

PhD defence Emma Hobbs

Towards elimination of *Taenia solium* in the Eastern Province of Zambia: a call for an integrated approach

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Dit is de omschrijving

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Summary:

Taenia solium (the pork tapeworm) is a neglected tropical parasite common in many developing countries in Asia, Latin America and sub-Saharan Africa where pigs are raised in areas of poverty. Globally, it infects over 50 million people and causes 28,000 human deaths every year, making it the most important food-borne zoonosis.

Adult *T. solium* tapeworms live in human intestines (taeniosis, TS), and shed thousands of infective eggs into the host's feces every few days. Ingestion of the eggs via contaminated food or water leads to infection with the larval stage of the parasite – usually in pigs (porcine cysticercosis, PCC) but also in humans (human cysticercosis, HCC). HCC can cause serious health problems, particularly when the cysticerci lodge in the host's brain and spinal cord (neurocysticercosis, NCC). NCC can cause severe progressive headache, blindness and stroke, and is the leading cause of epilepsy in the developing world.

While effective tools for control of *T. solium* are available, to date only one field study, in Peru, has successfully eliminated active transmission of the parasite. No similar integrated studies have yet been conducted in sub-Saharan Africa, where levels of *T. solium* infections are among the highest in the world.

The 'CYSTISTOP' project, '*Taenia solium* elimination versus control: what is the best way forward for sub-Saharan Africa?' was designed to address this important gap. CYSTISTOP is a six-year community-based *T. solium* intervention study that began in 2015 in the Eastern Province of Zambia, where *T. solium* is endemic. It aims to evaluate the effectiveness, cost-effectiveness and local acceptability of a short-term, integrated human- and pig-based *T. solium* elimination package as compared to a longer-term pig-only control strategy.

In the 'elimination' study arm, deworming of eligible humans and pigs, and pig vaccinations were conducted every four months for a total of six iterations. In the 'control' study arm, only annual deworming of pigs was conducted. No specific interventions were conducted in the 'negative control' study arm, although human health education was conducted in all three study arms. Sampling of pigs and humans was conducted at the beginning, middle and end of the intervention period to evaluate the impact of the interventions on disease occurrence.

The major objective of this doctoral thesis was to evaluate the impact of CYSTISTOP's two-year, integrated human- and pig-based 'elimination' strategy. Baseline prevalence of active PCC in the study villages was 32%, and TS was 16%. After the two-year intervention period, prevalence of active PCC was 0% and TS had decreased to 2%. These results showed that the integrated interventions significantly decreased *T. solium* transmission in the study

villages, and eliminated active infections in the intermediate pig host.

Three additional objectives were investigated in this doctoral study. Baseline questionnaires collected preliminary costing data relating to pig-keeping in the villages, and investigated human health conditions commonly associated with NCC (seizures, chronic headache, vision problems). Over 50% of respondents (n=267) had reportedly experienced one of the surveyed conditions, which were responsible for productivity losses and unemployment. Pigs infected with PCC were mostly unable to be sold, causing substantial economic losses for subsistence farmers.

Focus group discussions and questionnaires conducted in the study villages collected qualitative data about the local acceptability and perceptions of the piloted interventions. Feedback indicated that the interventions were generally well accepted and valued by the communities, although there were reportedly some concerns that the vaccinations being given to pigs were causing pig deaths. Behavioral changes had reportedly been implemented in the villages to reduce parasite transmission (e.g. washing hands, using toilets, properly cooking pork), thanks to CYSTISTOP's educational messages.

Finally, educational workshops conducted in three primary schools used a computer-based *T. solium* advocacy program called 'The Vicious Worm', to evaluate its educational impact on knowledge uptake and retention in Grade 5 and 6 primary school students. The students' knowledge was quite high at baseline (average score 62%), and was significantly improved immediately after the educational session, as well as one year later.

The results of this thesis provide important proof of concept that an integrated human- and pig-based intervention strategy can potentially eliminate *T. solium* transmission in Zambia.