: INTRODUCTION

1.1.BACKGROUND

Human African Trypanosomiasis (HAT), also known as sleeping sickness, is a debilitating vector-borne disease mainly occurring in sub-Saharan Africa (World Health Organization, 2006). It is caused by a protozoa belonging to the genus *Trypanosoma* transmitted by tsetse flies (Family: Glossinidae, Genus: *Glossina*). The two species of the human infective trypanosomes are *Trypanosoma brucei gambiense* (found in west and central Africa) and *Trypanosoma brucei rhodesiense* (found in eastern and southern parts of Africa, including Zambia) (Simarro *et al*, 2008). Wild animals are the main reservoirs for the parasite (Anderson *et al*, 2011). Trypanosomes also cause disease in livestock, in which case the disease is referred to as African Animal Trypanosomiasis (AAT) also known to as *Nagana* (Blum *et al*, 2006). The absence of an effective vaccine against trypanosomiasis makes its control very difficult. As such, trypanosomiasis is currently controlled by either (i) directly targeting the parasite by means of chemotherapy, or (ii) by targeting the tsetse vector including the use of bait technology (odour baited insecticide treated targets), aerial or ground spraying with non-residual insecticides, sterile insect technique (SIT), and bush clearing (Jannina & Cattand, 2004; Lutumba *et al*, 2005).

HAT may not seem as an important disease on the world stage as diseases such as malaria, tuberculosis and HIV/AIDS, but is nevertheless an important disease in sub-Saharan Africa, responsible for a considerable degree of suffering and mortality in countries where it is endemic (Hide, 1999). Apart from the fact that the final outcome of the disease if untreated is death for the victim, equally devastating is the effect of the disease on communities and quality of life resulting from the debilitating symptoms (Knudsen & Slooff, 1992).

Control of HAT in Zambia has been based on passive case detection and treatment of HAT cases in hospitals in transmission areas (Mwanakasale & Songolo, 2011) which in most cases has missed HAT patients in the community who are unable to go to the health centres. Understanding the way a disease manifests itself by health personnel is very important in diagnosis. The ability to detect HAT patients depends on disease knowledge amongst health workers, which in turn encourages patients to visit the health centre for diagnosis (Odiit *et al*,

2004; Sindato *et al*, 2008). Translation of such knowledge into proper care of patients is among the critical areas in health care delivery. This is only possible if health service providers have the right knowledge of health problems they are dealing with (Chappuis *et al*, 2005). It is assumed that the more years of service for the health staff in a particular district, the more knowledge and experience gained from the type and occurrences of diseases in the area. Inadequate knowledge of any aspect of a disease is a potential contributing factor to mis-diagnosis; therefore, assessing the knowledge of practitioners could be an important step in identifying target receptors for public health education (John *et al*, 2008).

WHO (2005) estimates that (i) in the affected parts of Africa, over 65 million people, the majority of whom live in remote rural areas, are at risk of contracting HAT, (ii) more than 500,000 people are infected with the disease, and that (iii) about 50,000 people die from the disease every year with the situation rapidly deteriorating and increasingly more new cases being registered every year (Table 1). Despite the WHO projection of over 65 million people at risk in Africa, only a fraction of that population are under surveillance and relatively few cases are diagnosed annually (Engels & Savioli, 2006).

Table 1: New cases of HAT from 2000 to 2009 in some endemic countries

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	**Total**
Uganda	300	426	329	338	335	473	261	119	138	129	**2,848**
Tanzania	350	277	228	113	159	186	127	126	59	14	**1,639**
Zambia	9	4	5	15	9	7	6	10	13	4	**82**
Zimbabwe	0	0	0	0	0	3	0	0	0	3	**6**
Mozambique	-	-	1	-	1	-	-	-	-	-	**2**

Source: WHO [*http://www.who.int/emc/diseases/tryp/trypanogeo.html*](http://www.who.int/emc/diseases/tryp/trypanogeo.html)

The WHO Expert Committee on HAT Control and Surveillance held in 1995, in consideration of huge uncertainties between the reported cases and factual field situation estimated that the true number of cases was at least 10 times more than the reported ones. Thus, from the 30,000 reported cases annually, it was estimated that some 300,000 infected individuals remained ignored in the field (WHO, 2006). According to Odiit *et al* (2005), significant under-detection revealed that for every three reported HAT cases, approximately two additional cases went undetected and resulted into death and also that, for every patient dying on admission, approximately 12 are dying unseen, indicating a high level of under-detection. The inability of health centres to detect HAT due to insensitive techniques for HAT diagnosis (Chappuis *et al*, 2005) among others could have also contributed to such underestimated prevalence of HAT (Duke *et al*, 1984; Chappuis *et al*, 2005).

According to WHO (2005), Zambia reports less than 100 cases of HAT per year. As shown in table 1, 82 cases of HAT have been reported between the years 2000-2009 (http://www.who.int/emc/diseases/tryp/trypanogeo.html). However, according to Simarro *et al* (2008), an upward trend of HAT cases has been recorded in the old foci of HAT in the Northern part of the Luangwa valley between 1999 and 2006. With Chama and Chipata being among the districts that are still recording HAT cases in North-Eastern Zambia (Mwanakasale & Songolo, 2011), there is therefore, likelihood that Mambwe and Chama districts which are situated in the central Luangwa valley of Eastern Zambia (Fig. 1), could have such trends and recording more cases than indicated in table 1 above, but highly under-reported due to the remoteness of these areas (World Bank, 2000).

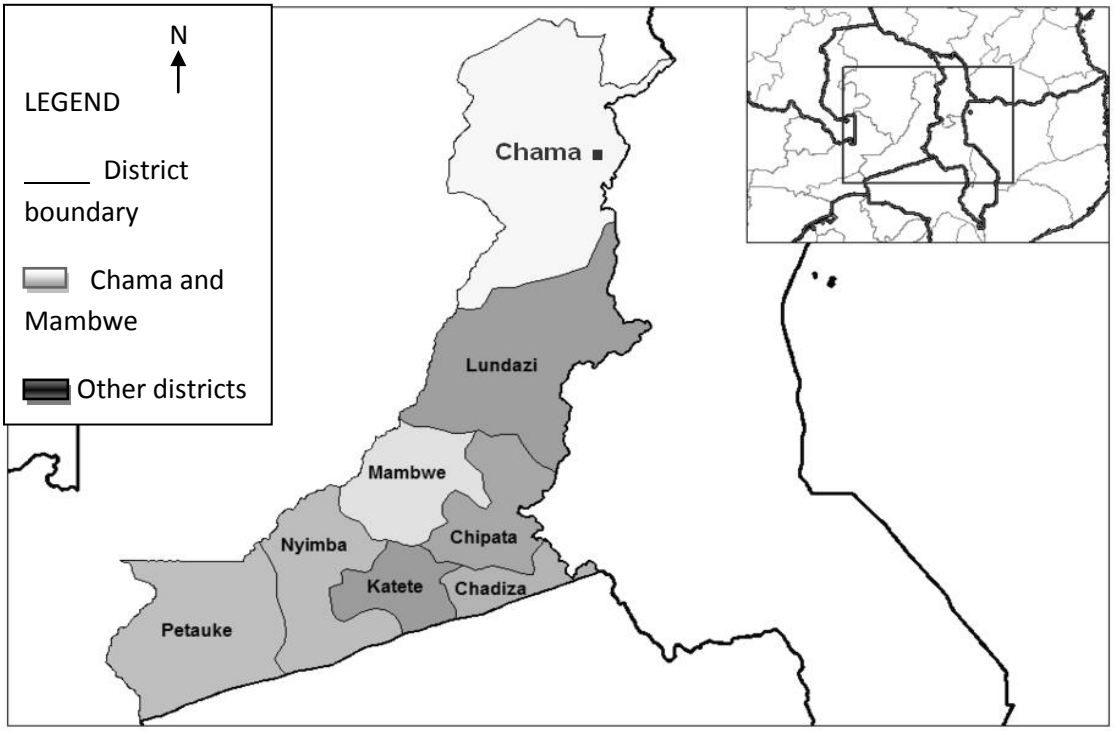

Figure 1: Map of Zambia showing location of Chama and Mambwe districts

Source: CSO-Geographic Information Systems Unit

This study therefore aimed at gaining insights into the prevailing position of the health services relative to HAT; investigate the level of knowledge, disease awareness among health personnel and diagnostic capacity of HAT at RHCs in Mambwe and Chama districts. The study is expected to help identify opportunities that may exist for improved detection of cases of HAT in the tsetse infested areas of the Luangwa valley as well as provide an overview of mortality cases due to HAT that may otherwise go undiagnosed.

1.2. STATEMENT OF THE PROBLEM

HAT is overwhelmingly a disease of tsetse infested remote rural areas inhabited by wild animals where man is a casual intruder and access to medical facilities is very limited. There is considerable under-diagnosis of HAT caused by *T. b. rhodesiense* in sub-Saharan Africa including Zambia (Odiit *et al,* 2005). Therefore data available on cases of HAT diagnosed annually in Zambia as indicated in table 1 might not represent the actual situation on the ground. Initial symptoms of HAT are very similar to those of other common febrile diseases such as malaria and HIV/AIDS and this gives reason to suspect that in the absence of experienced personnel and diagnostic tools, HAT could easily be mistaken for other common ailments and may hence exist and cause fatalities without being identified as such (Odiit *et al,* 2004). Poor diagnostic facilities, shortage of experienced laboratory personnel, reduced knowledge and awareness of the disease among health care workers are probably significant determinants of both under-diagnosis and under-reporting of the disease (Fig. 2). As reported in a recent study (Mwanakasale *et al,* 2013), a number of challenges were identified that needed to be addressed if HAT was to be eliminated in a lowly endemic country such as Zambia. These included the following: shortage of trained health workers, inadequate diagnostic and treatment centres, lack of more sensitive laboratory diagnostic techniques and shortage of drugs for HAT treatment. In general, there is reduced knowledge of neglected tropical diseases such as HAT among medical practitioners in sub-Saharan Africa (John *et al*, 2008) which may have an effect on diagnosis. It is likely that a number of HAT cases may be missed by the local health facilities, even though treatment is readily available through WHO initiatives (WHO, 2002).

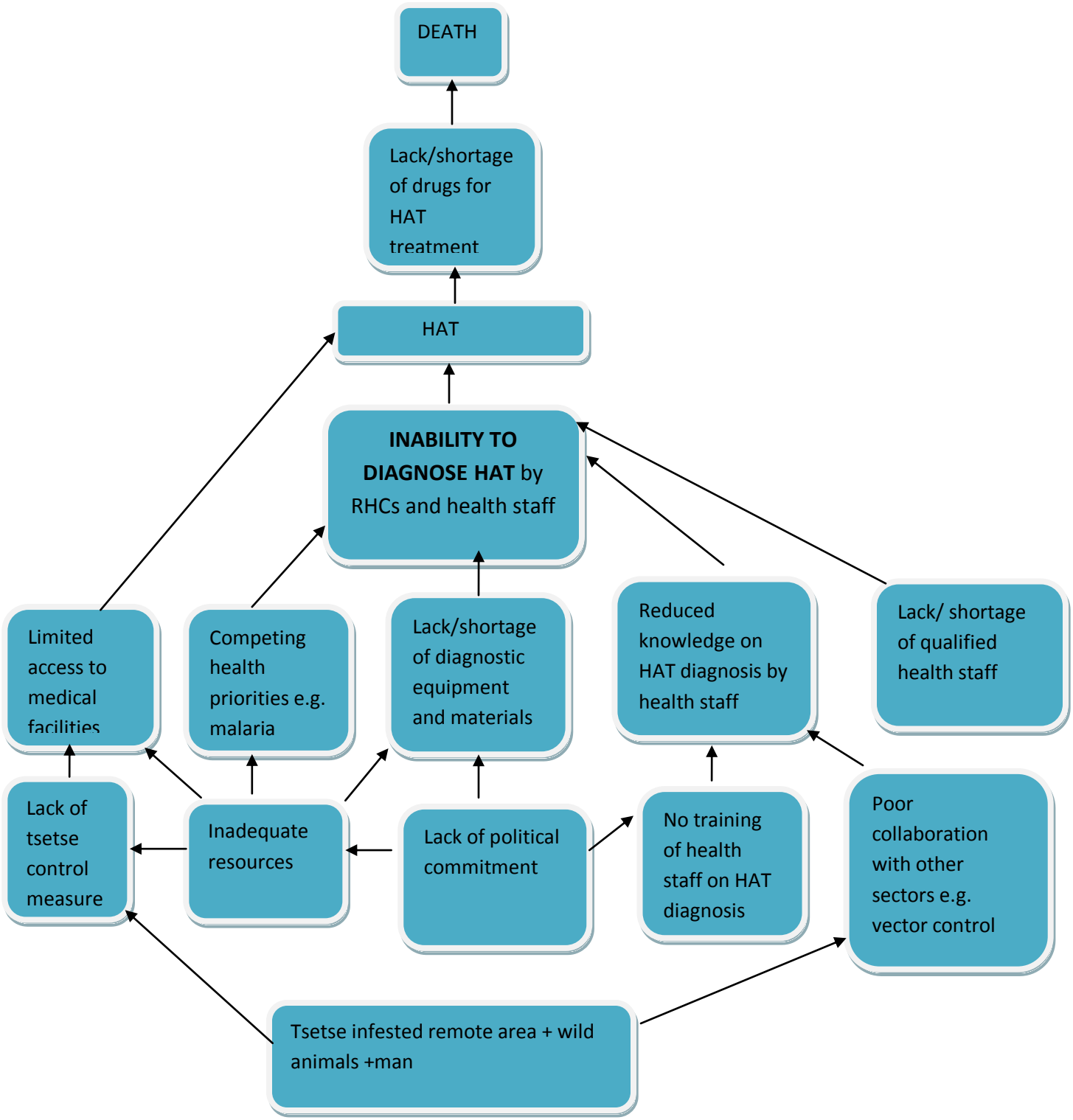

Figure 2: Problem Analysis Framework stating relationships of factors related to the core problem

1.2.1. Review of factors affecting the core-problem

Definition of the core-problem: Refers to the central and most important part of the research undertaken, in this case, the focus was on "The inability of health personnel to diagnose HAT".

Definition of ability: In this context, refers to the capacity of health personnel to diagnose HAT in respect to their levels of education, occupation, Knowledge and awareness of HAT, duration of service, availability of diagnostic tools for HAT detection as well as government and private sector support towards the management of HAT.

There are several factors that can be attributed to the inability to diagnose HAT among health personnel at RHCs in tsetse infested areas (see also Fig. 2). Some of these factors are reviewed below.

1.2.1.1.Lack of and qualified health personnel

Non availability of qualified health workers with the skill on the diagnosis of the parasite causing HAT might contribute to missed diagnosis of HAT and hence, lack of information on the occurrence of the disease in the area.

1.2.1.2. Lack/reduced knowledge and awareness on HAT

Lack of training on HAT diagnosis among health personnel may lead to their reduced/lack of knowledge on the manifestation/investigation of HAT hence, increasing the chances of mis-diagnosis of the disease.

Lack of awareness about the existence of HAT in the area especially among both health workers may lead to the assumption that HAT does not occur when in the actual fact it does and continue causing fatalities without being recognized as such.

1.2.1.3. Lack of political commitment

HAT is among the neglected tropical diseases which in order to be managed will require strong political commitment and support. Management of HAT requires organized efforts of the local government and other organizations as well as financial resources especially for the control of the tsetse vector.

1.2.1.4. Inadequate resources

Most governments are unable to respond quickly to problems either because there is no specific financial allocation for HAT control in the Ministries of Health (MOH) or those responsible for allocating resources for the management of HAT often do not understand the extent or

implications of the problem. Human, financial and material resources all play an important role towards HAT management as well as any other disease.

1.2.1.5. Competing health priorities

Competing health priorities such as the "roll back malaria" and "stop HIV/AIDS" programmes have forced health workers to forget about other diseases such as HAT which are equally important, hence, leaving loop-holes for outbreaks or disease re-occurrences, which may in-turn increase mortality rates if not properly managed.

1.3. RESEARCH QUESTIONS

The following were the study questions:

- What is the influence of knowledge and awareness among health workers on the diagnosis of HAT?
- What is the influence of HAT management and practices among health workers on the diagnosis of HAT?
- What is the influence of demographic characteristics of health workers on the capacity of the health centres to diagnose HAT?

1.3. OBJECTIVES

The objectives of the study were as follows:

1.3.1. General Objective

To assess the ability of RHCs and health workers to diagnose and manage HAT in the tsetse-infested Chama and Mambwe districts within the Luangwa valley in eastern Zambia.

1.3.2. Specific Objectives

- To investigate and compare the levels of HAT knowledge and awareness among the health workers in the selected RHCs in Mambwe and Chama districts.
- To compare the HAT diagnostic capacity of RHCs between Mambwe and Chama districts and establish how health workers diagnose, treat and manage HAT.
- To establish the reported HAT cases during the last ten years at the selected RHCs

1.4. Hypotheses

Null Hypothesis: In the settled tsetse infested parts of the Luangwa valley, health personnel and RHCs do not have the ability to diagnose HAT.

Alternative Hypothesis: In the settled tsetse-infested parts of the Luangwa valley, health personnel and RHCs have the ability to diagnose HAT.

CHAPTER 2: LITERATURE REVIEW

The Luangwa valley in Zambia supports high densities of tsetse flies and wildlife reservoirs and is recognized as a historical sleeping sickness focus. However, there is limited information published and available on studies done on HAT in relation to the health delivery system in HAT foci in Zambia. Data from a study conducted prior to this one identified a number of challenges that needed to be addressed if HAT was to be eliminated in lowly endemic countries like Zambia (Mwanakasale *et al*, 2013). A similar study conducted in Tanzania reviewed that medical practitioners in rural health facilities had poor knowledge of transmission of HAT and its clinical features compared to their urban counterparts (John *et al*, 2008). Another study conducted in Uganda on quantifying the level of under-detection of *T. b. rhodesiense* HAT cases emphasized the need to improve its surveillance through passive and active case finding as well as through increased awareness among affected communities, health workers and commitment of more resources for health services at the local level (Odiit *et al*, 2005).

2.1. HUMAN AFRICAN TRYPANOSOMIASIS

HAT is a zoonosis and remains an important public health problem in Zambia. It not only affects people's health, but because it also affects livestock (Fèvre *et al*, 2001; Simukoko *et al*, 2007), causing lowered productivity and death, it ruins their livelihood. Annual losses in agriculture alone have been estimated at over US$5 billion (Budd, 1999; WHO, 2004). HAT presents itself in two forms: a chronic form caused by *T. b. gambiense*, which occurs in west and central Africa (Gambian HAT), and the acute form, caused by *T. b. rhodesiense*, which occurs in eastern and southern Africa, including Zambia (Rhodesian HAT) (Fig. 3) (Picozzi *et al*, 2005).

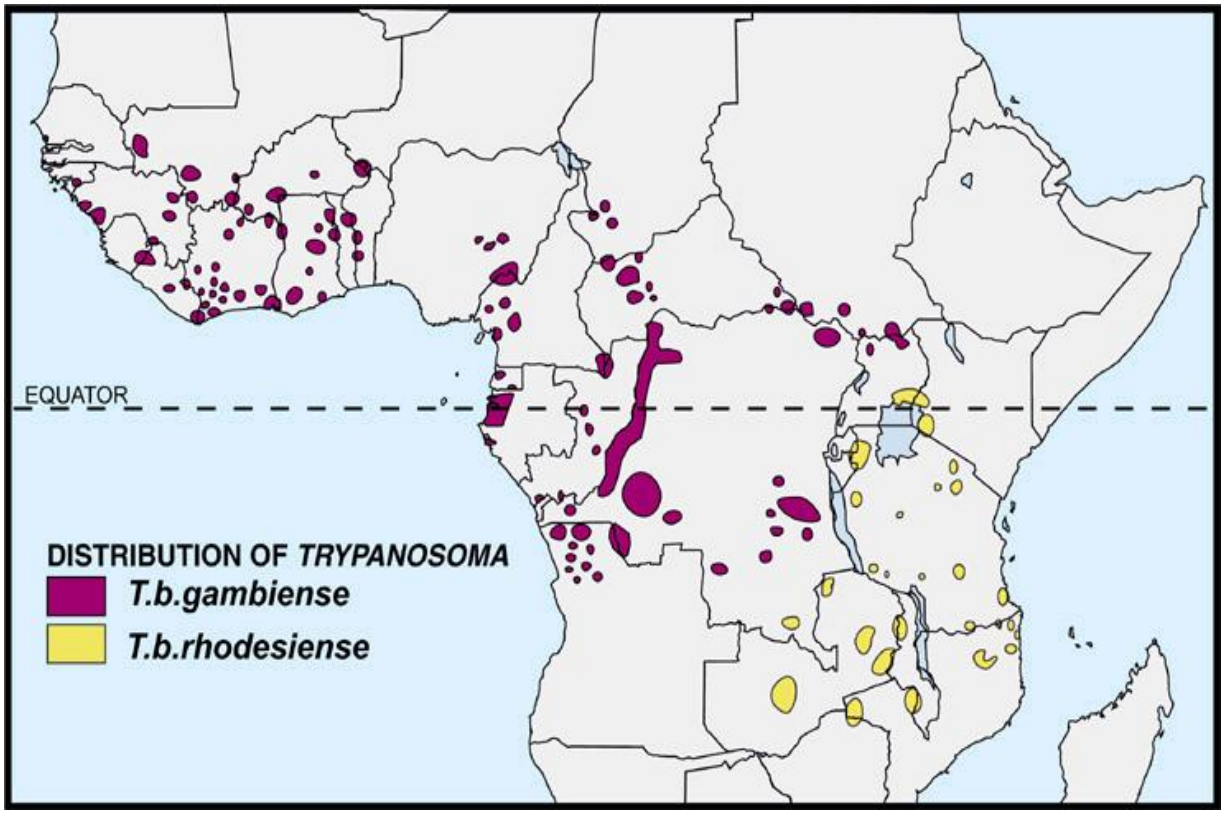

Figure 3: Map showing parts of Africa affected by HAT

Source: WHO 2006

The Gambian HAT, if left untreated, lasts for years while the Rhodesian HAT may take only a few months before death occurs (Simarro *et al*, 2008). Both forms of the disease have early and late/chronic stages. The early or haemolymphatic stage of the disease is characterized by relatively non-specific symptoms including irregular febrile episodes, headaches, weight loss, muscle and joint pains, anaemia, rash and loss of appetite (Oditt *et al*, 2005). During the late stages of infection when trypanosomes invade the central nervous system (CNS), patients experience severe headache, stiff neck, periods of sleeplessness, and depression. Focal seizures, tremors and palsies are also common. Coma eventually develops, and the patient dies (MacLean *et al*, 2010).

2.1.1. Disease distribution

HAT is a neglected tropical zoonotic disease (NTD) affecting poor rural communities living in the tsetse fly infested regions of Africa (WHO, 2006) with limited access to medical facilities

which hampers the surveillance and therefore the diagnosis and treatment of cases. In addition to poverty, displacement of populations and war are important factors leading to increased transmission and this alters the distribution of the disease due to weakened or non-existent health systems. WHO (2005) estimates that in affected parts of Africa, over 65 million people are at risk of catching HAT, but only a fraction of that population are under surveillance (Engels & Savoili 2006). In Zambia, HAT is distributed along the Luangwa and Zambezi valley basins with cases being sporadically reported (Fig. 4) (Manag'andu *et al*, 2012; Namangala *et al*, 2013).

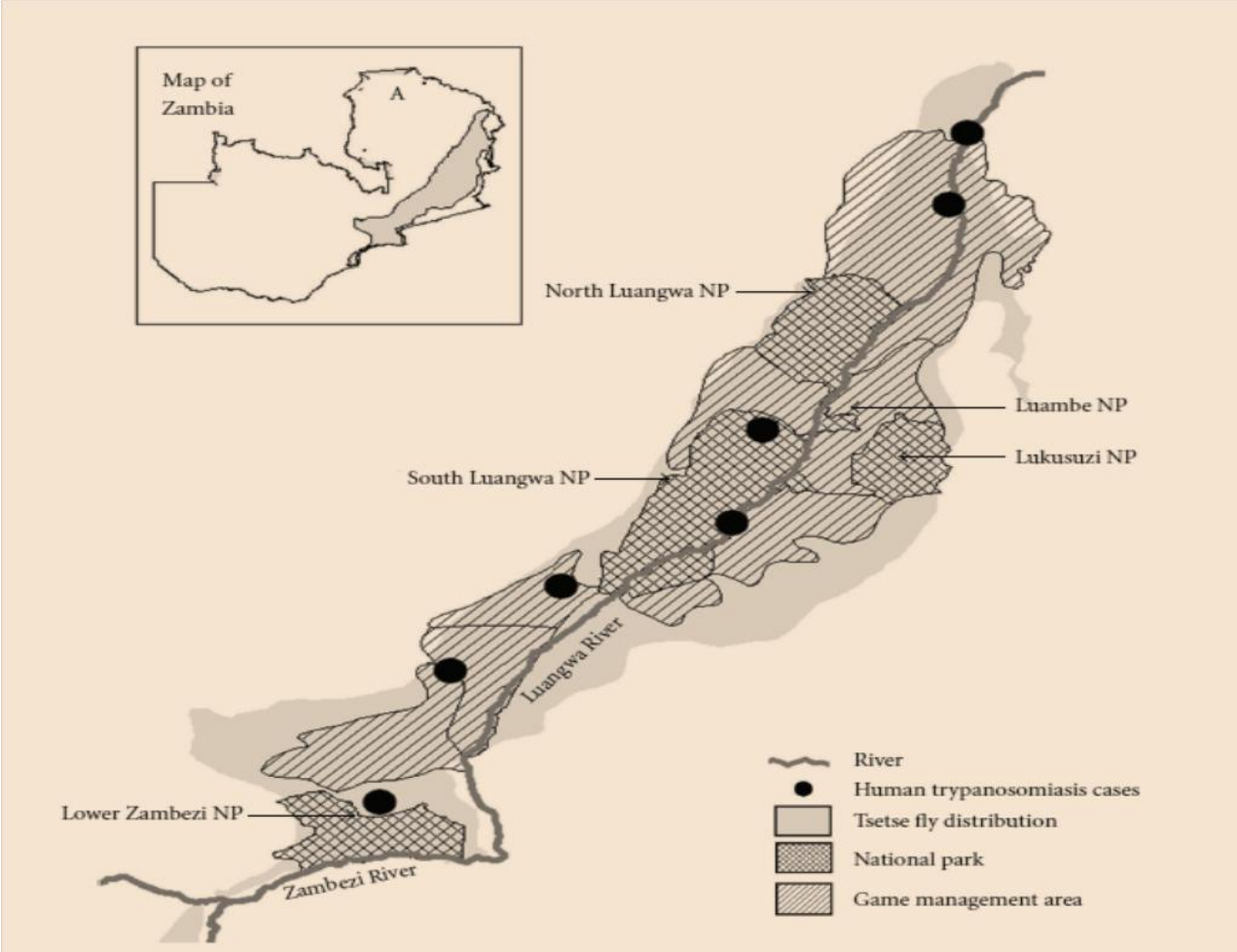

Figure 4: Map of showing distribution of HAT along the Luangwa and Zambezi valley basins

Source: Munang'andu et al, 2012.

There is no dedicated structure for surveillance or control of HAT in Zambia. It is difficult to access the exact situation of the disease in countries like Zambia due to the remoteness of the areas where HAT occurs which hinders diagnostic activities.

2.1.2. WHO response

In 2000 and 2001, WHO established public-private partnerships with Aventis Pharma (now Sanofi) and Bayer HealthCare which enabled the creation of a WHO surveillance team, providing support to endemic countries in their control activities and the supply of medicines free of charge. The partnership was renewed in 2006 and in 2011. The success in curbing the number of sleeping sickness cases encouraged other private partners to sustain the WHO's initial effort towards eliminating the disease as a public health problem (http://who.int/features/qa/universal_health_coverage/en/index.html). The objectives of the WHO Programme are to:

- Strengthen and coordinate control measures and ensure field activities are sustained
- Strengthen existing surveillance systems
- Ensure accessibility to diagnostic and treatment
- Support the monitoring of treatment and drug resistance throughout the network
- Develop an information database and epidemiological analysis of data, including the atlas of the HAT, completed in collaboration with the Food and Agriculture Organization (FAO)
- Implement training activities
- Support operational research to improve treatment and diagnostic tools
- Promote collaboration with the FAO in charge of animal trypanosomiasis and the International Atomic Energy Agency (IAEA) dealing with vector control through male flies made sterile by irradiation. The three UN agencies along with the African Union have promoted the Programme Against African Trypanosomiasis (PAAT)

- Coordinate and synergize vector control activities lead by the Pan African Tsetste and Trypanosomosis Eradication Campaign (PATTEC) of the African Union.

2.2.THE PARASITE

HAT is transmitted by haemoflagellated parasites called trypanosomes (Fig. 5) of the genus *Trypanosoma*, subgenus *Trypanozoon*, Species *Trypanosoma brucei*, Subspecies *T. b. rhodesiense* and *T. b. gambiense* (Hide, 1999). A typical trypanosome is a very small unicellular organism varying in size from 10 to over 35µm, living in the blood of its vertebrate host (Burri & Brun, 2003). The trypanosomes are studied with the aid of a microscope, with or without staining.

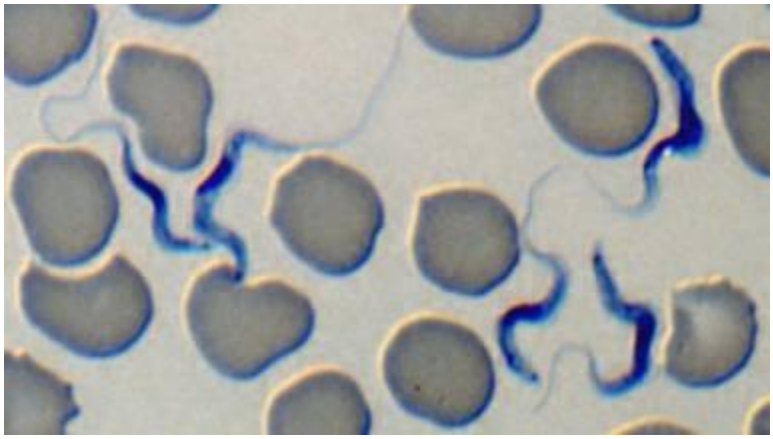

Figure 5: Blood stream trypanosomes

Source: WHO http://www.who.int/emc/diseases/tryp/trypanogeo.html

The parasite is taken up by the tsetse fly as it feeds on blood of the vertebrate host. The ingested bloodstream trypomastigotes transform into procyclic trypomastigotes in the fly's midgut and multiply. They later transform into epimastigotes, migrate to the salivary glands, then transform into metacyclic trypomastigotes (infective form) and multiply once again by binary fission (Burri & Brun, 2003). When an infected tsetse fly bites human skin while it is feeding on blood, metacyclic trypomastigotes are transmitted to the skin from the salivary glands of the fly and later into the lymphatic and blood vessels where they transform into bloodstream trypomastigotes and multiply by binary fission (Katsidzira & Fana, 2010). Once inside the human host, the infective *T.brucei* evades the immune system by constantly modifying its

surface glycoprotein by the process of antigenic variation, which in turn hampers the design of an effective vaccine against HAT (Richard *et al,* 2006).

2.3. THE TSETSE FLY VECTOR

Trypanosomiasis is transmitted to man and animals by a blood sucking insect, the tsetse fly (Stich *et al*, 2002). Encroachment of people and their livestock into tsetse infested areas and the subsequent disappearance of large game animals as a result of human interference forces tsetse to feed on humans and their livestock (Simukoko *et al*, 2007). Tsetse flies include all the species in the genus *Glossina*. While tsetse flies resemble house flies, having a similar size ranging from 8 to 17 mm, two anatomical characteristics make them easily distinguishable while resting: (i) tsetse flies fold their wings completely so that one wing rests directly on top of the other over their abdomen and (ii) they have a long proboscis which extends directly forward and is attached by a distinct bulb to the bottom of their head (Torr *et al*, 2007). Tsetse flies are believed to be extremely old insects because fossil tsetse has been identified from the Florissant Fossil Beds in Colorado and some species have also been described in Arabia (Hide, 1999). Today, the living tsetse flies are almost exclusively found on the African continent south of the Sahara (WHO 2006). There are about 30 known species and subspecies of tsetse flies which can be divided into three distinct groups or subgenera: (i) Austenia (*fusca group*), (ii) Nemorhina (*palpalis group*) and (iii) Glossina (*morsitans group*). Only nine species and subspecies, belonging to either the *palpalis* or *morsitans* groups, are known to transmit HAT (Stich *et al*, 2003).

2.3.1 The fusca group

Much less is known about the distribution and ecology of the species of this group than of most species of the other two groups, partly because none is of major economic importance and partly because many are difficult to detect. Most species never feed on man and are not attracted to his presence. They occupy islands of rain forests often associated with watercourses (Torr *et al,* 2007).

2.3.2 The palpalis group

The distribution of *G. palpalis* and *G. fuscipes*, vectors of HAT and animal trypanosomiasis includes the block of west-central African rain forest but some species extend far out through the

humid savanna and into the drier savannas along rivers and streams (Richard *et al*, 2006). They occur along river systems draining into the Atlantic Ocean, Mediterranean Sea and the inland drainage systems of some of the great African lakes. The palpalis group is responsible for the transmission of Gambian HAT (Picozzi *et al*, 2005).

2.3.3 The morsitans group

All species of this group are restricted to the savanna woodlands surrounding the lowland rain forest. In the wetter areas, the flies roam widely over the woodland, but in the drier parts of their range, such as the Sudan savanna of West Africa, they are centered on the mesophytic vegetation of watercourses, particularly during the severe dry season (Torr *et al*, 2007). *G. morsitans,* in pan-African terms, is the most important species of *Glossina.* It infests an enormous area, is a vector of sleeping sickness in Eastern and Southern Africa (including Zambia), and is a major vector of animal trypanosomiasis. *Glossina m. morsitans* occurs from Mozambique and Zimbabwe in the south to Tanzania in the north. The seemingly endless 'miombo' (*Brachystegia-Julbernardia*) woodland of East Africa is its typical habitat, although it also occurs in mopane (*Colophospermum mopane*) woodlands of Zambia (Stich *et al*, 2002). Sporadic cases of Rhodesian HAT usually arise among people whose activities bring them into contact with the tsetse vector of the morsitans group of the savanna woodland. Here the vectors normally feed on game animals, but will readily feed on man coming in this environment (Hide, 1999).

2.4. THE TRYPANOSOME RESERVOIRS

Trypanosomes are true multi-host parasites capable of infecting a wide range of wildlife species that constitute a reservoir of infection for both people and domestic animals (Anderson *et al*, 2011). Wildlife reservoirs of trypanosomes include bushbucks, waterbucks, hartebeests, warthogs, hyenas, impalas, kudu and lions (Haydon *et al*, 2002). Natural infections of trypanosomes occur in wild animals which are taken in by a tsetse fly when it feeds on the animal. The fly becomes infected and is able to transmit the disease to uninfected people and animals it may feed on (Welbur & Oditt, 2002). Wildlife reservoirs of HAT-causing trypanosomes do not show any clinical signs of the disease. HAT is a zoonosis and to some

extent an occupational disease with many species of game and domestic animals harbouring the parasite and sustaining sporadic transmission to humans (Haydon *et al*, 2002).

In addition to wildlife, domestic animal reservoirs for *T. b. rhodesiense* include cattle, sheep, goats, pigs and dogs while *T. b. gambiense* reservoirs include pigs and sheep (Richard *et al*, 2006).

2.5. THE HUMAN HOSTS OF TRYPANOSOMES

Humans are the main hosts for *T. b. gambiense* although natural infections have been reported in animals. People are usually infected following entry into tsetse-infested habitats. Man is generally the normal mammalian host for *T. b. gambiense* and wild animals are adventitious hosts (Stich *et al*, 2003). In contrast, the usual mammalian hosts of *T. b. rhodesiense* are wild ungulates and man is an adventitious host (Anderson *et al*, 2011). This form of sleeping sickness is associated with areas inhabited by wild animals in which man is a casual intruder. Trypanosomes are mostly transmitted to man through the bite of an infected tsetse fly but there are other ways in which people are infected with HAT:

- Mother-to-child infection: the trypanosome can cross the placenta and infect the fetus.
- Mechanical transmission through other blood sucking insects is possible. However, it is difficult to assess the epidemiological impact of transmission.
- Accidental infections have occurred in laboratories due to pricks from contaminated needles. (WHO, 2013).

The people most at risk from the disease are those whose occupations traditionally take them into the depths of the savanna woodlands such as hunters, honey-gatherers, woodcutters, fishermen and, in more recent years, game-wardens and tourists (Welburn & Oditt, 2002). In endemic areas of the disease, men are much more at risk than women and children (Fevre *et al*, 2001).

2.6. HAT DIAGNOSIS

HAT diagnosis is based on the combination of both clinical and investigative data. The diagnosis of HAT follows a three-step pathway: screening, diagnostic confirmation, and staging. The

majority of control programs rely on active case detection through mass population screening. Active screening of the population at risk is required, in order to identify patients at an early stage and reduce transmission. Exhaustive screenings require a major investment in human and material resources. In Africa such resources are often scarce, particularly in remote areas where the disease is mostly found. As a result, many infected individuals may die before they can ever be diagnosed and treated. Screening tools therefore need to be sensitive, quick, and cheap.

2.6.1. Clinical diagnosis

The clinical presentations of *T. b. gambiense* and *T.b.rhodesiense* HAT are remarkably different. While *T.b.gambiense* HAT is generally a chronic illness that lasts for years, *T. b. rhodesiense* HAT usually presents as an acute febrile illness that is fatal within weeks or months if left untreated (Burri & Brun, 2003). The typical features of the disease are fever, headache, general malaise and enlargement of lymph nodes, particularly the posterior cervical glands and oedema of the face (MacLean *et al*, 2010). Diseases such as malaria, enteric fever, tuberculosis meningitis and HIV infection can mimic or even coexist with HAT (WHO, 2006). Clinical presentation in a geographical location where the disease is known to be endemic simply provides a diagnostic clue. However, the non specific nature of many clinical features makes it imperative to exclude other infections like tropical fevers hence the need for laboratory diagnosis.

2.6.2. Microscopic diagnosis

Most patients are diagnosed by microscopic examination of trypanosomes of a giemsa-stained thin/ thick blood smear, wet blood film, or quantitative buffy coat (QBC) (Legros *et al*, 2002). Wet blood film is cheap, simple and gives immediate results. It is particularly used for *T. b. rhodesiense* but not useful *T. b. gambiense* because blood parasite levels are usually high in *T. b. rhodesiense* infections compared to the later, which is usually associated with low parasitaemia, especially in early stages of infection (Chappuis *et al*, 2004). To improve the accuracy of detecting trypanosomes, the thin or thick giemsa stained blood film is used for both *T. b. rhodesiense* and *T. b. gambiense.* The method is simple, cheap and can also detect other parasites (microfilaria and plasmodium). Disadvantages of the method include: limited sensitivity and requires more time for preparation and examination (Chappuis *et al*, 2005). A QBC is also used

for trypanosome detection where blood is concentrated in heparinised capillary tubes and examination of the buffy coat junction (a specific level in the capillary tube where trypanosomes can be found) is done under the microscope at 40 x 10 resolutions for the presence of mobile trypanosomes. The technique has improved sensitivity, relatively rapid and can be used for the diagnosis of other parasites but it is sophisticated, materials used are fragile, and it is expensive (Van, 1992).

2.6.3. Serological methods

The diagnostic confirmation and staging of the Gambian HAT are based on the same methods as Rhodesian HAT (Chappuis *et al*, 2005). Confirmation relies on the finding of trypanosomes in the blood, lymph nodes, or cerebrospinal fluid (CSF). The Card Agglutination Test for Trypanosomiasis (CATT) currently is used for diagnosis of *T.b.gambiense* in most areas of endemic infection (Robays *et al*, 2004). Unfortunately, it is estimated that 20 to 30% of patients are missed by the standard parasitological techniques if the blood parasite levels are low (Robays *et al*, 2004). The LATEX has been developed as a field alternative to the CATT. It has showed a higher specificity but lower or similar sensitivity to trypanosomes (Buscher *et al*, 1999). ELISA has also been employed in detecting specific antibodies but the sophisticated equipment required limits its use for remote testing of samples collected in the field (Truc *et al*, 1999). Staging of the disease is a key step that allows classification of the patient into first (hemolymphatic) or second (meningoencephalitic) stage of the disease. In the absence of reliable blood tests able to detect CNS (Central nervous system) invasion by the parasite, HAT staging relies on the CSF examination obtained by lumber puncture. It is a vital step in the diagnostic process. WHO recommends that second stage HAT is defined by the presence in the CSF of one or more of the following: (i) raised white blood cell count (>5cells/µl), (ii) trypanosomes, and (iii) increased protein content (>370mg/l) (Chappuis *et al*, 2005).

2.6.4. Molecular techniques

Molecular techniques such as polymerase chain reaction (PCR) have significantly improved the sensitivity and accuracy of trypanosome diagnosis compared to the traditional parasitological methods (Thumbi *et al*, 2008). Molecular tests differentiate between trypanosome species and subspecies using specific primers (Cox *et al*, 2005). While PCR is the method of choice for the

detection of both AAT and HAT, its use in the field is limited by cost implications and the requirements for highly trained personnel (Truc *et al*, 1999; Solano *et al*, 2002). The invention of the loop-mediated isothermal amplification (LAMP) method a decade ago has given new impetus towards development of point of care diagnostic tests based on amplification of pathogen DNA, a technology that has been the precinct of well-developed laboratories (Wastling *et al*, 2010). LAMP, a highly sensitive, specific, and yet simple diagnostic technique for parasite detection is currently being used for trypanosome diagnosis (Njiru, 2012). LAMP demonstrated to be a potential tool in the staging of HAT which is critical for the therapeutic decisions (Namangala *et al*, 2012). An advantage of LAMP over PCR is that it is less expensive, rapid, sensitivity is equal to or higher than that of classical PCR targeting the same gene, robust, has higher specificity, allows visual detection and amplification at isothermal conditions (low heat required, hence water bath and exothermal chemical units are sufficient) (Wastling *et al*, 2010; Njiru, 2012).

2.7. HAT TREATMENT AND CONTROL

There is no dedicated structure for surveillance or control of HAT in Zambia. One century ago, HAT was believed to curb the development of colonial territories (Smith *et al*, 1998). As soon as the cause of the disease was clearly identified, colonial authorities established extensive control operations. Systematic screening, treatment and patient follow-up were established in western and central Africa for Gambian HAT while animal reservoir and vector control was implemented in eastern and southern Africa for the Rhodesian HAT. By the 1960s, disease transmission was practically interrupted in all endemic areas but lack of sustained surveillance systems and the overlooked risk of re-emergence of the disease led to flare-ups that have been observed in past endemic areas leading to worrisome increase in the number of reported cases (Simarro *et al*, 2011). Non availability of effective diagnostic tools in resource-poor endemic areas is a critical barrier to effective treatment and control of infectious diseases. HAT control is currently achieved by targeting the tsetse vector and/or the parasite itself (Jannin & Cattand, 2004). Because of antigenic variation, there is no effective vaccine against HAT (Lutumba *et al*, 2005).

2.7.1. Targeting the parasite

Early diagnosis and access to prompt treatment using trypanocides are the key components of current strategies for HAT control (Bukachi *et al*, 2009). The current treatment of HAT is based on four main drugs, namely suramin, pentamidine, melarsoprol, and eflornithin (difluoromethylornithine, or DFMO), with nifurtimox undergoing evaluation (WHO, 2012). Early stage Rhodesian HAT is treated with suramin while pentamidine is used in early stage Gambian HAT. Treatment is effective and prevents disease progression. Melarsoprol is the only effective drug for the late stage disease in both forms of HAT, as the drug crosses the blood-brain barrier (Legros *et al*, 2002). However, the major problem with melarsoprol is associated with severe toxic adverse effects from which up to 10% of the treated cases may die (Pepin & Milord, 1994; Legros *et al*, 2002). The unacceptable toxicity of the currently available drugs for HAT underpins the urgency of developing more effective and safer drug regimes (Kennedy, 2004).

2.7.2. Targeting the Tsetse Vector

While the control of domestic animals as HAT reservoirs appears to be a reachable objective that would in turn allow the control of *T. b. rhodesiense* infections in affected areas (Kabasa, 2007), the control of wildlife and the vector in protected areas and game reserves could be more complicated due to conservationist, ecological, and environmental considerations. Current methods for tsetse control include non-insecticidal and insecticidal methods.

2.7.2.1 Non-insecticidal methods

These can be classified in two forms: ecological and biological methods (Torr *et al*, 2007). Ecological methods include (i) evacuation of populations by moving people from tsetse infested areas to tsetse free areas, (ii) bush clearing by destruction of essential habitat of tsetse and, (iii) game destruction. The latter methods were severely criticized and abandoned because of their environmental implications (Engels & Savoili, 2006).

Biological control relies on the existence of some pathogens of tsetse (WHO, 2006). The complexity of the reproductive system and the low fecundity of tsetse suggest that they would be vulnerable to control using insect growth regulators. These substances interfere with chitin

synthesis and prevent successful reproduction, effectively sterilizing female tsetse. One of the difficulties of this method is the development of mechanisms for getting the substances into the fly, since to be effective, they have to be taken up through the cuticle (Burri & Brun, 2003). SIT (Sterile Insect Technique) is another form of biological control and its success depends upon a high probability of wild females mating with sterile male rather than a wild fertile male (WHO, 2006). This requires a much greater number of sterile males to be released than the number of wild males in the natural population (Stich *et al*, 2003). For SIT to be effective, it has been estimated that the number of sterile male flies released should be sufficient to ensure that they inseminate at least 10% of the females (WHO, 2006).

2.7.2.2 Insecticidal methods

Chemical control depends upon sufficient contact between the tsetse fly and the insecticide for the fly to pick up lethal dose. The use of insecticides was engineered in a number of ways such as: ground spraying, aerial spraying, sequential aerosol technique, or in more localized areas using hand-held or vehicle-mounted fogging machines, and the artificial and live-bait technique (Stitch *et al*, 2003). Methods like aerial spraying have proved to be successful in countries like Botswana (Kgori *et al*, 2006) but the costs involved has limited its use in many areas. A simpler and cheaper device involves a suspended screen of blue and black cloth (tsetse target) impregnated with an insecticide provide satisfactory results. Flies are attracted to the blue segments and land on the black segment, quickly succumbing to the insecticide (Engels & Savoili, 2006).

CHAPTER 3: METHODOLOGY

3.1. STUDY DESIGN

The study was cross sectional comparative. Data on reported HAT cases was obtained from the district health centers which were purposively selected.

3.2. STUDY AREA

The study was conducted in Mambwe and Chama districts of the Eastern and Muchinga provinces of Zambia (Fig. 6).

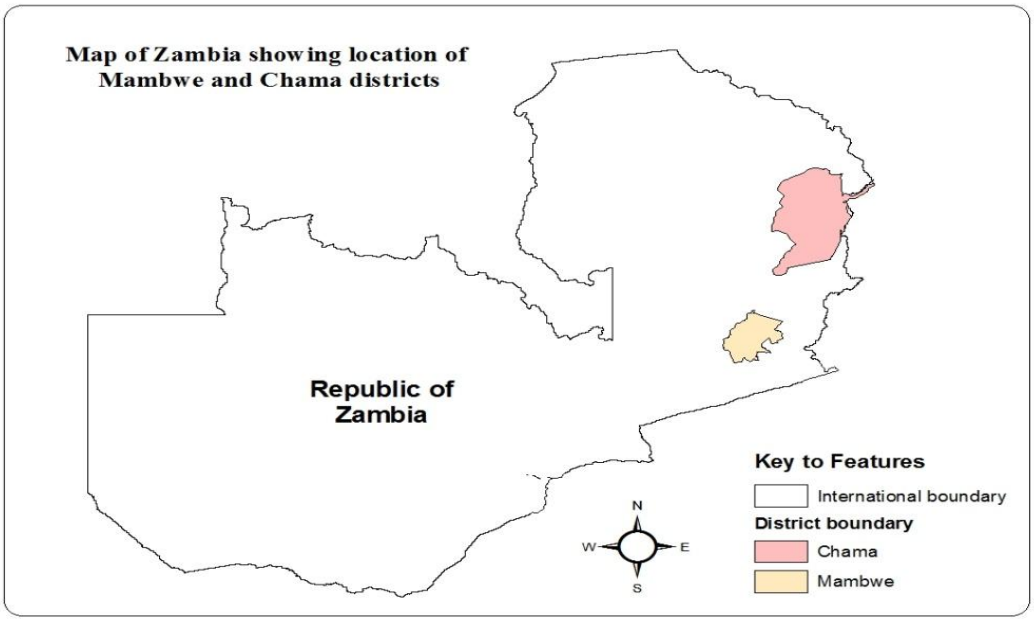

Figure 6: Map showing the study area

Source: Chilanga Tsetse & Trypanosomiasis control-Geographic Information Systems Unit

The two districts were purposively selected because they are tsetse infested, inhabited with wild animals, man is a casual intruder and HAT has been previously reported from them (Mwanakasale & Songolo, 2011). Mambwe district (Fig. 7A) has a total area of 4,840 square km. The total human population of Mambwe district is estimated at 68,918 while that of Chama

district (Fig. 7B) is estimated at 103,894 (Zambia, 2010 Census of Population and Housing Summary Report). Chama district has a surface area of 17,630 square km making it the biggest district in eastern Zambia

A. **B.**

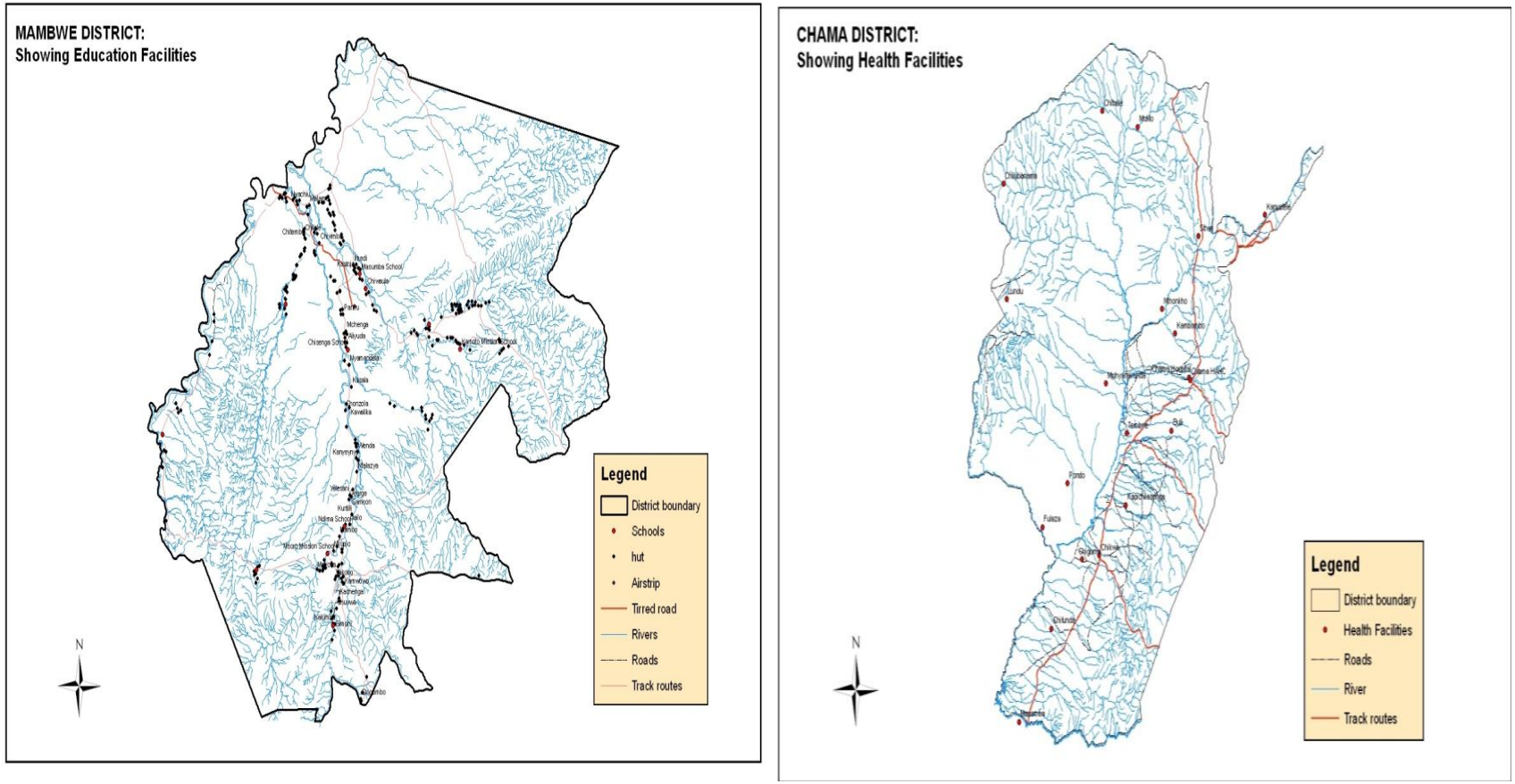

Figure 7: Mambwe (A) and Chama (B)

Source: CSO-Geographic Information SystemsUnit

Note: Most RHCs are located near schools as in the case of Mambwe district

3.3. STUDY VARIABLES

The independent variables included the levels of knowledge, availability of equipment, sector collaboration, political commitment, competing health priorities, staff occupation, staff level of education and duration of service in the district, while inability to diagnosis of HAT was the dependent variable (Table 2).

Table 2: Study Variables

Variable	**Indicator**	**Scale of measurement**
Dependent Variable		
Inability to diagnosis of HAT		
Independent variables:		
Level of Knowledge and awareness	Responses to questions related to knowledge and awareness about HAT	• Nominal • Ordinal: Yes=1 No=2 Don't know =88
Availability of diagnostic equipment & materials	Responses to questions related to availability of diagnostic equipment and materials	• Ordinal
Collaboration with	Correct responses to questions	• Ordinal:

other sectors	related to collaboration with other sectors	Yes=1 No=2 Don't know = 88
Competing health priorities	Responses to questions related to health priorities	• Ordinal: Yes= 1 No=2 88 = Don't know
Political commitment	Responses to questions related to GRZ financial support towards HAT management	• Ordinal: Yes=1 No=2 Don't know=88
Level of education	Highest level of education of staff reached	• Nominal: University=1 College =2 Secondary =3 Primary = 4 None=5

Occupation	Profession of respondent	• Nominal: medical officer =1 clinical officer =2 nurse =3 laboratory technician = 4 other =5
Duration of service	Number of years worked in the district	• Interval: 10-5years = 1 5-10years = 2 <5years = 3

3.4. SAMPLE SIZE

Purposive sampling was used to select the two tsetse infested districts with human population at risk of HAT. The total RHCs for Mambwe and Chama were 13 and 20, respectively. To determine the number of cluster centres to be included in the study from each district, the formula below by Alain Bouchard (2004) was used:

$$n = \frac{N_o}{1 + N_o / N}, \quad \text{where } N_o = t^2 (p)(1-p)/d^2$$

n is the number of clusters , N is the total health centres while t is the figure obtained from the student's t table. . Thus, p=0.5 at 95% as the confidence level, N= 20 for Chama and N= 13 for Mambwe, d= 5% = 0.05, t=0.55

$N_0 = t^2 (p) (1-p)/d^2$

$= 0.55^2(0.5) (1-0.5)/0.05^2$

= **30.25**

Therefore using the above formula**; n for Mambwe = 9 and n for Chama = 12** indicating the numbers of cluster health centres to be visited from each district. These centres were also selected purposively from the total centres in each district. Due to low staffing levels of health personnel at the health centres, the numbers of clusters were increased to 11 for Mambwe district. Diagnosis and treatment of patients is the responsibility of a range of health personnel including medical officers, laboratory technicians, nurses, clinical officers and environmental health technicians. For the purpose of this study, all these categories of staff were referred to as health personnel and were included in the study. There are a total of 77 and 136 health personnel in Mambwe and Chama districts, respectively (MOH, 2009). At least 50% of the total numbers of the categorized health personnel present from each district were included. From Chama district, 52 health personnel were included while 49 health personnel were enrolled from Mambwe district indicating 79% and 80% of the total health personnel from Chama and Mambwe districts, respectively (Table 3).

Table 3: Staff at the centres involved in the study

	No. of centres visited	Total target staff at centres visited	Total staff interviewed	% Staff involved
Chama District	12	62	52	79
Mambwe District	11	65	49	80
Total	23	127	101	

3.5.DATA COLLECTION

A structured questionnaire was used to gather demographic data of staff from the health centres visited, the health personnel present were interviewed on their levels of knowledge, awareness of HAT, how they diagnose, treat and manage the disease (see Appendix 4). A record sheet on information obtained on past HAT cases recorded from the RHCs was another source of data (see Appendix 5). Data collection was carried out from April to May 2013 and from June to July 2013. Data collection was done in two phases due to the non availability of resources and also just after the rains because during the rainy season, most of the roads were impassable.

3.6.DATA ANALYSIS

The raw data collected from the questionnaires were stored in SPSS-statistics 20 and then converted to basic excel format for easy handling. After checking for quality and completeness, all the data were then transferred to Stata/SE version 11.0. Responses given by staff from all health centres were measured according to the scales of measurements provided for the specific variables. Frequencies were then compared between the two districts involved. The data from the interviews were summarized as frequencies and percentages and analyzed using descriptive statistics. Confidence interval was set at 95%. The chi-square test was used to compare proportions between districts. For each analysis, Pearson's chi-square $P < 0.05$ were considered statistically significant in order to reject the null hypothesis. Fisher's exact test was used where expected results were less than 5.

3.7.STUDY LIMITATIONS

Financial resources were the biggest challenge since the whole programme was self sponsored. Work could not commence as initially scheduled because most of the roads in the study area were impassable during the rainy season**.** Distances between the health centres as well as the poor road network were a major limiting factor. Therefore, only the centres in tsetse infested areas, mainly those covering the population near the national parks, were considered. Low staffing levels at centres visited was a concern and it greatly affected the sample size. Most centres only had one or two trained staff.

3.8. ETHICAL CONSIDERATIONS

Scientific and ethical clearance was sought from the institutional research ethics committee at the University of Zambia (Reference N^{o} **001 – 12 – 12**). Before the project was initiated, clearance was also sought from the MOH headquarters, Eastern Provincial Health Director and District directors of health from both districts involved. Consent was also obtained from the health officers of each respective health centre before commencement of the interviews who were also informed that there were no risks involved for taking part in the study. Local requirements, rules and regulations were observed during the study with the respondents made aware of the benefits of the study which were; (i) Contribute to the understanding of the health services rendered in the study areas relative to HAT, (ii) Help identify gaps in the current diagnosis of HAT in the tsetse infested areas of the Luangwa valley and suggest improvements for the good of the local communities and the country at large, (iii) Contribute, through improved HAT case detection and knowledge among health workers, towards more effective control measures of the disease. The study confidentiality was ensured through the use of codes instead of names. Respondents were assured that information collected was to be treated confidentially and that it would be used to prepare reports which were not to include any specific names and as such there would be no way to identify sources of information.

CHAPTER 4: RESULTS

A total of 101 health personnel were involved in the study, of which 52 came from Chama district while 49 were from Mambwe district. The data and responses for the study reflect only the opinions and views of individuals from the centres involved in the study.

4.1. Demographic data

Table 4 below shows the centres that were visited from the two districts involved. A total of 23 health centres were visited during the study i.e. 12 from Chama and 11 from Mambwe districts.

Table 4: List of health centres involved in the study

S/N	CHAMA DISTRICT	S/N	MAMBWE DISTRICT
1	Chama General Hospital	1	Kamoto Mission Hospital
2	Tembwe	2	Chikowa
3	Kambombo	3	Airport
4	Nthonkho	4	Ncheka
5	Buli	5	Chilanga
6	Sitwe	6	Masumba
7	Kalovia	7	Kakumbi
8	Kanyelele	8	Nsefu
9	Mphyanakunda	9	Mpomwa
10	Katangalika	10	St. Lukes (Msoro)
11	Chikwa	11	Kasamanda
12	Kambwili		

As shown in table 5, about 87% (n=101) of the total staff interviewed from both districts had at least attended tertiary education, while about 13% (n=101) had attended secondary education. None of the health centres included in the study, had staff attending to patients that had only attended primary education or no formal education at all. The trend observed was the same from both districts (Fig. 8).

Table 5: Level of education of staff involved in the study

District	University	College	Secondary	Totals
Chama	2 (3.8%)	39 (75.0%)	11 (21.2%)	52
Mambwe	3 (6.1%)	44 (89.8%)	2 (4.1%)	49
Total	**5 (4.95%)**	**83 (82.18 %)**	**13 (12. 87%)**	**101**

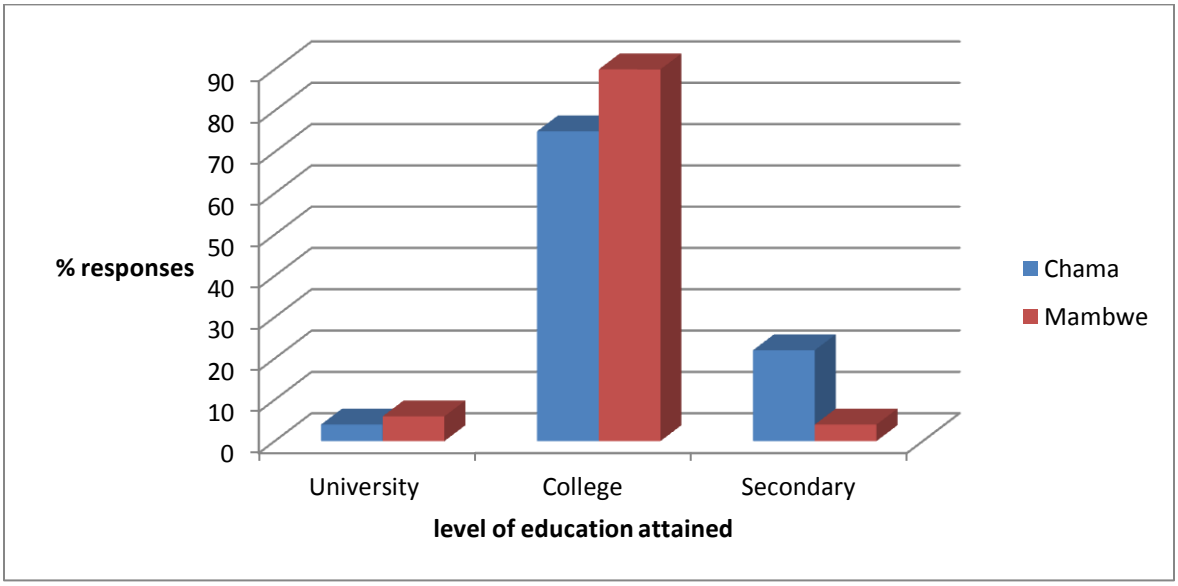

Figure 8: Level of education of health personnel from Chama and Mambwe districts

The presence of qualified health personnel from the centres visited was satisfactory i.e. about 95% of the staff were among them medical officers, clinical officers, nurses, environmental health technicians (EHTs) and laboratory technicians (LTs) while only 15% included other staff

(see Table 6). According to table 6, Chama and Mambwe districts had similar staffing levels of various categories of health personnel except for nurses who seemed to be more in Mambwe than Chama. The overall numbers for the categorised staff listed present at each particular health centre, however, were extremely low.

Table 6: Occupation of health personnel involved in the study

District	**Medical officers**	**Clinical officers**	**Nurses**	**Environmental health technicians**	**Lab technicians**	**Other**	**Total**
Chama	2 (3.8%)	7 (3.5%)	22 (42.3%)	5 (9.6%)	4 (7.7%)	12 (23.0%)	**52**
Mambwe	2 (4.1%)	3 (6.1%)	31 (63.3%)	4 (8.1%)	6 (12.2%)	3 (6.1%)	**49**
Total	**4 (3.96%)**	**10 (9.90%)**	**53 (52.48%)**	**9 (8.91%)**	**10 (9.90%)**	**15 (14.85%)**	**101**

The duration of service in their particular districts for most of the staff involved in the study was short (Fig. 9). The trend was the same from both districts with more staff indicating to have served less than 5years in their respective districts. However, it can be observed (Fig. 9) that despite the two districts having similar trends in staff's duration of service, Mambwe district indicated to have slightly more staff serving less than 5years in the district compared to Chama district which reported less staff serving less than 5years and more staff serving between 5 and 10years and over 10years.

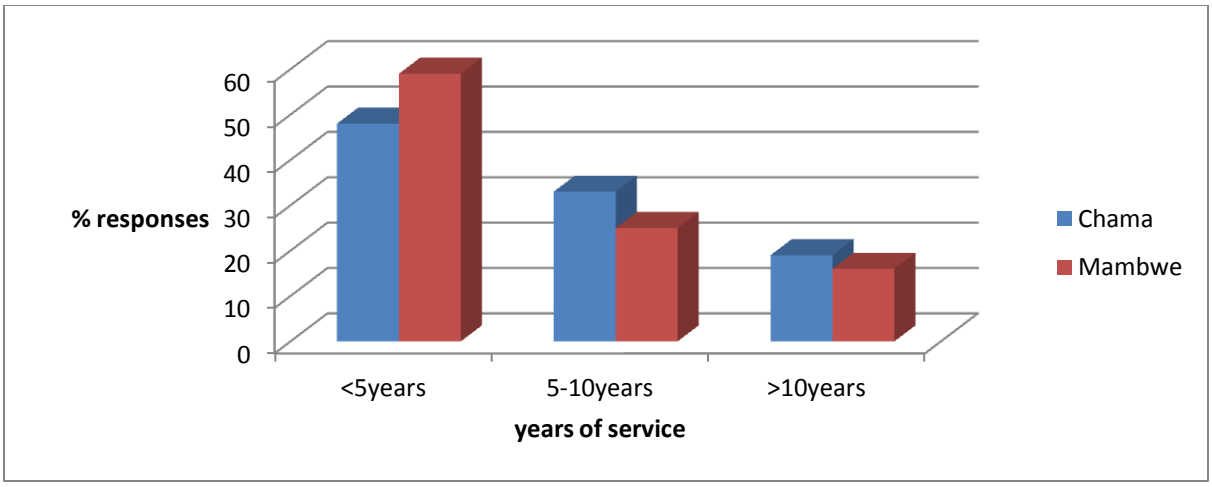

Figure 9: Duration of service of respondents from Chama and Mambwe districts

Results further indicate that about 48% (25/52) of the staff from Chama district and about 59% (29/49) of the staff from Mambwe district had worked in their respective districts for less than 5 years while about 19% (10/52) of the staff from Chama district and about 16% (8/49) of the staff from Mambwe district had served for more than 10 years (Table 7). These results showed no significant difference in the responses in duration of service of personnel in their respective districts.

Table 7: Responses on duration of service of health personnel in their districts.

DISTRICT	<5years	5-10years	>10years	Totals
Chama	25 (48.1%)	17 (32.7%)	10 (19.2%)	52
Mambwe	29 (59.2%)	12 (24.5%)	8 (16.3%)	49
Totals	**54 (53.5%)**	**29 (28.7%)**	**18 (17.8%)**	**101**

χ^2=1.29 P =0.52

4.2. Knowledge and awareness of HAT

Malaria, diarrhoea, pneumonia and non-pneumonia respiratory tract infections were the four most common diseases reported from both Mambwe and Chama districts. Responses on staff knowledge and awareness on the possible occurrences of HAT in their respective districts showed that about 67% (n=52) of the staff from Chama district carried out further investigations for malaria negative cases compared to 42.9% (n=49) of their Mambwe counterparts (χ^2=7.22,

d.f=2, P=0.027) (Fig. 10). Therefore, based on the variables measured in the study, health personnel from Chama have better ability to diagnose HAT than their Mambwe counterparts. On the other hand, staff from both districts indicated to be aware of the possible occurrences of HAT in their respective districts with no significant difference observed between them (χ^2=5.45, d.f=2, P>0.05) and also indicated to have had received patients with symptoms of a disease similar to malaria but which after laboratory diagnosis was found not to be malaria (χ^2=2.17, d.f=2, P>0.05). The later also showed no significant difference on responses given between the two districts involved. On the other hand, 40.4% of staff from Chama district (n=52) indicated to have encountered at least one case of HAT compared to 4.1% of their Mambwe counterparts (n=49) (χ^2=18.90, d.f=2, P=0.000) (Fig. 10) indicating a very high significant difference between the responses given.

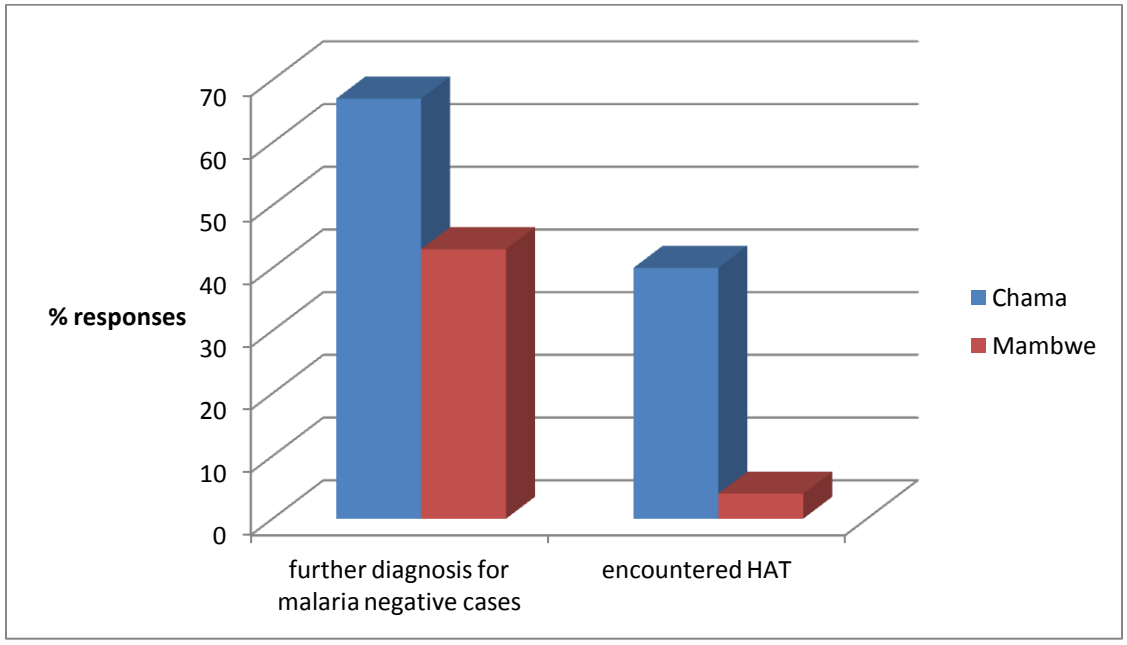

Figure 10: Responses on knowledge of HAT diagnosis in Chama and Mambwe districts

The overall responses on the relationship between the duration of service of staff and their knowledge and awareness of HAT were as shown in table 8 below, indicating no statistically significant difference (P >0.05). A negative association between staff duration of service in their districts and their levels of knowledge and awareness of possible occurrences of HAT in their

districts was observed, suggesting that duration of service of health staff may have no influence on the staff's levels of knowledge and awareness of HAT.

Table 8: Measure of association between staff duration of service and their responses on knowledge and awareness of HAT

Knowledge and awareness of HAT		Duration of service of health staff				Fisher's exact test P values
		>10years	5-10years	<5years	**Totals**	
Ever received patients with symptoms of disease similar to malaria	Yes	52	28	17	**97**	0.652
	No	1	0	1	**2**	
	Don't know	1	1	0	**2**	
Totals		**54**	**29**	**18**	**101**	
Awareness of HAT in district	Yes	44	26	14	**84**	0.565
	No	7	2	4	**13**	
	Don't know	3	1	0	**4**	
Totals		**54**	**29**	**18**	**101**	
Encountered suspected HAT at health centre	Yes	8	8	7	**23**	0.082
	No	46	21	11	**78**	
Totals		**54**	**29**	**18**	**101**	

Results on cross tabulations in table 9 below showed no statistically significant difference (P >0.05) in the overall responses between level of education and HAT awareness. Such findings may suggest that the level of education of respondents had no influence on their levels of HAT

awareness. On the association between respondent's occupation and their responses on carrying out further diagnosis for malaria negative cases, results also showed no significant difference in the overall responses from the two districts indicating that staff's occupation had no influence on further diagnosis carried out for malaria negative cases.

Table 9: Cross tabulations between staff level of education and their responses on awareness of HAT and also between staff occupation and their responses on further diagnosis for malaria negative cases

		Level of education of respondents				Fisher's exact test P values
		University	College	Secondary	**Totals**	
Responses on HAT awareness	Yes	5	69	10	**84**	0.711
	No	0	11	2	**13**	
	Don't know	0	3	1	**4**	
Totals		**5**	**83**	**13**	**101**	
		Responses on further investigations done for malaria negative cases				Fisher's exact test P values
		Yes	No	Don't know	Totals	
Occupation of respondents	MO	3	1	0	**4**	0.292
	CO	8	2	0	**10**	
	Nurses	24	27	2	**53**	
	LT	7	2	1	10	
	Other	14	8	2	**24**	
Totals		**56**	**40**	**5**	**101**	

As shown in table 10, respondents from both districts had knowledge on how to identify a case of HAT. Evidence is shown in the similarity in responses regarding their knowledge ($P > 0.05$) to identify a case of HAT.

Table 10: Responses on Knowledge on identification of a case of HAT

		Chama District				Mambwe District				
S/N		No. gave response	%	No. Did not give response	%	No.gave response	%	No. Did not give response	%	Chi-square P values
1	Abnormal sleep	41	78.8	10	21.2	39	79.6	10	20.4	0.618
2	Fever	39	75	13	25	36	73.5	13	26.5	0.860
3	Body pains	25	48.1	27	51.9	21	42.9	28	57.1	0.599
4	Headache	27	51.9	25	48.1	22	44.9	27	55.1	0.480
5	Lymph node enlargement	13	25	39	75	11	22.4	38	77.6	0.763
6	Microscopy	26	50	26	50	27	55.1	22	44.9	0.608
7	Other	13	25	39	75	11	22.4	38	77.6	0.763

NOTE: P-values are for No. gave response (Chama Vs Mambwe)

4.3. Availability of tools/equipment for HAT diagnosis and cases reported

Responses on the availability of basic tools for HAT diagnosis from Chama district showed that of the 52 respondents, 64.7% (33/52) reported availability of microscopes at their health centres, 47.1%(24/52) centrifuges, 80.4(42/52) slides and cover slips, 54.9%(28/52) capillary tubes, 49%(25/52) giemsa staining solution, 99.9%(51/52) syringes and needles and 51%(26/52) filter papers. In the case of Mambwe district, of the 49 respondents, 79.6%(39/52) reported availability of microscopes at their health centres, 67.3%(33/49) centrifuges, 85.7(42/49) slides and cover slips, 71.4%(35/49) capillary tubes, 75.5%(37/49) giemsa staining solution, 98%(48/49) syringes and needles and 55.1%(27/49) filter papers. Therefore, there was no significant difference in the availability of basic tools that could be used for HAT diagnosis in the two districts (Fig.11), though Mambwe district indicated to have slightly more tools compared to Chama district.

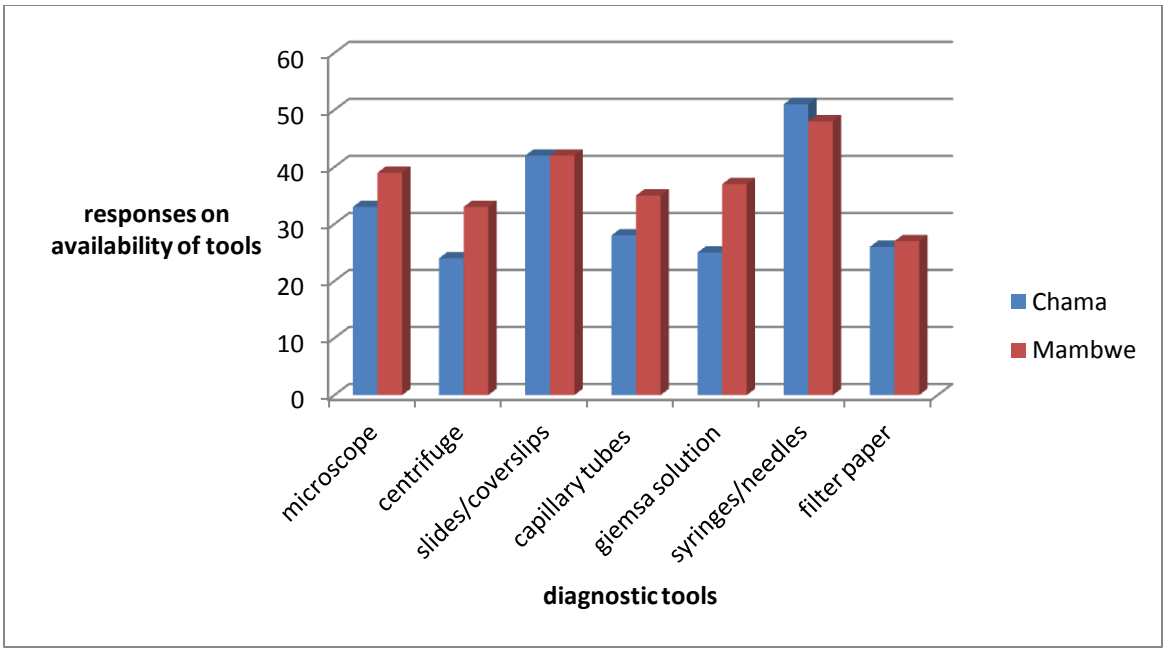

Figure 11: Availability of tools for diagnosis in Chama and Mambwe districts

Between 2003 and 2013, 43 suspected HAT cases were reported from Chama district, of which 8 were confirmed and treated with suramin (early stage HAT) or melarsoprol (late-stage HAT). No record was available for the outcome of the other cases. On the other hand Mambwe district only reported one case (in March 2013) during the same period which was confirmed and later referred to the University Teaching Hospital in Lusaka for treatment.

4.4. Government support, health priorities and collaboration with vector control unit/private sectors

Responses from individual districts on GRZ support received for the management of HAT indicated 13.5% (7/52) for Chama district and 0.0% (0/49) for Mambwe district compared to 99.9% (51/52) and 100% (49/49) GRZ support received for the management of malaria, HIV/AIDS and TB in Chama and Mambwe districts, respectively (Fig. 12). These results showed a very high significant difference (P=0.000) in the support rendered by the government for HAT between the two districts with Chama district indicating to receive slightly more support compared to Mambwe district. The overall trend in GRZ support from both districts, however, still shows low support for HAT compared to the support for malaria, HIV/AIDS.

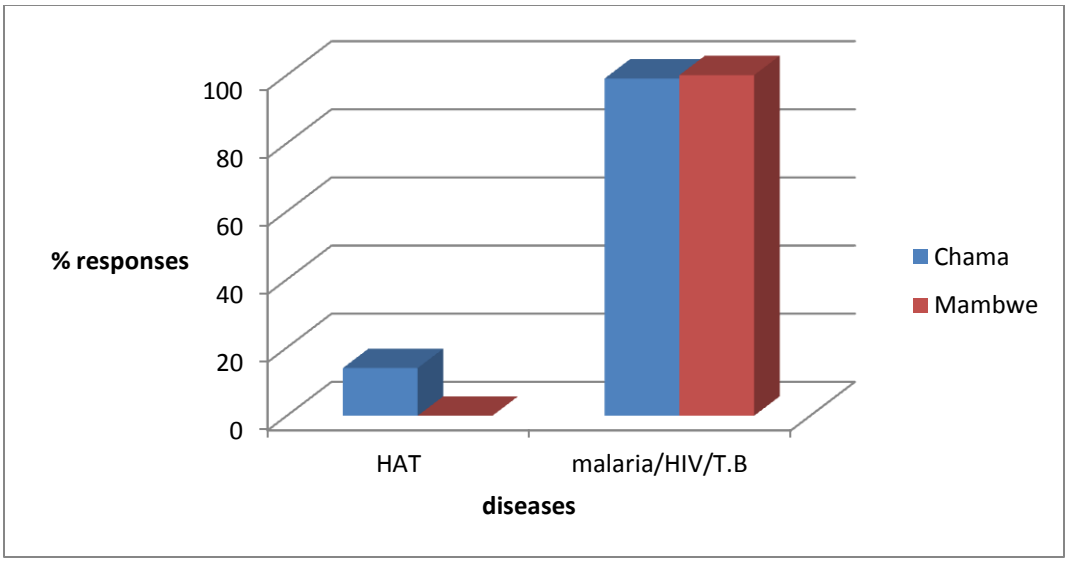

Figure 12: GRZ support for endemic diseases in Chama and Mambwe districts

Responses in relation to collaboration between vector control unit/private sectors and the government on issues regarding HAT management were also considered. As shown in Table 11, there was no significant difference on the overall responses given from the two districts (Fisher's exact, P >0.05) suggesting that neither of the districts involved was receiving significant support from the government for the management of HAT compared to the support being received for the management of malaria, HIV/AIDS and tuberculosis (TB).

Table 11: Responses showing association between GRZ support and collaboration with other sectors on HAT management and other diseases

Responses for GRZ support		Collaboration with other sectors (vector control unit and private) on HAT management				Fisher's exact test P values
		Yes	No	Don't know	Totals	
HAT	Yes	4	3	0	7	0.256
	No	24	53	17	94	
Totals		28	56	17	101	
Malaria	Yes	27	56	17	100	0.446
	No	1	0	0	1	
Totals		28	56	17	101	

HIV/AIDS and TB	Yes	28	55	17	100	1.00
	No	0	1	0	1	
Totals		28	56	17	101	

Table 12 further shows that similar GRZ support for malaria, HIV/AIDS and TB was available in Chama and Mambwe districts (Fisher's exact, P>0.05). On the other hand, a highly significant difference was observed from both districts (Fisher's exact, P =0.007) between the support provided by the government for HAT management and awareness and programmes that were running in the districts. Overall, results from both districts, indicate that support from both the government and private sectors was biased towards the management of HIV/AID, TB and malaria rather than HAT.

Table 12: Responses on association between GRZ support and programmes running in the districts on awareness and management of HAT

Responses for GRZ support for diseases		Programmes running in the districts on awareness and management of HAT				Fisher's exact test P values
		Yes	No	Don't know	Totals	
HAT	Yes	5	2	0	7	**0.007***
	No	15	59	20	94	
Totals		20	61	20	101	
Malaria	Yes	19	61	20	100	0.396
	No	1	0	0	1	
Totals		20	61	20	101	
HIV/AIDS and T.B	Yes	20	61	19	100	0.396
	No	0	0	1	1	
Totals		20	61	20	101	

*indicates significant P <0.05

CHAPTER 5: DISCUSSION

Mambwe and Chama are among the tsetse infested districts in Zambia located along the Luangwa valley. With the presence of wild animals as potential reservoirs for trypanosomes, people living in such tsetse infested areas are at increased risk of catching HAT. Therefore, one would expect RHCs located in such HAT known foci to be equipped with basic laboratory tools for HAT diagnosis, health practitioners deployed in such areas to be well trained and vested with the knowledge on HAT diagnosis and be more alert and aware about the possibility of HAT occurring in their areas. In the current study, however, of the 101 respondents from both districts, about 87% of the staff attending to patients at the RHCs visited had at least attained tertiary education while about 13% had secondary education. None of the respondents reported not to have had formal education. Therefore such results were satisfactory regarding the levels of education of respondents. Unfortunately, the numbers of the trained staff available at the RHCs visited was low, which in most cases was as low as only one or two trained health staff per RHC. Such low staffing levels could have compromised the provision of quality healthcare to each and every person visiting the RHC. The fact that the few available health workers may have also been overwhelmed with the large numbers of patients to attend to could have contributed to their inability to detect some HAT cases passing through the health facility.

It is assumed that the more years of service for the health staff in a particular district, the more knowledge and experience gained from the type and occurrences of diseases in the area. In agreement with that notion, data from this study suggest that most of the staff who had served longer (at least 10 years) in their respective districts had experienced at least one case of HAT in their working life. Such an experience could enable them more easily recognize another HAT case they could subsequently encounter. However, data analysis using Fisher's exact test revealed that the health personnel's level of education and duration of service were not statistically associated with their levels of knowledge and awareness of HAT occurrences in their respective districts.

Understanding the way a disease manifests itself by health personnel is very important in diagnosis. The ability to detect an infection depends on disease knowledge amongst health workers, which in turn encourages patients to visit the health centre for diagnosis (Odiit *et al*, 2004; Sindato *et al*, 2008). Unfortunately, clinical detection of HAT in its early stage is not

easily achievable in rural settings of Africa as initial symptoms of the disease are often confused with those of other common febrile diseases such as malaria TB and influenza (MacLean *et al*, 2010). Results of this study revealed that on average, health personnel from the RHCs visited in Chama and Mambwe districts did possess basic knowledge on identification of a HAT case (including abnormal sleep, fever, headache, body pains, lymph node enlargement and microscopy) and were aware of the possible occurrences of HAT. Respondents from both districts also indicated to have had received patients with symptoms of a disease similar to malaria but which after laboratory diagnosis was found not to be malaria and could thus easily been HAT. Despite such responses, staff from Chama (67.3%) carried out further investigations for those cases that were malaria negative compared to their Mambwe counterparts (42.9%) and also staff from Chama reported to have encountered more HAT cases compared to staff from Mambwe (P=0.000). Therefore, such results may also indicate that staff from Chama district where less likely to miss a case of HAT when re-occurred compared to their Mambwe counterparts. With malaria being one of the top most four diseases reported from both districts, there is therefore a possibility that in those areas where HAT and malaria are endemic, HAT could easily be mistaken and treated as malaria due to the similarities in clinical symptoms (Malele *et al*, 2006). There is also a possibility that HAT may co-exist with malaria, HIV/AIDS and TB (WHO, 2006), in which case patients are treated only for the later diseases. In this case, patients with co-infections may even be said to be resistant to the drugs being administered (Legros, 2002; Legros *et al*, 1994), when in the actual fact they are just being treated for one disease and not for the others. Since HAT affects poor people living in remote rural areas where access to medical facilities is limited, patients who are not properly diagnosed after several visits to the health centres may resort to many different alternative healthcare options (Bukachi *et al*, 2009).

With one case of HAT being reported from Mambwe district and several others from Chama district, it is not known as to how many possible cases could have gone unreported and resulted in death without seeking medical attention (Kinung'hi *et al*, 2006). According to the WHO expert committee on HAT control and surveillance (1995) and Odiit *et al*, 2005, it can extrapolated that from the 8 confirmed HAT cases reported in Chama district between 2003 and 2013, 80 more cases remained unreported in the field and about 5 cases died undetected. Furthermore, from the one case reported from Mambwe district, 10 more cases could have gone

undetected in the field. The rate of death due to HAT remains unknown as a number of HAT cases only present themselves to the health centers in the late stage and generally with similar manifestations to TB and HIV/AIDS (Fevre *et al*, 2008).

Despite the fact that there was no significant difference in the availability of basic tools that could be used for HAT diagnosis in Mambwe and Chama districts, and that the two districts had similar staffing levels of categorized health personnel involved in HAT diagnosis, Chama district reported more cases of HAT (43 cases) during the period 2003 to 2013. Such a trend could have resulted from the fact that Chama district was receiving some support for the management of HAT i.e. 13% response compared to Mambwe district which indicated 0% response regarding support for the management of HAT. With the current scenario where most parasitic diseases especially in rural areas are detected using rapid tests, most RHCs including those visited reported low presence of compound microscopes which when available can help detect trypanosomes even during examination of malaria parasites. The presence of rapid and highly sensitive, effective point of care diagnostic tests such as LAMP (Njiru, 2012) could improve detection and minimize missing HAT cases in such endemic area.

Considering the geographical location of Chama and Mambwe districts, it is possible that HAT cases occurring along the borders of Zambia may not be reported in Zambia but instead reported in the neighbouring countries or districts (Chisi *et al*, 2011). For instance, some of the HAT cases from Chama are conveniently reported in Malawi (Chisi *et al*, 2011). Similarly, some remote areas in Chama district that are apparently located near Mpika district but very far from Chama town could also instead report cases to Mpika district. As such, the actual cases being reported from Chama are not well documented (Mwanakasale *et al*, 2013).

Currently, the major burden of HAT in Africa including Zambia is mortality (WHO, 2014), but if a greater proportion of cases could be detected, almost all of the deaths could be preventable. The opportunities of preventing the deaths of HAT cases are greater than many other diseases including HIV/AIDS. However, governments in sub-Saharan Africa seem to be more committed to support malaria, HIV/AIDS and TB (Mwanakasale & Songolo, 2011) due to the major health impact they have on communities unlike HAT which is viewed to affect much fewer people. However, as shown in this study and elsewhere (WHO, 1998; Odiit *et al*, 2005), this notion may not be true as HAT is seriously under-estimated and could have a negative impact on the

country's economy if not properly managed (Burri & Brum 2003). Results of the study regarding government support towards the management of HAT showed 13.5% responses from Chama and none from Mambwe while the support provided for malaria, HIV/AIDS and TB results was 99.9% and 100% from Chama and Mambwe districts, respectively. The lack of political and financial support as demonstrated in the study, in most cases has contributed to most health personnel shifting their attention only to the much campaigned and supported diseases which may at least explain in part the re-emergence of NTDs such as HAT (Smith *et al,* 1998). The MOH seem to be overwhelmed by the number of diseases under their management which has made them concentrate more on those diseases that receive more financial support than those that do not or receive less support. The study also revealed lack of collaboration between the departments of health and the vector control unit (John *et al,* 2008) which may also contribute to the pitfalls in the control and management of HAT.

Support from the private sector could go a long way in preventing some of the NTDs. Currently, WHO has provided support for the control and management of most NTDs including HAT (WHO, 2005). Chama district, in particular, was observed to perform better in terms of disease diagnosis and reporting than Mambwe because of the support the former was receiving from WHO in form of drug supply and staff capacity training programmes on disease diagnosis (Chama Hospital records, 2009).

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- In conclusion, studies have shown that increased knowledge and awareness of a disease among health personnel results in increased diagnosis of that particular disease (John *et al*, 2008; Mwanakasale *et al*, 2013), but based on the findings of this study, there was reduced HAT diagnosis from the health centres visited though health personnel from both districts were knowledgeable about HAT diagnosis and also aware about the possible occurrences of the disease in their respective areas.
- Health personnel from Mambwe district reported to have more diagnostic capacity to detect HAT compared to their Chama counterparts despite the later district reporting more HAT cases.
- A number of factors could have contributed to the low levels of HAT diagnosis and reporting from Chama and Mambwe districts, including; (i) shortage of highly sensitive HAT diagnostic tools at health centres (ii) shortage of experienced laboratory personnel and generally low staffing levels.

Therefore based on the hypothesis of this study, it can be said that in the settled tsetse infested parts of the Luangwa valley, health personnel at RHCs have the ability to diagnose HAT but lack necessary government and private support for the management and control of the disease.

6.2 Recommendations

Elimination of HAT is technically feasible and economically justifiable as one of the important initial steps in Africa's efforts to alleviate poverty. With studies conducted along the Luangwa valley, this study included, factors contributing to the inability of health personnel to diagnose and manage HAT have been identified. There is evidence that tsetse flies have actually caused havoc to communities leaving along tsetse infested belts and thus there is need for local authorities to consolidate resources for interventional programmes to the identified problem. Based on the findings from this study, the following recommendations are suggested:

- Trained laboratory personnel need to be deployed to RHCs in such tsetse-infested remote rural areas. Such staff also need to be provided with refresher courses on both clinical and laboratory diagnosis of HAT in order to improve case detection and to be able to distinguish it from other febrile conditions such as malaria, TB and HIV/AIDS.
- Strong health systems need to be in place that will allow for improved case detection in known HAT transmission foci.
- Simple, cost effective diagnostic techniques such as microscopy and LAMP could be available at the RHCs for improved detection of HAT.
- Cost effective measures for the control of the tsetse vector within tsetse infested areas with human settlements and Chemotherapy for livestock reservoirs for trypanosomiasis also need to be supported by both the Government and the private sector.
- More epidemiological studies on possible co-infection of HAT with malaria, HIV/AIDS and TB should be undertaken in the known HAT transmission foci.
- There should be continuous HAT surveillance in the known HAT transmission foci to improve on the reporting system of the disease.

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World Health Organization (2006) **Human African Trypanosomiasis (sleeping sickness): Epidemiological update**. *WER* 81:71-80.

World health organization (2012) **The World Health Report**. Geneva: WHO

APPENDICES

APPENDIX 1: WORKPLAN

Activities	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug Sept Oct	Nov
Proposal development														
Presentation at GPPF and approval														
Resource mobilization														
Data collection														
Data analysis and Thesis writing														
Thesis submission														

APPENDIX 2: BUDGET

Activity	Responsible person	Place	Requirements	Quantity	Unit cost (ZMW)	Total cost (ZMW)
Development of research instrument	Researcher Research assistant	Lusaka	Plain paper Printing Duplicating	3 Lump sum Lump sum	30	90 500 500
					SUB-TOTAL	1,090
Pilot Study/Data collection	Researcher Assistants Driver	Mfuwe Chama	Note books Pens/pencils Transport Allowances: Researcher/Ass/Driver	4 Pack of 10 Fuel/oils meals nights	5 1 50 200	20 10 4,000 1,500 2,000
					SUB-TOTAL	7,530
Data analysis and Report writing	Researcher	Mfuwe Chama Lusaka	Ream of paper Printing/Binding Duplicating Transport	1 Lump sum Lump sum Fares/fuel	30	30 500 100 1,000
					SUB-TOTAL	1,630
					TOTAL	10,250
					10% contingency	1,025
					GRAND TOTAL	11,275

APPENDIX 3: INFORMED CONSENT

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF COMMUNITY MEDICINE

INFORMATION & CONSENT FORM FOR HUMAN AFRICAN TRYPANOSOMIASIS STUDY

TITLE: A COMPARATIVE STUDY ON THE CAPACITY OF HEALTH WORKERS AND HEALTH CENTRES TO DIAGNOSE HUMAN AFRICAN TRYPANOSOMIASIS IN TSETSE INFESTED CHAMA AND MAMBWE DISTRICTS OF EASTERN ZAMBIA

SECTION A: INFORMATION SHEET

I am a Master of Public Health (MPH) Student in the School of Medicine, University of Zambia. I am conducting a survey on the capacity of health staff and health centres to diagnose sleeping sickness in your district.

The objectives of this study are to (i) to investigate and compare the levels of HAT awareness among the health workers in the selected rural health centres in Mambwe and Chama districts, (ii) to compare the diagnostic capacity of RHCs between the two selected districts and establish how health workers diagnose and treat HAT, (iii) to establish the reporting system of HAT cases during the last ten years at the selected RHCs.

The study involves asking a series of questions from a questionnaire based on the objectives stated above. The information collected will be treated confidentially and will be used to prepare reports which will not include any specific names. There are no risks involved for taking part in the study.

The results obtained from this study will (i) Contribute to the understanding of the health services rendered in the study areas relative to HAT, (ii) Help identify gaps in the current diagnosis of HAT in the tsetse infested areas of the Luangwa valley and suggest improvements for the good of the local communities and the country at large, (iii) Contribute, through improved HAT case detection and knowledge among health workers, towards more effective control measures of the disease. Participation in this research is voluntary. The participants are free to ask any questions and if they feel dissatisfied, they are free to decline from participating without any penalty.

No costs or compensation will be charged to the participants for taking part in the study.

SECTION B: CONSENT FORM

The purpose of the study has adequately been explained to me and I understand the aim, benefits and confidentiality of the study. I further understand that if I agree to take part in this study, I can withdraw at any time without having to give an explanation and that taking part in this study is purely voluntary.

Signature or thumb print of respondent……

Signature of witness…… Place……..

Date……..……

Contacts : Mulenga Gloria, Dept of Community Medicine, School of Medicine, UNZA : 0977628915, *mmukuka2000@yahoo.com*

Prof. B. Namangala (Head, Paraclinical Studies Dept, School of Vet. Medicine): 0211-293727, *b.namangala@unza.zm*

The Chairperson Biomedical Ethics Committee: 0211-256067, *unzarec@zamtel.zm*

APPENDIX 4: INTERVIEW/QUESTIONNAIRE FOR HEALTH PERSONNEL

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF COMMUNITY MEDICINE

TOPIC: **"**A COMPARATIVE STUDY ON THE CAPACITY OF HEALTH WORKERS AND HEALTH CENTRES TO DIAGNOSE HUMAN AFRICAN TRYPANOSOMIASIS **IN TSETSE INFESTED CHAMA AND MAMBWE DISTRICTS OF EASTERN ZAMBIA"**

Dear respondent,

I am a Master of Public Health (MPH) Student in the School of Medicine, University of Zambia. I am conducting a survey on perceptions and practices towards diagnosis of sleeping sickness among health personnel in your district. The main objectives for my study are as follows:

- To investigate and compare the level of HAT awareness among health workers in the selected rural health centres in Mambwe and Chama districts.
- To compare the diagnostic capacity of RHCs between the two selected districts and establish how health workers diagnose and treat HAT
- To establish the reporting system of HAT cases during the last ten years at the selected RHCs

You have been randomly selected to assist in this study. Your participation in this research is voluntary. Please note that your views in this interview shall not be, in any way, used for any other purpose other than the advancement of this study. You are therefore assured that your views shall not be used in any way that might damage your reputation as an individual or otherwise, integrity, emotions, or indeed professional conduct as the information provided will be treated with high level of confidentiality.

Your cooperation in this exercise will be highly appreciated.

Yours sincerely,

Gloria M. Mulenga

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF COMMUNITY MEDICINE

TOPIC: **"A COMPARATIVE STUDY ON THE CAPACITY OF HEALTH WORKERS AND HEALTH CENTRES TO DIAGNOSE HUMAN AFRICAN TRYPANOSOMIASIS IN TSETSE INFESTED CHAMA AND MAMBWE DISTRICTS OF EASTERN ZAMBIA"**

QUESTIONAIRE ID……

NAME OF RHC: ……..

INSTRUCTIONS:

1. No name should appear on/and or in this questionnaire.
2. Answer all the questions.
3. Tick √ in the space provided next to your choice
4. Write in provided space wherever appropriate
5. Use a pen/pencil in the questionnaire.

SECTION A: DEMOGRAPHIC DATA **FOR OFFICIAL USE**

1. Occupation/position of the respondent at the centre
   [1]Medical Officer [2] Clinical Officer

   [3]Nurse [4] Laboratory Technician
   [5]Other (specify)…….

2. Indicate numbers of staff at the clinic with the following occupations
   (Write in the space provided)

NOTE: Ask only in-charge of centre or if respondent is the only staff at the center

   [1]Doctors…… [2] Clinical Officer…….

   [3]Nurses……. [4] Laboratory Technician……..
   [5]Other (Specify)……

3. Highest level of education of the respondent
   [1] University [2] College

   [3] Secondary [4] Primary

   [5] None of the above

4. For how long have you being working in this district?
   [1] Less than 5years
   [2] Between 5 and 10years
   [3] More than 10years

SECTION B: KNOWLEDGE AND AWARENESS ON HAT

5. What are the most common diseases that the centre records? Mention at least four.
   I. ……
   II. …….....
   III. ……
   IV. ……...

6. Based on clinical signs, are further diagnosis or investigations done for malaria negative cases?

   [1]Yes [2] No [88]Don't know

7. Has the clinic ever received any patient with severe symptoms of a disease similar to malaria, but after laboratory diagnosis was found not to be malaria?
   [1]Yes [2] No [88] Don't know

8. Are you aware of the possible occurrences of sleeping sickness in the district?
   [1]Yes [2] No [88]Don't know

9. How would you identify a case of sleeping sickness at this health centre
   [**Tick** √ in the box next to your choice]

   [1]Abnormal sleep

   [2]Fever

   [3]Body pains

   [4]Headache

   [5] Lymph node enlargement

   [6]Microscopy

   [7] Other (specify)…….

10. Have you ever encountered a case of sleeping sickness at this health centre?
    [1]Yes [2] No

    If NO skip to Question 13

11. If any case was recorded, was it treated or referred to a higher hospital?
    [1]Yes, it was treated [2] No, it was not treated
    [3] Referred

12. If treated, mention the drugs that were used
    …….
    …….

SECTION C: AVALIABILITY OF TOOLS/EQUIPMENT FOR DIAGNOSIS

13. Does the centre have the following equipment/materials that can be used for the diagnosis of sleeping sickness?
    [**Tick** √ the equipment present in the space provided]

    [1] Microscope

[2] Centrifuge

[3] Slides and cover slips

[4] Capillary tubes

[5] Giemsa staining solution

[6] Syringes and needles

[7] Filter paper

SECTION D: COLLABORATION WITH OTHER SECTORS

14. Does the centre collaborate with other sectors e.g. vector control, for the management of sleeping sickness?
    [1]Yes [2] No [88]Don't know

15. Has the centre at any case worked with other government or private departments in issues regarding the management of sleeping sickness
    [1]Yes [2] No [88]Don't know

16. Does the centre receive any financial support from the private sector specifically for the management of sleeping sickness?
    [1]Yes [2] No [88]Don't know

SECTION E: COMPETING HEALTH PRIORITIES

17. Are there any programmes currently running in the district on awareness and management of sleeping sickness?
    [1]Yes [2] No [88]Don't know

18. Has the district ever had education programmes on sleeping sickness for the community?

    [1]Yes [2] No [88]Don't know

SECTION F: POLITICAL COMMITTMENT

19. Does the centre receive any GRZ support towards the management and control of the following disease?
    [**Tick** √ in the box provided]

    [1]Sleeping sickness ☐

    [2]Malaria ☐

    [3]HIV/AIDS ☐

    [4]T.B ☐

20. Has the centre ever received any GRZ support towards the management of sleeping sickness
    [1]Yes [2] No] [88]Don't know ☐

21. Do you know if there any health policy on the management of HAT?
    [1]Yes [2] No] [88]Don't know ☐

THE END

THANK YOU FOR YOUR COOPERATION

APPENDIX 5: TRYPANOSOMOSIS RECORD SHEET

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF COMMUNITY MEDICINE

HUMAN AFRICAN TRYPANOSOMOSIS RECORD SHEET

Province…….

District……

Recorder……

RHC	Longitude ^{o} E	Latitude ^{o} S	No. of HATcases reported	Date reported	Case outcome: Treated/not treated	Comment

APPENDIX 6: GRADUATE PROPOSAL PRESENTATION FORUM CLEARANCE

THE UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE

Telephone: 252641
Telegram: UNZA, Lusaka
Telex: UNZALU ZA 44370
Email: selestinenzala@yahoo.com

P.O. Box 50110
Lusaka, Zambia

==========

26th November, 2012

Ms Gloria Mulenga
Department of Community Medicine
School of Medicine
LUSAKA

Dear Ms Mulenga,

RE: GRADUATES PROPOSAL PRESENTATION FORUM (GPPF)

Having assessed your dissertation entitled **"Perceptions and Practices towards the Diagnosis of Human African Trypasomiasis (HAT) among Health workers in Tsetse infected Chama and Mambwe districts of the Eastern Province of Zambia".** We are satisfied that all the corrections to your research proposal have been done. The proposal meets the standard as laid down by the Board of Graduate Studies.

You can proceed and present to the Research Ethics.

Yours faithfully,

Dr. S. H. Nzala
ASSISTANT DEAN, POSTGRADUATE

CC: HOD – Community Medicine

APPENDIX 7: BIOMEDICAL RESEARCH ETHICS CLEARANCE

THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: unzarec@unza.zm
Assurance No. FWA00000338
IRB00001131 of IORG0000774

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

11th January, 2013.

Your Ref: 001-12-12.

Ms Gloria Mulenga,
School of Medicine,
Department of Community Medicine,
PO Box 50110,
Lusaka.

Dear Ms Mulenga,

RE: SUBMITTED RESEARCH PROPOSAL: **"PERCEPTIONS AND PRACTICES TOWARDS THE DIAGNOSIS OF HUMAN AFRICAN TRYPANOSOMIASIS AMONG HEALTH PERSONNEL AT RURAL HEALTH CENTERS IN TSE-TSE INFESTED AREAS OF LUANGWA VALLEY"**

Your application for a waiver of ethics review for the protocol **"Perceptions and Practices Towards the Diagnosis of Human African Trypanosomiasis Among Health Personnel at Rural Health Centers in Tse-Tse Infested Areas of Luangwa Valley"** was reviewed. The waiver is hereby granted in accordance with the University of Zambia Biomedical Research Ethics Committee procedure on granting waiver of ethics review.

CONDITIONS:

- The waiver is based strictly on your submitted proposal. Should there be need for you to modify or make changes to the proposal you will need to seek clearance from the University of Zambia Biomedical Research Ethics Committee.
- This waiver does not release you from any other applicable obligations in ensuring confidentiality.
- If you need any clarifications please consult this office.
- **Ensure that a final copy of the results is submitted to this Committee.**

Yours sincerely,

Dr. J.C Munthali
CHAIRPERSON

Date of approval: 11 January, 2013 **Date of expiry:** 10 January, 2014

APPENDIX 8: MOH RESEARCH CLEARANCE

All Correspondence should be addressed to the
Permanent Secretary
Telephone: +260 211 253040 5
Fax : +260 211 253344

In reply please quote:
MH/101/17/6
No.....

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH

REPUBLIC OF ZAMBIA MINISTRY OF HEALTH 04 APR 2013 PROVINCIAL MEDICAL OFFICER P. O. BOX 510023, CHIPATA

NDEKE HOUSE
P. O. BOX 30205
LUSAKA

DMO – Mambwe
facilitate
PMO

13th February 2013

Dr. H Halwiindi,
The University Zambia
School of Medicine
Department of Public Health,
P.O.Box 50110,
Lusaka
ZAMBIA

Dear Dr. Halwiindi,

Re: Request for Authority to Conduct Research - Mulenga Gloria

The Ministry of Health is in receipt of your request on behalf of the above named student, for authority to conduct research in **"Perceptions and Practices on the Diagnosis of Human African Trypanosomiasis among Health Personnel in Tsetse Infested Chama and Mambwe District".** I wish to inform you that following submission of your research proposal to my Ministry, our review of the same and in view of the ethical clearance, my Ministry has granted you authority to carry out the study on condition that:

1. The relevant Provincial and District Directors of Health where the study is being conducted are fully appraised;
2. Progress updates are provided to MoH quarterly from the date of commencement of the study;
3. The final study report is cleared by the MoH before any publication or dissemination within or outside the country;
4. After clearance for publication or dissemination by the MoH, the final study report is shared with all relevant Provincial and District Directors of Health where the study was being conducted, and all key respondents.

Yours sincerely,

Dr. W. Chilengwe
Acting Permanent Secretary
MINISTRY OF HEALTH
Cc: District Medical Officer

MAMBWE DISTRICT MEDICAL OFFICE 0 APR 2013 P.O. BOX MANSHYA

Cleared DMO

15 APR 2013 Approved