

**Taenia solium Cysticercosis/Taeniosis is a Potentially Eradicable
Disease: Developing a Strategy for Action¹**

Background and Justification

Taeniosis/cysticercosis due to the pork tapeworm, *Taenia solium*, is a classical zoonosis, recognized since antiquity, which, as a result of a variety of demographic, technical, and political factors, is emerging as an increasingly important condition in both endemic and non-endemic regions. Neurocysticercosis (NC) is infection of the central nervous system with the larval stages (cysticerci) of *T. solium*. The two-host life cycle of the tapeworm involves humans as definitive hosts and swine as intermediate hosts. Pigs are the source of human taeniosis, an intestinal tapeworm infection acquired by eating undercooked pork containing cysticerci, the larval or metacestode phase of *T. solium*. Human cysticercosis, however, is acquired by ingesting *Taenia* eggs shed in the feces of a human tapeworm carrier and thus may occur in humans who neither eat pork nor share environments with pigs. Although cysticerci may localize throughout the body, most clinical manifestations result from their presence in the central nervous

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system, where they can cause seizures, hydrocephalus, and other neurologic dysfunctions.

Cysticercosis is widely endemic in rural areas of Latin America (most notably Mexico, Guatemala, El Salvador, Honduras, Colombia, Ecuador, Peru, Bolivia and Brazil), Asia and Africa. The World Health Organization estimated that 50,000 deaths due to neurocysticercosis occur every year; of course, many times that number of patients survive but are left permanently disabled by recurrent seizures or other neurologic damage.

Taenia solium is potentially eradicable, however, there are still no documented examples in which eradication has been achieved through active intervention. Theoretically, there are several characteristics of the parasite which appear to make it vulnerable to eradication: 1) the life cycle requires humans as definitive hosts, 2) tapeworm infections in humans are the only source of infection for pigs, the natural intermediate hosts, 3) swineherds can be managed, 4) no reservoirs for infection exist in wildlife, and 5) practical methods of surveillance now exist for cysticercosis in pigs (visual inspection of tongues) and humans (antibody assay) and taeniosis in humans (coproantigen assay), and 5) technology for intervention is available in the form of safe and effective drugs for mass chemotherapy of taeniosis in humans and cysticercosis in swine. *T. solium* appears to be a good candidate for eradication because it gradually disappeared from most European countries even without control measures targeted specifically at

it. Factors credited with the elimination of *T. solium* include improvements in general sanitation and economic status, the introduction of indoor pig husbandry, and rigorous meat inspection.

Obstacles To Overcome

T. solium is widely endemic in rural areas of developing countries where political, socioeconomic, and environmental conditions permit the tapeworm's life cycle in pigs and humans to be completed. Even though special studies reveal that morbidity caused by NC is measurable and severe in endemic populations, the nature of the disease and the lack of locally-available diagnostic facilities make NC an essentially silent and un-recognized disease of humans within most affected communities; this complicates efforts to motivate and empower the community to initiate efforts to control the disease. Pig owners, however, easily recognize the infection in their animals; the fact that cysticercosis reduces the value of infected pigs suggests a focus for education and prevention measures. Local populations rarely understand the relationship between cysticercosis in pigs and taeniosis in humans and thus lack knowledge and incentive to change behavior that fosters transmission. In many if not most communities where *T. solium* is endemic there is an absence of piped water, sanitary infrastructure, waste disposal, and other basic services; consequently, intervention measures must be designed to circumvent these deficiencies to the extent possible. Primary health care facilities are also often lacking or inadequate. Since the disease is generally related to poverty and all its associated

manifestations, all strategies to control the disease must consider costs and locally-available resources.

Developing An Action Plan

Several, alternative strategies for control of T. solium have been proposed. A comprehensive program of long-term intervention involves appropriate legislation, health education, modernization of swine husbandry practices, improvement of efficiency and coverage of meat inspection, provision of adequate sanitary facilities, and measures to detect and treat human tapeworm carriers. This comprehensive approach, although not targeted at *T. solium*, is what incidentally reduced transmission in European countries. Political and economic realities in many communities where T. solium is endemic today, however, provide little hope that all of these measures can be implemented in the near future.

To achieve more rapid progress toward eradication and substantial reduction of sickness and death caused by neurocysticercosis, short-term control programs have been proposed based on the identification of foci and the treatment of everyone or all diagnosed or suspected cases of taeniasis in humans, with the goal of immediate interruption of transmission from humans to pigs and other humans. Alternative approaches that have been proposed but not yet evaluated are chemotherapy or anthelmintic treatment of pigs. Following the intervention of one or more rounds of mass chemotherapy or vaccination, progress can be maintained by

integrating control activities into primary health care systems to aid in identifying and targeting intervention at new foci of transmission. To be effective in the long term, control measures based these short-term approaches have to be supported by aggressive educational campaigns and by significant improvements in personal hygiene and general sanitation within the disease-endemic area.

As a first step toward achieving prevention and control of taeniasis and cysticercosis, it is necessary to develop national plans to identify regions where *T. solium* is endemic, to measure prevalence of taeniosis and cysticercosis in pigs and humans, and to evaluate the economic and social costs of the disease. There is a need for operational research aimed at verifying the effectiveness, costs, and benefits of alternative intervention strategies against T. solium in a variety of geographic and socioeconomic.