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Effective and sustainable prevention and control of pork tapeworm diseases in humans and pigs in Tanzania: a policy brief

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Pork tapeworm (*Taenia solium*) is a parasite that causes serious diseases in humans and pigs. The parasite causes epilepsy in humans and is estimated to be responsible for approximately 212 deaths per year in Tanzania. The parasite costs Tanzanian society approximately USD 8 million annually due to costs for management of epilepsy caused by the parasite (USD 5 million) and losses due to condemnation of infected pork (USD 3 million). Pork tapeworm diseases are currently not a control and prevention priority in Tanzania, and collaborative efforts among relevant sectors at various levels are limited. This policy brief recommends a One Health approach for effective and sustainable control of the pork tapeworm diseases. It puts forward fourteen actionable recommendations for the country to achieve this goal

KEYWORDS

policy engagement, neglected zoonoses, elimination, one-health, *Taenia solium*, Tanzania

Introduction

Pork tapeworm, *Taenia solium*, is a hidden threat that thrives between humans and pigs. In humans, the adult parasite causes intestinal infections (taeniasis), while it can lead to tissue infections (cysticercosis) in both humans and pigs. Taeniasis occurs when someone eats infected, undercooked pork, and cysticercosis from consuming food or water contaminated with eggs of the parasite - found in the feces of humans suffering from taeniasis. When it infects the brain or spinal cord, it can cause neurocysticercosis, responsible for 30% of acquired epilepsy in highly endemic regions (1).

In areas with poor sanitation and pigs are kept free-range, this parasite is widespread. For example, in 2012, an estimated 17,853 new epilepsy cases and 212 deaths in Tanzania were linked to the pork tapeworm (2), costing the country around USD 5 million in epilepsy-related expenses and USD 3 million in pig-related losses.

To combat this, Tanzania has established a national neglected tropical disease (NTD) control program (https://www.ntdcp.go.tz/) and the National One Health Strategy (3). Laws like the Animal Disease Act of 2003, the Meat Industry Act of 2006, and the Animal Disease Regulations of 2007 (4–6) regulate meat safety, but gaps remain. For instance, there are no clear guidelines on handling infected pig carcasses, risking infected meat entering the food supply. Our research highlights that meat inspectors often use criteria for a less dangerous parasite (the beef tapeworm) when assessing pig carcasses, leading to improper handling of infected meat.

Despite these measures, pork tapeworm diseases remain highly prevalent. Recent studies found porcine cysticercosis in 7.3% to 22.3% of pigs in certain districts (7, 8) and human cysticercosis prevalence at 1.4% (9). Contributing factors include (i) inadequate resources, (ii) poor hygiene practices, (iii) lack of sector collaboration, (iv) low community awareness, (v) insufficient diagnostic tools, and (vi) absence of specific surveillance systems for these diseases.

The persistence of porcine and human cysticercosis in Tanzania could be attributed to several factors, including the following: (i) Despite the pork tapeworm diseases being included in the country's list of NTDs affecting humans, there are no resources allocated for their prevention and control; (ii) There are limited resources to facilitate hygiene and sanitary practices, especially in rural settings; (iii) There is lack of collaboration and coordination among key sectors from community to the national level; (iv) There is low knowledge of communities and improper practices related to pork tapeworm diseases; (v) Pork tapeworm diseases are not specifically reported in the current disease surveillance systems making it difficult to realize their burdens; (vi) There is inadequate diagnostic tools and skilled personnel for pork tapeworm disease diagnosis; (vii) There is inadequate human resource and pig slaughter facilities for effective meat inspection (10); and (viii) There is no documented guideline on what should be the fate of a pig carcass infected with the pork tapeworm when confirmed during meat inspection. This leaves a loophole for potential approval of the infected carcasses for human consumption, whether intentionally or because of ignorance. In our many years of research on the pork tapeworm diseases we have noted that many meat inspectors use the criteria for bovine cysticercosis (caused by a less dangerous parasite *Taenia saginata*) when judging pig carcasses infected with *T. solium* cysticercosis.

This policy brief recommends prioritizing pork tapeworm diseases and adopting the One Health approach for effective and sustainable control.

Policy options and implications

This policy brief puts forward fourteen actionable recommendations for effective and sustainable prevention and control of pork tapeworm diseases in humans and pigs in Tanzania. The overarching recommendation is to use a One Health approach, which brings together a multidisciplinary team to tackle this complex health challenge. Implementation of the recommended actions may be insufficient due to limited resources which are also required for preventing and controlling other diseases. However, concurrent implementation of the recommended actions through the One Health approach will ensure cost-effectiveness and sustainability in the prevention and control of the pork tapeworm diseases in Tanzania.

Actionable recommendations

For effective and sustainable prevention and control of pork tapeworm diseases in Tanzania, we provide fourteen (14) recommendations with specified implementers, actions, timeline after government adoption, and measurable indicators (Table 1).

TABLE 1 Recommendations for effective and sustainable prevention and control of pork tapeworm diseases in humans and pigs in Tanzania.

Recommendation	Implementer	Action	Timeline (after government adoption)	Indicator
1. Include pork tapeworm diseases among NTDs prioritized for prevention and control in Tanzania	Ministry of Health	Implement government-supported community deworming programs	12 months	Reduction in taeniasis prevalence by 20% in the first year

(Continued)

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TABLE 1 Continued

Recommendation	Implementer	Action	Timeline (after government adoption)	Indicator
2. Ensure sustainable supply of clean and safe water to all households within the recommended distance of 400 meters (11)	Ministry of Water and Irrigation	Construct and maintain water supply systems in underserved areas	24 months	Access to clean water for 90% of households within the recommended distance
3. Promote One Health approach for the management of pork tapeworm disease at all levels	One Health Coordinating Desk (currently at Prime Minister's Office)	Conduct quarterly One Health coordination meetings and awareness campaigns countrywide	6 months	Improved coordination and collaboration among health sectors as evidenced by quarterly reports
4. Strengthen health education in schools, with emphasis on pork tapeworm disease prevention and control	Ministry of Education	Integrate pork tapeworm education into the school curriculum	12 months	Number of schools implementing the new curriculum and student awareness levels increased by 30%
5. Provide refresher courses on meat inspection, work ethics, policies and regulations, diagnosis, and treatment	Ministry of Health & Ministry of Livestock and Fisheries	Organize biannual training sessions for meat inspectors and health workers	6 months	At least 70% of meat inspectors and health workers trained within the first year
6. Ensure availability of accurate diagnostic tools and drugs	Ministry of Health	Procure and distribute diagnostic tools and medications to health facilities	12 months	80% of health facilities equipped with necessary diagnostic tools and drugs
7. Enforce by-laws requiring construction and proper use of toilets	City, Municipal, and District Councils	Conduct regular inspections and awareness campaigns	12 months	Compliance rates increased by 50% in the first year
8. Enforce by-laws requiring pig confinement	City, Municipal, and District Councils	Conduct regular inspections and awareness campaigns	12 months	Compliance rates increased by 50% in the first year
9. Enforce by-laws requiring slaughtering of pigs at authorized facilities with mandatory meat inspection	City, Municipal, and District Councils	Conduct regular inspections and awareness campaigns	12 months	Compliance rates increased by 50% in the first year
10. Specifically include *T. solium* taeniasis and cysticercosis in the national disease surveillance systems with compulsory zero reporting	Ministry of Health	Update the national disease surveillance guidelines	6 months	*T. solium* taeniasis and cysticercosis reported in 100% of relevant surveillance reports
11. Consider *T. solium* taeniasis and cysticercosis as a possible differential diagnosis in patients suspected of intestinal worms and/or epilepsy	Clinicians	Conduct training and awareness sessions for clinicians	12 months	70% of clinicians trained and applying the new diagnostic considerations
12. Recruit an adequate number of livestock health extension officers (at least one per village or similar administrative unit) to ensure community coverage	President's Office, Regional Administration, and Local Government (PO-RALG)	Initiate recruitment and training programs	18 months	At least 80% of villages (or similar administrative units) with a dedicated livestock health extension officer
13. Allocate resources for the construction of pig slaughter slabs and enhancement of mobility for meat inspectors	City, Municipal, and District Councils	Budget allocation and project implementation	24 months	100% completion of planned slaughter slabs and increased mobility for meat inspectors
14. Include a regulation on the action to be taken for pig carcasses infected with the pork tapeworm when confirmed during postmortem inspection	Ministry of Livestock and Fisheries	Draft and enforce the new regulation	12 months	100% adherence to the new regulation by meat inspectors

Conclusions

- Diseases caused by pork tapeworm (*Taenia solium*) have continued to affect the health and wellbeing of Tanzanians to date despite the country's efforts in the control of neglected tropical diseases
- The persistence of these diseases is likely due to lack of specific attention (in terms of guidelines and resources) and collaboration to facilitate disease prevention and control
- This policy brief puts forward fourteen actionable recommendations for prevention and control of the pork tapeworm diseases in Tanzania and recommends implementation of the actions using a One Health

approach to enhance effectiveness and sustainability of the prevention and control strategy
- Sustainable control of pork tapeworm diseases will contribute to the prevention of acquired epilepsy and reduction of economic losses in the pig industry
- This will consequently contribute to achievement of several sustainable development goals (SDGs): SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 3 (Good health and well-being) and SDG 6 (Clean water and sanitation)

Author contributions

HN: Conceptualization, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing, Investigation, Data curation. GM: Validation, Visualization, Writing – review & editing. FM: Validation, Visualization, Writing – review & editing. CW: Validation, Visualization, Writing – review & editing. FlK: Validation, Visualization, Writing – review & editing. MK: Validation, Visualization, Writing – review & editing. AC: Validation, Visualization, Writing – review & editing. ChN: Validation, Visualization, Writing – review & editing. MN: Validation, Visualization, Writing – review & editing. IM: Validation, Visualization, Writing – review & editing. CoN: Validation, Visualization, Writing – review & editing. SM: Validation, Visualization, Writing – review & editing. BN: Validation, Visualization, Writing – review & editing. FaK: Validation, Writing – review & editing. CK: Validation, Writing – review & editing. AN: Validation, Writing – review & editing, Visualization. EM: Validation, Writing – review & editing, Investigation, Project administration, Visualization.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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