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Preliminary evaluation of Community-Led Total Sanitation for the control of *Taenia solium* cysticercosis in Katete District of Zambia

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ABSTRACT

Taenia solium taeniasis/cysticercosis is a zoonotic disease endemic in sub-Saharan Africa. It is associated with poor sanitary practices, free-range pig husbandry and lack of disease awareness in endemic communities. A comparative research was conducted with pre and post-intervention assessments in nine villages to evaluate Community-Led Total Sanitation (CLTS) as an intervention measure for the control of porcine cysticercosis in Katete District in the Eastern Province of Zambia. Blood samples were collected from pigs for circulating antigen detection and a questionnaire focused on the household was administered to a total of 153 respondents whose pigs were examined (64 pre-intervention, 89 post-intervention), in order to obtain information on general demographic characteristics, pig husbandry practices, sanitation practices and associated knowledge and awareness of *T. solium* infections. The first sampling was conducted prior to the implementation of the CLTS and second sampling eight months after triggering of CLTS in the selected villages. A total of 379 pig serum samples were examined using the B158/B60 Ag-ELISA to detect *T. solium* cysticercosis, 104 pre-intervention and 275 post-intervention, of which 14 (13.5%) and 45 (16.4%) were positive, respectively. Wald test *p*-values were computed to assess significant differences in the variables of interest mentioned above for the pre and post CLTS. The research revealed that CLTS as a control measure did not significantly improve *T. solium* infections in pigs. The research also revealed that the sanitation practices and awareness of cysticercosis did not change. It is recommended that a longer term evaluation be undertaken when the villages have been declared open defaecation free. In addition, the research recommends that health education, mass drug treatment and pig vaccination be incorporated, as an essential component of prevention and control programmes for *T. solium* infections.

1. Introduction

Taenia solium cysticercosis is one of the neglected tropical diseases targeted for control by the World Health Organization (WHO) Sixty-sixth World Health Assembly

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(2013). The available epidemiological data on cysticercosis in Africa indicates that *T. solium* cysticercosis is endemic in the entire sub-Saharan region (Sikasunge et al., 2008; Assana et al., 2010; Praet et al., 2010; Krecek et al., 2012). The life cycle of *T. solium* includes pigs as the natural intermediate hosts, harbouring the larval vesicles or cysticerci (cysticercosis), and humans as the definitive host, harbouring the intestinal adult form or tapeworm (taeniasis) (Flisser et al., 2006). Persons infected with *T. solium* tapeworms intermittently shed proglottids and/or substantial numbers of infective eggs in their faeces. Human cysticercosis occurs when humans accidentally ingest *T. solium* eggs via the faecal - oral route or contaminated food. This may lead to infection of the central nervous system manifesting as neurocysticercosis, a major cause of acquired epilepsy, chronic headaches, seizures, hydrocephalus and other neurological manifestations (Ndimubanzi et al., 2010).

The WHO (WHO, 2011) estimates that approximately 50 million people worldwide have cysticercosis infection, although estimates are probably low since many infections are subclinical and there are relatively few population based data on prevalence (Ndimubanzi et al., 2010). Cysticercosis is endemic in many regions of Central and South America, Sub-Saharan Africa, and Asia. However, infections have also been detected in developed countries due to international migration and furthermore, carriers of the intestinal *T. solium* have also been found even in Muslim countries that, in principle, do not eat pork (Flisser, 2011).

The prevalence of porcine cysticercosis varies (2.0–41.2%) in sub-Saharan Africa depending on the region and type of diagnostic tool used to detect it (Assana et al., 2013). The current pig diagnostic tools available are; parasitological, immunodiagnostic and meat inspection with the immunodiagnostic tools being more sensitive. Cysticercosis prevalence is often higher in rural or peri-urban areas, which lack pit latrines and where open defaecation is practised (Assana et al., 2013). Most of the rural pigs are raised in a free-range management system giving them access to human faeces. In addition, the lack of properly inspected pig slaughter houses and effective enforcement of public health legislature leads to backyard slaughtering practices of pigs, and local consumption of the contaminated meat contributes to the maintenance of the life cycle (Maridadi et al., 2011). However, up to now, not many large-scale control programmes have been undertaken in sub-Saharan Africa. Endemic developing countries face many disease problems and focus their priority on high mortality diseases such as malaria, tuberculosis and AIDS. They also have limited resources available and *T. solium* is often not given the attention it deserves (Assana et al., 2012).

Economic impact studies by Carabin et al. (2006) and Praet et al. (2010) have revealed that infected pigs have been found to contribute 4.7–26.9% of the overall costs of pig husbandry, resulting in total annual losses of €10 million and US$18.6 to US$34.2 million, respectively. However, this estimation gives only an indication rather than an accurate determination of the economic losses. Usually in Africa, a pig carcass with cysticercosis is sold at a reduced price thereby causing a loss to either the farmer or the intermediary agent (Mkupasi et al., 2011; Ngowi et al., 2009).

In Zambia, survey records in six of the nine provinces from 2003 to 2008 based on meat inspection, tongue palpitation and serological tests give a prevalence of 7.3–34% for porcine cysticercosis confirming its endemicity (Phiri et al., 2003; Sikasunge et al., 2007, 2008). Pig keeping and pork consumption in Zambia have increased significantly from 1990 (Phiri et al., 2003). In the Katete District the pig population has increased from 63,627 in 2003 to 89,467 in 2010 (CSO Post Harvest Season Report, 2002; CSO Population and Housing Descriptive Tables, 2010). In addition, the increased demand for pork in urban areas of the country has resulted in the transportation of pigs from these rural smallholder communities to large population centres (Phiri et al., 2002). However, despite the evidence, few control measures have been developed in combating *T. solium* cysticercosis in Zambia. One of the possible control measures is the improvement of basic sanitation, hygiene and health education, which has proved to be an efficient strategy for many parasitic and infectious disease transmitted by faeces (Fleury et al., 2013).

Community-Led Total Sanitation (CLTS) is an innovative community-based sanitation programme pioneered in 1999 by Kamal Kar (a development consultant from India) in a small community in Bangladesh, which looks at modifying the normative environment in which open defecation occurs (Kar, 2005). The programme aims at reducing open-air defecation in rural communities through the construction of pit latrines. It is assumed that the success of CLTS will lead to the control of poor sanitation-related diseases, including human/porcine cysticercosis infections.

In 2007, UNICEF in conjunction with the Government of Zambia piloted the CLTS approach in Choma District of the Southern Province, where the coverage was 40%. Twelve communities were triggered by trained CLTS facilitators and within two months, sanitation coverage increased from 23% to 88% within a population of 4536 and 75% of the villages were verified as open defecation free (ODF). Following the success of the pilot project, "The 3 Million People Sanitation Program" was launched in April 2012 by the Minister of Local Government and Housing in Zambia. Twelve districts including Katete in Eastern Province of Zambia were selected for the pilot that took place between April and June 2012 (Zulu et al., 2010).

The objective of the research reported here was to conduct a preliminary evaluation of the effectiveness of CLTS as a control measure against porcine cysticercosis in the Katete District. The research was done by comparing the seroprevalence of *T. solium* porcine cysticercosis and the knowledge, attitude and practices of the pig farmers before and 8 months after the implementation of the CLTS intervention in 9 villages in the Katete District of the Eastern Province of Zambia.

2. Materials and methods

2.1. Research area and population

The research was carried out in the Vulamkoko and Chimtende catchments in the Katete District of the Eastern