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Minyoo Matata - The Vicious Worm - A Taenia solium Computer-Based Health-Education Tool - in Swahili

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proteins that bind carbohydrates for pathogen capture or triggering an immune response. Interestingly, the nature of parasite glycans is often different from that of mammalian surface glycans, and specific targeting can be envisaged. We found that agents that bind mannose-rich oligosaccharides are potent antitrypanosomals that produce parasitological cure in animal models of acute sleeping sickness without any toxic side-effects. Carbohydrate-binding agents are abundant in nature. If we can exploit this concept and identify new agents that specifically bind to parasite surface glycoconjugates, we are providing a new approach to a selective chemotherapy for these diseases.

How do you propose to discover new molecules or compounds that target the surface glycans of trypanosomatids? Are there any promising leads?

While many carbohydrate-binding proteins exist, the discovery and design of new low-molecular-weight nonpeptidic carbohydrate-binding agents (CBAs) amenable to clinical development is a major challenge. Several nonpeptidic CBAs have been identified; nonetheless, much effort is still necessary to fully develop this concept. For instance, the pradimicin family of carbohydrate-binding nonpeptidic natural products, with antifungal and antiviral properties, was first isolated from the bacterium *Actinomadura hibisca*. Pradimicin-S, a water-soluble derivative with excellent pharmacokinetic properties, is highly active against *Trypanosoma brucei*. Valuable tools would be the development of technology and high-throughput assays that could allow for the identification of novel glycan-binding molecules or the application of knowledge on the mode of binding and structural determinants of the interaction to the rationale design of agents with improved specificity and binding affinity.

The WHO aims to reduce the overall burden of these diseases by 2020. In your opinion, are we on track to achieve those goals? Why?

A recent WHO report describes the impact of neglected diseases and how millions are at risk in endemic countries. Although key advances have been achieved there is still much to be done. In the case of kinetoplastid diseases, such as sleeping sickness, leishmaniasis, or Chagas' disease, there are several novel exciting entities in the drug-discovery pipeline; yet success in delivering new drugs to the clinic needs major investment. We need to establish the requirements of a new antitrypanosomal for successful treatment in clinical trials, obtain an improved understanding of the complexity of the pathology of the disease, and identify unknown aspects of parasite–host interactions that determine the establishment and maintenance of infection. Improved screening methodology and *in vivo* models are contributing to this goal, and we hope to see a major success in the near future.

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Science & Society

Minyoo Matata – The Vicious Worm – A *Taenia solium* Computer-Based Health-Education Tool – in Swahili

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Lack of knowledge is one of the main risk factors for the spread of the zoonotic parasite *Taenia*

solium. The computer-based health-education tool 'The Vicious Worm' was developed to create awareness and provide evidence-based health education as a specific measure in control strategies. To increase the reach of the tool, a new version in Swahili was developed and can now be downloaded for free from <http://theviciousworm.sites.ku.dk>.

Improved Knowledge: A Key Strategy for the Control of *Taenia solium*

Taenia solium taeniosis/cysticercosis is a zoonotic parasitic disease that contributes to substantial public health and economic consequences across the globe [1]. It is endemic in areas where pigs are raised in free-ranging systems, where sanitation facilities are inadequate, where personal and meat hygiene are deficient, and where information and knowledge on the parasite are lacking. A significant part of the control of this pathogen rests on educating residents of endemic communities about the risks factors, transmission routes, diagnostic tools, and transmission prevention and control. Improved knowledge through health education was suggested by the World Health Organization (WHO) as one of the five key strategies for the control of *T. solium* taeniosis/cysticercosis (http://www.who.int/neglected_diseases/NTD_RoadMap_2012_Fullversion.pdf).

What Is 'The Vicious Worm'?

'The Vicious Worm' is an open-access digital-based health-education tool for *T. solium* taeniosis/cysticercosis. The English version of the programme was developed in 2014 by the University of Copenhagen as part of an EU-7th framework funded programme Integrated Control of Neglected Zoonoses in Africa (ICONZ) with the hope of having evidence-based health education included as a specific control measure in any control strategy [2]. The tool was designed to

create awareness of *T. solium* taeniosis/cysticercosis at all levels, from policy makers to school children in rural communities. The computer programme provides information on transmission, diagnosis, treatment, risk factors, prevention, and control of *T. solium* taeniosis/cysticercosis, and targets a range of stakeholders across different sectors and disciplines. The educational materials included in 'The Vicious Worm' are illustrated short stories, videos, scientific texts, and policy and information sheets displayed using an interactive map and separating issues for a generalised 'village', 'town', and 'city' audience. Simple information on the parasite for lay people and children can be found at 'village level'; technical information for health and agriculture professionals and students can be found at 'town level'; and information for national and international policy makers can be found at 'city level'.

How to Increase the Impact of the Health-Education Tool

'The Vicious Worm' was tested in Tanzania on agriculture and veterinary officers and health workers and had a positive impact among these stakeholders, as they significantly improved their knowledge after using the programme [3].

As all age groups are susceptible to the disease, in order to be effective, health education should target the population at all socioeconomic and age levels [4]. In East Africa, where cysticercosis is a problem across several countries [5], Swahili is the most commonly spoken language (with more than 50 million speakers) [6]. To increase the use and impact of this health-education tool in East African communities where English is not always spoken, a Swahili version of the full tool was created.

Minyoo Matata: The Vicious Worm Now Also in Swahili

The new version of 'The Vicious Worm' was produced in collaboration with the original developers at the University of

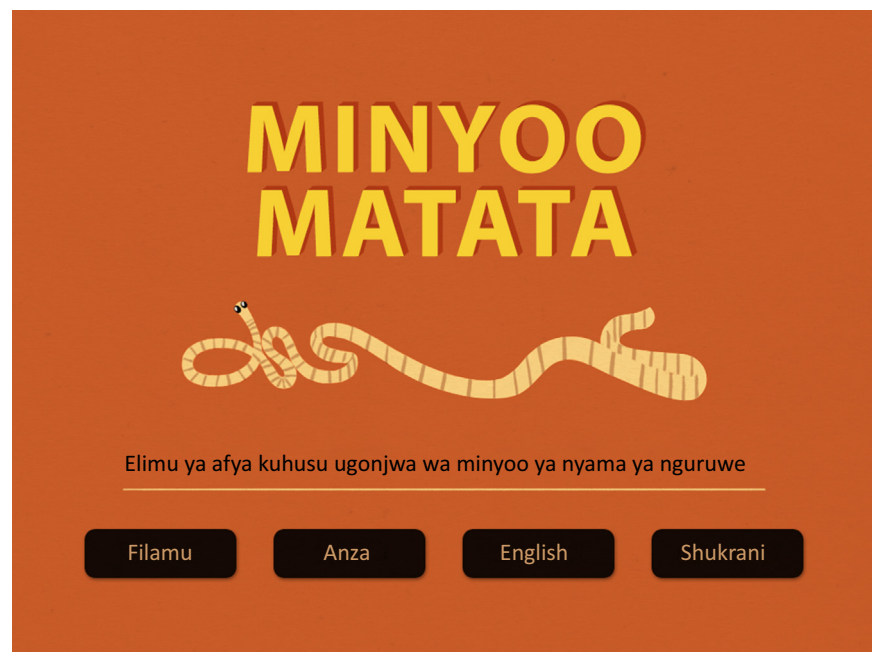
Copenhagen and researchers at the University of Liverpool and the International Livestock Research Institute in Kenya. For the new version, the educational material of the English version was systematically translated and back-translated to ensure accuracy, formatted, and implemented in a new version. The beta version of the 'Minyoo Matata' – The Vicious Worm – A *Taenia solium* Taeniosis/Cysticercosis Health-Education Tool – in Swahili is now available and can be downloaded for free through the homepage <http://theviciousworm.sites.ku.dk>. This new version of the programme allows the switching of languages between English and Swahili (Figure 1). English and Swahili versions of the programme are also available as an Android app for android tablets and smart-phones and can be downloaded for free through the Android app store.

The Way Forward

Control of *T. solium* taeniosis/cysticercosis is in large part dependent on behavioural changes in pig-keeping and at-risk

communities, and 'The Vicious Worm' tool is effective in providing the information that leads to those behavioural changes. Previous targeting has, however, focussed on adults, and further work is required to assess the effectiveness of the tool in children and, indeed, the onward transmission of information and health messages from adults to children and vice versa. We expect that the impacts of health education using the tool in both adults and children will be more effective in Swahili, which will broaden the relevance of the tool to the large group of Swahili speakers in East and Central Africa.

In East Africa, well over 60% of mobile phones now sold are data-enabled smart-phones, and many internet kiosks or cyber-cafes sell short-term internet access through smart-phones and computers (<http://www.ca.go.ke/images/downloads/STATISTICS/Sector%2020Statistics%20Report%20Q1%202015-16.pdf>). In addition, computers are increasingly available in state-operated schools. Throughout Kenya,



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Figure 1. Title Page of Minyoo Matata – The Vicious Worm – A *Taenia solium* Taeniosis/Cysticercosis Health-Education Tool – in Swahili.

approximately 15 000 000 school children have access to information and communication technologies (e.g., <http://cfsk.org/>); our hope is that the tool will be widely accessible and may also be useful to teachers in comparing Swahili and English versions.

While the programme will be targeted to those areas where this endemic disease is a significant problem, translating the tool to Swahili will theoretically make it accessible and appropriate for more than 50 million Swahili speakers in East Africa [6]. Better knowledge at all levels will help to achieve the WHO's goal of eliminating this public and animal health problem (http://www.who.int/neglected_diseases/NTD_RoadMap_2012_Fullversion.pdf), a goal which is fully aligned with a number of programmes on disease surveillance and control currently taking place in endemic countries across the globe.

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Spotlight

Patchy Parasitized Skin Governs *Leishmania donovani* Transmission to Sand Flies

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Doehl *et al.* have combined empirical data with computer simulation to demonstrate that RAG-2 mice intravenously infected with *Leishmania donovani* form heterogeneous skin parasite patches that govern infectiousness to sand flies. This model provides a much-needed tool to explore the

relevance of asymptomatic and symptomatic visceral leishmaniasis patients as infection reservoirs.

One of the burning questions facing programs aimed at control and elimination of anthroponotic visceral leishmaniasis (AVL) concerns identification of the main source of infection for sand fly vectors [1,2]. To date, the comparative contribution of asymptomatic, symptomatic, or post-kala azar dermal leishmaniasis patients to outward transmission of *L. donovani*, the causative agent of AVL, to vector sand flies remains unknown and represents a serious obstacle to control efforts. Doehl *et al.* [3] developed a model using RAG-2 immunodeficient mice that lack the rag-2 gene and cannot generate mature T or B lymphocytes, in combination with red fluorescent *L. donovani* parasites to address questions pertaining to host infectiousness for vector sand flies. The authors demonstrate that, in addition to invading visceral organs, *L. donovani* parasites injected into the tail vein of RAG-2 mice reproducibly form skin patches of variable size 6 months into the infection. Distinct from recent reports of atypical dermotropic strains of *L. donovani* where the infection is confined to skin ulcers [4], Doehl *et al.* [3] demonstrate the involvement of intact-looking skin as a common clinical manifestation of viscerotropic strains that disseminate to visceral organs and cause AVL. This is important, as contribution of intact skin to sand fly infection is highly contested, even in *Leishmania infantum* infections where cutaneous lesions are frequently reported as a source of infectiousness to vector sand flies [5–7].

To address the relevance of parasite patchiness within intact skin to outward transmission to sand flies, Doehl *et al.* [3] compared scenarios of patchiness in infected animals at both a macro scale (parasite patches throughout the skin of an animal) and a micro scale (heterogeneous parasite distribution in one patch).