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Mass-treatment and insecticide-spraying of animal reservoirs for emergency control of *Rhodesiense* sleeping sickness in Uganda

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Key words Animal reservoirs; insecticide-spraying; mass chemotherapy; *Trypanosoma brucei rhodesiense*; tsetse control

Human African trypanosomiasis or sleeping sickness is a devastating disease that kills all those infected unless treated. Sleeping sickness tends to affect the poorest and marginalized rural communities with least access to health care. The acute form of the disease caused by *T.b. rhodesiense* was first recognized in south-east Uganda in 1898[1]. This epidemic which lasted until 1915, led to the death of over 350,000 people in south-eastern Uganda alone. Subsequently, there were a number of sporadic outbreaks of the disease. However, in the 1940s, a second major epidemic of sleeping sickness began in south-east Uganda which led to 2432 cases and 274 deaths[2]. The third major epidemic started in the 1970s and continued up to the end of 1980s[3]. In 1988, sleeping sickness extended to Tororo and Busia districts at the Uganda-Kenya border during which 1180 cases were reported. This epidemic was brought under control by the end of 1990s[4]. Southeast Uganda still remains the major focus of *T.b. rhodesiense* sleeping sickness with *Glossina fuscipes fuscipes* as the major vector[5].

Recent reports indicate that the area affected by *T.b. rhodesiense* sleeping sickness has increased 2.5-fold since 1985[4], extending further north into Soroti, Kaberamaido, Apac, Lira districts[6] and probably Gulu district. This northern spread of the disease could easily lead to the merger of the south-eastern *T.b. rhodesiense* sleeping sickness focus with the north-western *T.b. gambiense* focus. This is likely to complicate the epidemiology and control of the two forms of the disease. According to Simarro *et al*[7], *T.b. rhodesiense* cases reported in Uganda from 2000 to 2009 were: 300 (2000), 426 (2001), 329 (2002), 338 (2003), 335 (2004), 473 (2005), 261 (2006), 119 (2007), 138 (2008) and 129 (2009)[7]. Most of these cases were reported in Iganga, Soroti, Kaberamaido, Dokolo and Lira[7]. Most cases of *T.b. rhodesiense* are linked to livestock reservoirs[7]. Livestock reservoirs are important especially in south-east Uganda where these are responsible for over 50% of the reported cases of *T.b. rhodesiense* cases during the period 2000 to 2009[7].

Control of sleeping sickness mainly relies on case finding and treatment[8] coupled with tsetse control during epidemics to suppress transmission. Case finding is normally focused on screening people in and around known foci of the disease. Though not widely practised, there is growing evidence that domestic animal reservoirs, including cattle, pigs and small ruminants need to be treated to prevent persistence and spread of *T.b. rhodesiense* sleeping sickness[9–11]. The zoonotic nature of *T.b. rhodesiense* is well recognized, and cattle and pigs have long been reported to be its major reservoirs in south-east Uganda[10, 12–15]. Animal reservoirs have been incriminated in the persistence of *T.b. rhodesiense* sleeping sickness in old foci[10]. Movement of cattle from sleeping sickness endemic areas during restocking programs is responsible for emergence of new foci[9]. It is reported that up to 18% of the domestic animals in emerging sleeping sickness foci may be acting as reservoirs for the disease[5].

Whereas the role of animal reservoirs is well-documented in the epidemiology of *T.b. rhodesiense* sleeping sickness, targeting of animal reservoirs is rarely exploited in the control of sleeping sickness. Moreover, case studies on this control intervention in *Rhodesiense* sleeping sickness foci in Africa and their follow-up reports are scarce. Hence, we present a case study and its follow-up report on three sleeping sickness foci in south-east Uganda where mass-treatment and insecticide-spraying of cattle and pigs were applied to suppress outbreaks of *T.b. rhodesiense* sleeping sickness and monitored over a period of up to 17 years.

Buteba, Kisoko and Osukuru sleeping sickness foci are located in Tororo district in south-east Uganda, an area predominantly infested with *G. fuscipes fuscipes.* Sleeping sickness outbreaks are normally focalized; affecting a cluster of tsetse-infested villages[16]. Communities in these villages practise mixed crop-livestock farming, keeping mainly cattle and pigs which act as reservoirs for *T.b. rhodesiense*.

Outbreaks of Human African Trypanosomiasis due to *T.b. rhodesiense* occurred in Buteba (1990–91), Kisoko (1992–93) and Osukuru (2001–02) foci in Tororo district. Outbreaks were monitored through the number and places of origin of patients admitted at the LIRI Hospi-

tal—a sleeping sickness treatment centre in Tororo district. In turn, an advance medical team went ahead to create awareness among affected communities. The disease signs and symptoms, mode of transmission, and importance of cattle and pigs as reservoirs for *T.b. rhodesiense* were highlighted. At the end of each community education session people in the affected villages were asked to bring their cattle and pigs to designated areas for mass-treatment and insecticide-spraying by the veterinary team on programmed dates. The cluster of villages at different places that constituted the sleeping sickness foci were targeted during implementation of control interventions.

Control interventions were conducted in Kayoro Parish, Buteba Subcounty in March 1991, Petta Parish, Kisoko Subcounty in March 1993, and in Osukuru, Nyalakot and Kayoro Parishes, Osukuru Subcounty in April 2001. During the implementation of the control interventions, all cattle and pigs presented were treated with diminazene aceturate (Berenil®, Hoechst GmBH, Germany) at a dosage rate of 7 mg/kg body weight. In addition, animal reservoirs were sprayed with deltamethrin pour-on (Spoton®, Coopers, Harare, Zimbabwe) on the backline at a dosage rate of 1ml/10 kg body weight. For each village, the number of animals treated was recorded.

Following control interventions, sleeping sickness patients reporting to LIRI Hospital from Buteba, Kisoko and Osukuru foci were monitored through patient records from the time of the outbreaks in 1991 to 2008. As shown in Fig. 1, from January 1990 to March 1991, 59 patients presented for treatment from Buteba focus. During the proceeding outbreaks, 18 patients presented from Kisoko focus from May 1992 to February 1993 (Fig. 2) and 69 patients presented from Osukuru focus from January 2001 to January 2002 (Fig. 3).

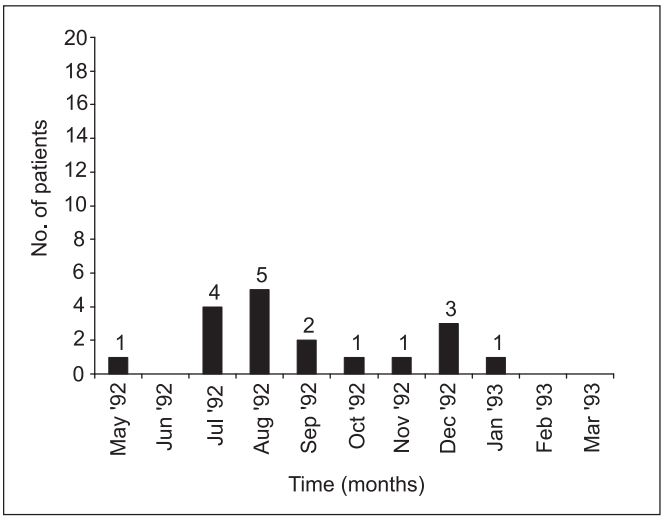

Fig. 2: Distribution of *T.b. rhodesiense* sleeping sickness patients from Kisoko focus in Tororo district, Uganda during the outbreak from 1992 to 1993.

The number of tsetse hosts and animal reservoirs (cattle and pigs) treated and sprayed during the outbreaks in Buteba, Kisoko and Osukuru foci are shown in Table 1. By January 2008, 6–17 years since the last outbreaks, no resurgence of sleeping sickness outbreak was observed in these foci.

Although cattle and pigs are the most important domestic animal reservoirs in south-east Uganda[10, 13, 15, 17, 18], earlier interventions mainly targeted cattle as was the case in Buteba focus. This was mainly because cattle were the dominant livestock type in the area. Blood meal studies

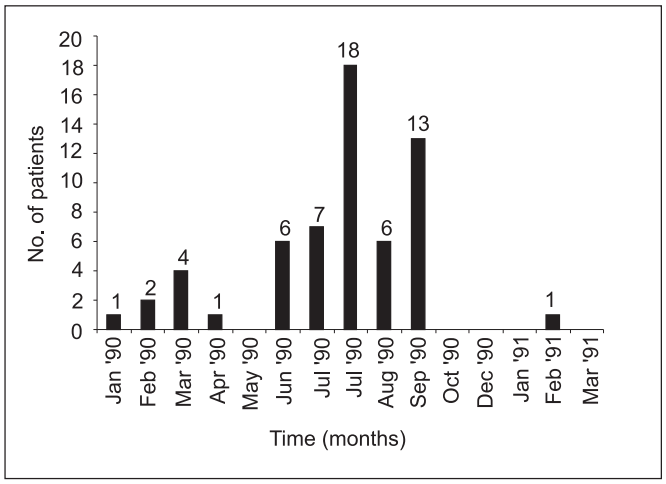

Fig. 1: Distribution of *T.b. rhodesiense* sleeping sickness patients from Buteba focus in Tororo district, Uganda during the outbreak from 1990 to 1991.

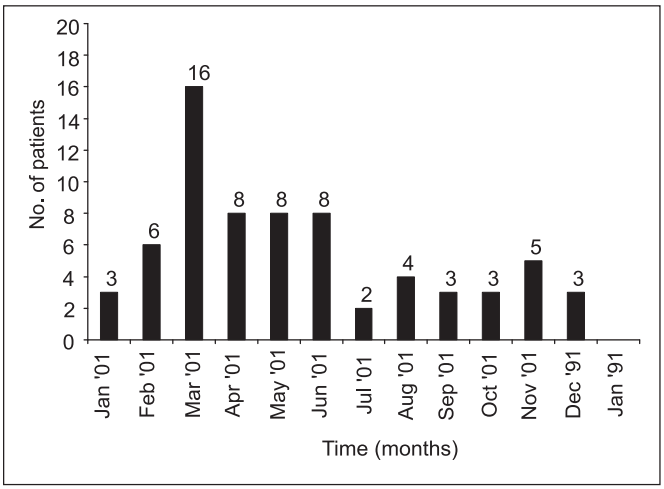

Fig. 3: Distribution of *T.b. rhodesiense* sleeping sickness patients from Osukuru focus in Tororo district, Uganda during the outbreak from 2001 to 2002.

Table 1. Number of cattle and pigs treated and sprayed in respective foci and the duration since the last outbreak

	Sleeping sickness foci		
	Buteba	Kisoko	Osukuru
No. of cattle treated and sprayed	1791	937	1771
No. of pigs treated and sprayed	–	224	18
Duration since outbreak to 2008 (yr)	17	15	6

have shown that the number of times tsetse feeds on cattle is proportional to the number of cattle in the domestic herds[15]. During intervening years, however, as more evidence unfolded, interventions targeted both cattle and pigs as was the case in Kisoko and Osukuru foci. Blood meal analysis has consistently shown that cattle, pigs and monitor lizards are the most preferred hosts for *G. fuscipes fuscipes* in south-east Uganda[15]. Inclusion of pigs in mass treatment and insecticide spraying is of epidemiological significance given that communities in disease foci keep pigs within homesteads where *G. fuscipes fuscipes* is reported to be predomestic[19]. Current thinking is that a whole range of domestic reservoirs, including cattle, pigs, sheeps and goats needs to be treated. Previous omission of pigs, sheeps and goats during treatment is reported to be partly responsible for the continued persistence of sleeping sickness in south-east Uganda[20]. Upon realization of the importance of livestock reservoirs in propagation of cases of *T.b. rhodesiense* sleeping sickness in Uganda, Waiswa and Kabasa[21], embarked on a programme to treat 200,000 cattle with diminazene aceturate and spray them with deltametrin in the Districts of Soroti, Kaberamaido, Dokolo, Lira, Amolatar and Apac. This programme is reported to have decreased the prevalence of *T. brucei s.l.* in cattle by 70% within one year of implementation[21].

Combination of chemotherapy and application of insecticide pour-on on cattle is proven to exert rapid suppression of trypanosomiasis and tsetse population[22, 23]. However, mass-treatment of livestock with isometamidium chloride coupled with limited vector control in some foci in Soroti of Uganda did not yield the desirable impact on the prevalence of *T.b. rhodesiense* in cattle[6]. Because to be effective in the prevention of parasite transmission from livestock to people, mass-treatment and insecticide-spraying have to cover enough livestock (over 95%). In the present case study, the treatment and spraying campaign targeted over 95% of the cattle and pigs in the entire cluster of villages within the sleeping sickness focus. For logistic reasons, an approach involving gathering of cattle in designated communal areas coupled with "house-to-house visits" in search for pigs yielded excellent animal reservoir coverage. Combination of mass-treatment and vector control is likely to minimize occurrence and spread of drug resistant parasites. Economic evidence suggests that financial benefits of treating the animal reservoirs for *T.b. rhodesiense* sleeping sickness would be more than cover the costs of treatment[24]. Treatment of animal reservoirs is beneficial to animal health and productivity. Lowering the incidence of sleeping sickness by treating animal reservoirs reduces the cost of treating human patients[24]. In addition, it reduces the incidence of drug failure and toxicity associated with most especially melarsoprol—a drug for treatment of late stage cases[25,26].

In principle, livestocks for sale in sleeping sickness endemic areas in south-east Uganda are required to be treated before sale as a matter of Government policy[27], however, the policy has proved difficult to implement at a local level due to decentralization of public services[6]. Different aspects of control, i.e. tsetse, human and animal trypanosomiasis being handled by different government departments in most sleeping sickness endemic countries is another bottleneck. Successful implementation of mass-treatment and insecticide-spraying of animal reservoirs demands for inter-sectoral cooperation among veterinary, agriculture and health services at all levels [25,26].

In conclusion, application of mass-treatment and insecticide-spraying of animal reservoirs in disease foci as an emergency control intervention for *T.b. rhodesiense* sleeping sickness outbreaks by governments is recommended. There is need for further studies on the integration of land-use practices that eliminate tsetse habitats with application of mass-treatment and spraying of animal reservoirs in *rhodesiense* sleeping sickness foci.

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