COST EFFECTIVE CONTROL OF ZOONOTIC AFRICAN TRYPANOSOMIASIS IN KENYA: ANALYSING UNDERREPORTING FACTORS AND MODELING PREVALENCE IN BUSIA FOCI

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

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ABSTRACT

The study aimed at analyzing factors contributing to underreporting of zoonotic African trypanosomiasis and quantifying the human prevalence through utilization of prevalence data of the causative parasite in the blood of domestic animals and feedback from medical practitioners under a non outbreak endemic situation in Busia County. Human African trypanosomiasis (HAT) is caused by infection with protozoan parasites Trypanosoma brucei rhodesiense or gambiense transmitted to humans by tsetse fly (Glossina genus) bites which have acquired their infection from human beings or from animal reservoirs harbouring the human infective trypanosome parasites. Busia Kenya has reported negligible cases of HAT inspite of the neighbouring districts in Uganda shairing porous borders with Kenya continuing to report a marked prevalence. HAT is a major constraint on human health and livestock production and health and yet its prevalence is not appropriately captured due a variety of factors leading to inadequate attention by authorities. The Polymerase Chain Reaction (PCR) test permits differentiation of human and non human infective parasites subspecies especially T. b. rhodesiense found in Kenya and T. b. brucei based on the presence or absence of the SRA gene specific for T. b. rhodesiense. Parasitological techniques through microscopy are routinely used in diagnosing the disease in the field despite lacking the capacity to differentiate the sub species. To gain insight into this challenge the study was split into three distinct components.

The first component of the study sought to establish whether the knowledge and practice in the identification and management of HAT by medical practitioners had an impact on diagnosis and subsequent under reporting of the disease. A cross sectional survey was conducted through the use of semi structured questionnaires administered to medical practitioners and focus group discussions. This was carried out in selected health facilities in Busia County between June 2010 and December 2011 where the curriculum of medical practitioners was also reviewed. Kakamega referral hospital was also included. Chi Square ($\chi^2$) and logistic regression tests
expressed through odds ratios (OR) were carried out to establish relationship and association between knowledge and management practices by medical practitioners for HAT and several variables. Significance was set at $P \leq 0.05$. One hundred and twenty one (121) medical practitioners responded consisting of 72% males and 28% females. Twelve percent (12%) of the respondents reported having managed sleeping sickness before. Years of experience was statistically significant with more experienced respondents reporting to have had previous encounter with mixed zoonotic diseases including HAT as opposed to inexperienced ones ($\chi^2 = 14.21$, d.f=3, $p=0.002$). The odds of having a previous encounter with mixed zoonotic diseases including HAT was 42% greater for individuals with 5-10 years’ experience or more (OR 0.58, 95% CI 0.09-0.65, $p=0.009$) and were 2.5 times more than individuals who had <1 year experience (OR 2.5, 95% CI 2.61-8.43, $p=0.018$). There exist knowledge and practice gap on HAT by medical practitioners and this could be a contributing factor to poor diagnosis and under reporting of HAT. Refresher courses on zoonotic diseases such as HAT should be conducted with more emphasis placed on zoonotic diseases in the curriculum and training of medical practitioners and veterinarians.

The second component of the study was designed as a cross sectional study with both experimental and observation characteristics to establish the prevalence of *T.b.rhodesiense* parasites in the blood of domestic animals reported using descriptive and analytic statistics. A multi stage sampling involving sub Counties as strata and sampling sites located at sub location level as clusters was done from January 2011 to March 2012. A total of 3799 blood samples from domestic animals collected in 19 sites throughout the County were screened by parasitological techniques through microscopy (later confirmed by PCR) and PCR for *T.b.rhodesiense parasites*. A total of 9 and 47 blood samples from livestock respectively were found positive for *T.b.rhodesiense* respectively for the two tests. Microscopy recorded a sensitivity of 15% and specificity 99% using PCR test as the gold standard. The comparative analysis showed that there was poor agreement between microscopy and PCR with a Cohen’s
Kappa (k) value of 0.2816 in all domestic animals. The odds for being positive for any trypanosome in microscopy was 228 if one was tested positive under PCR. Human infective Trypanosoma brucei rhodesiense parasites were detected in 1.24% in all sampled livestock (47/3799) under PCR and 0.24% (9/3799) under Microscopy. In cattle, PCR and microscopy detected 33 (1.05% prevalence, 95% confidence interval 0.82%-1.32%) and 6 (0.77% prevalence, 95% CI, 0.57%-1.01%) positive cases respectively. There is therefore an urgent need for development and utilization of more accurate tools such as those involving molecular techniques like PCR for the effective diagnosis of HAT. The existing tests for diagnosis especially for routine field use are not adequately sensitive due to the characteristically low number of parasites found in the blood of sleeping sickness patients.

The third component of the study developed an explanatory HAT model to estimate prevalence in humans using data from domestic animal hosts under non epidemic conditions. A mathematical model for a vector borne disease involving two vertebrate host species and one insect vector species was developed and executed through R statistical software for statistical modeling and computing. The model predicted 637 people out of total population of 780,132 corresponding to a prevalence of 0.0816% were infected with HAT parasites and 244 livestock were carriers out of the population of 328,895 livestock corresponding to a prevalence rate of 0.074% were carriers of HAT parasites by the end of the year 2014. The animal reservoir is therefore crucial in determining not only the continued occurrence of the disease in humans, but its prevalence in the human host as well. The prevalence model of HAT T.b.rhodesiense developed utilizes the prevalence of HAT causing parasites in livestock to estimate the prevalence in humans under non epidemic conditions which is critical in quantifying the extent of underreporting of HAT in the Busia foci and beyond. The practice by medical practioners and choice of diagnostic test directly contribute to underreporting of HAT. The occurrence of HAT infection in animal reservoirs is a critical consideration in planning for effective control of the disease and the model proposed shall provide an insight into the HAT prevalence.