Zoonotic foodborne parasites and their surveillance

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Summary
Humans suffer from several foodborne helminth zoonotic diseases, some of which can be deadly (e.g. trichinellosis, cerebral cysticercosis) while others are chronic and cause only mild illness (e.g. intestinal taeniosis). The route of infection is normally consumption of the parasite's natural host as a human food item (e.g. meat). The risk for infection with these parasites is highest wherever people have an inadequate knowledge of infection and hygiene, poor animal husbandry practices, and unsafe management and disposal of human and animal waste products. The design of surveillance and control strategies for the various foodborne parasite species, and the involvement of veterinary and public health agencies, vary considerably because of the different life cycles of these parasites, and epidemiological features. *Trichinella spiralis*, which causes most human trichinellosis, is acquired from the consumption of pork, although increasingly cases occur from eating wild game. For cysticercosis, however, the only sources for human infection are pork (*Taenia solium*) or beef (*T. saginata*). The chief risk factor for infection of humans with these parasites is the consumption of meat that has been inadequately prepared. For the pig or cow, however, the risk factors are quite different between *Trichinella* and *Taenia*. For *T. spiralis* the major source of infection of pigs is exposure to infected animal meat (which carries the infective larval stage), while for both *Taenia* species it is human faecal material contaminated with parasite eggs shed by the adult intestinal stage of the tapeworm. Consequently, the means for preventing exposure of pigs and cattle to infective stages of *T. spiralis*, *T. solium*, and *T. saginata* vary markedly, especially the requirements for ensuring the biosecurity of these animals at the farm. The surveillance strategies and methods required for these parasites in livestock are discussed, including the required policy-level actions and the necessary collaborations between the veterinary and medical sectors to achieve a national reporting and control programme.

Keywords
Cysticercosis – Parasite – Surveillance – *Taenia* – *Trichinella* – Trichinellosis – Zoonosis.

Introduction

Parasitic foodborne infections of humans may involve both protozoan and helminth species of internal parasites. The route of infection is normally consumption of the parasite's natural hosts as a human food item (3).

Humans suffer from several foodborne helminth zoonoses, some of which can be deadly (e.g. trichinellosis, cerebral cysticercosis) while others are chronic and cause only mild illness (e.g. intestinal taeniasis) (13, 15, 16). In most countries, prevention of human exposure to these parasites is commonly under the control authority of Veterinary Services (e.g. food inspection). Some parasites, such as the protozoan parasites *Toxoplasma, Cryptosporidia* and *Cyclospora*, and fish-borne parasites such as liver and intestinal flukes, are generally not controlled, although, in the trade of marine fish, inspection may be required and/or the fish may be subjected to treatment to inactivate helminth parasites.

In this paper a selection of foodborne helminth species of nematode and cestode parasites are discussed, chosen for their public health and economic importance and the demands they place upon Veterinary Services. The examples *Trichinella spiralis* (trichinellosis) and *Taenia* spp. (cysticercosis and taeniosis) all share the common epidemiological feature of being meat-borne and they illustrate well the challenges faced in implementing

surveillance and control measures. The risk for infection with these parasites is highest wherever people have:

– a dependency on subsistence food production

– an inadequate knowledge of infection and hygiene

– poor animal husbandry practices

– unsafe management and disposal of human and animal waste products (13).

The design of surveillance strategies for these foodborne parasites and the involvement of veterinary and public health agencies vary considerably between parasite species, due to their distinct life cycles and epidemiological and ecological features (Table I). They are therefore discussed separately.

Trichinellosis

Trichinella spiralis has a cosmopolitan distribution and is the species of *Trichinella* most frequently identified in human outbreaks (8, 14). Although some *T. spiralis* outbreaks are derived from game meat, including wild boar, most human trichinellosis is caused by consumption of infected pork. Human infections from eating infected horsemeat were relatively frequent in Europe until recently when effective inspection measures for imported horses were implemented. *Trichinella* are intracellular parasites whose adult stage is embedded in the epithelial layer of the small intestine, and the larvae they produce migrate to striated skeletal muscle and form an intracellular cyst (trichinae). Hosts for *Trichinella* include a wide range of mammals, birds, and reptiles, but especially species of Suidae

(Fig. 1). Within the genus *Trichinella*, eight species have been described, but only *T. spiralis* is a major risk in pork-related outbreaks; two sylvatic species commonly found in wild animals, *T. pseudospiralis* and *T. britovi*, are only rarely found in farm-raised pigs (14). These genotypes have a much more limited geographic distribution than *T. spiralis* (18). Trichinellosis can be fatal in humans, but is clinically unapparent in animals (6).

Prevention of infection in humans

The prevention of *T. spiralis* infections in humans generally relies on:

– education of consumers as to the risk of infection from eating raw or undercooked pork or pork products

– the processing of pork by cooking, freezing or curing before human consumption

– the inspection of pig carcasses for infection at the abattoir (9).

Meat inspection

The most widely used method employed in the abattoir for the detection of *T. spiralis* in pork is artificial digestion of muscle samples to release any muscle larvae (trichinae) present and visualising them microscopically. The identity of recovered larvae can be confirmed by molecular genotyping (polymerase chain reaction [PCR]), not on the basis of morphology (9, 17). This procedure is also used for inspection of horsemeat. Non-inspected pork can be rendered safe for consumption by freezing according to internationally accepted treatment procedures (8, 9).

Table I
Major biological and epidemiological features of meat-borne parasites (13)

| Parasite	Distribution	Biology	Epidemiology
Nematoda (roundworms) *Trichinella* spp.	*T. spiralis* is the most important zoonotic species for humans and pigs. *T. spiralis* is cosmopolitan. Other species are primarily sylvatic and have geographical restrictions	The life cycle is unusual in that all stages occur in one host. Most species infect only mammals, including humans. Adults in the intestines produce larvae that invade the circulatory system and striated muscle where they encapsulate. If muscle larvae ('trichinae') are eaten by another mammal, larvae develop in the intestine to adult stage	The infection is acquired by ingesting raw, insufficiently cooked, smoked or cured meat. Outbreaks in humans are often associated with social events (i.e. Christmas and other celebrations) when special ethnic dishes, such as sausages, are prepared. Recently, European outbreaks have occurred among ethnic groups eating raw or lightly cooked infected horsemeat. Hunters are often at risk from infection with sylvatic species when consuming game, especially wild boar and bear
Cestoda (tapeworms) *Taenia saginata* (beef) *Taenia solium* (pork)	Worldwide, especially in Asia, Africa and Latin America	Adults infect only the human intestine. Intermediate host: *T. solium* larvae (cysticercus) are normally in pig muscle and viscera. However, if humans accidentally ingest eggs they may also serve as an intermediate host with cysticerci in muscle, viscera and brain (neurocysticercosis). *T. saginata* larvae (cysticercus) in cattle muscle	Consumption of raw or insufficiently cooked pork or beef produces adult worm infection (taeniosis). Indiscriminate human defecation, access of pigs to latrines and use of sewage effluent for irrigation of crops and pastures are critical risk factors
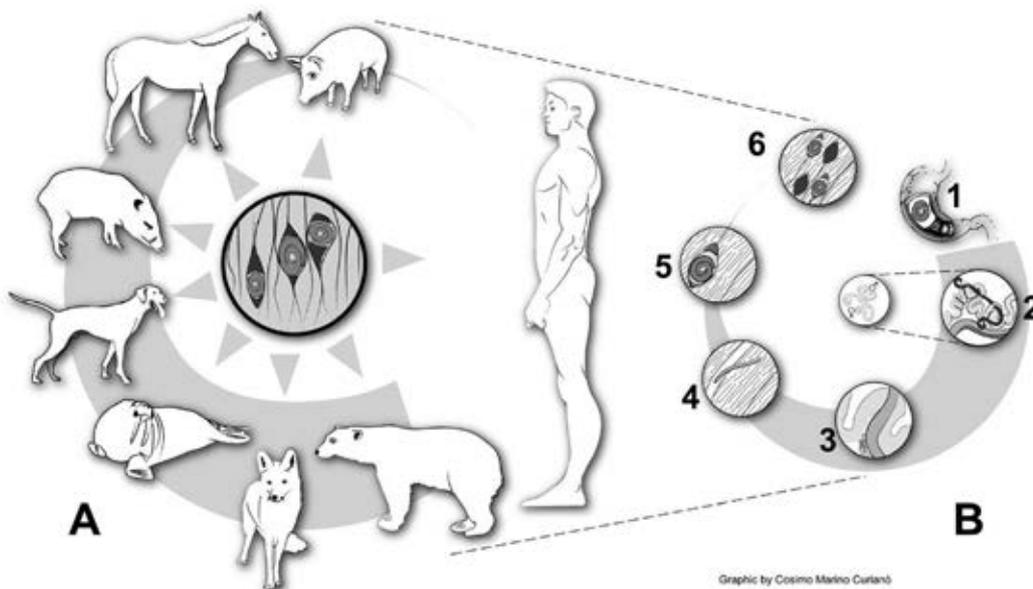
Fig. 1
Life cycle of *Trichinella spiralis*
Adapted from Fig. 1 in Chapter 1 of the *FAO/WHO/OIE Guidelines for the surveillance, management, prevention and control of trichinellosis* (8)

Meat and meat products derived from wildlife should also be considered a potential source of infection for humans, and subjected to the same inspection or meat-processing requirements as those prescribed for pork. Importantly, unlike the muscle larvae of *T. spiralis*, the larvae of some other *Trichinella* species found in the meat of wildlife may be resistant to freezing and, therefore, unfrozen game meat may pose a public health risk and should be well cooked before consuming (9, 17).

Serological detection

Serological tests (e.g. enzyme-linked immunosorbent assay [ELISA] using excretory/secretory antigen obtained from *in vitro* cultured muscle larvae) are available commercially for detecting infection in pigs but, although reliable for herd testing, these tests have not yet received general international food safety approval for the testing of individual pigs at the abattoir stage (10).

Prevention of infection in pigs

Prevention of infection in domestic pigs currently relies on the prevention of exposure of those animals to the meat of *Trichinella*-infected animals (pork scraps in food waste, infected commensal rodents, and wild animal meat) (9, 10).

Biosecurity measures

The most effective means to prevent the exposure of domestic pigs to *Trichinella* at the farm is the adoption of appropriate biosecurity measures. These measures are described in detail in the *FAO/WHO/OIE Guidelines for the Surveillance, Management, Prevention and Control of Trichinellosis* (8), and

in Chapter 8.13. of the World Organisation for Animal Health (OIE) *Terrestrial Animal Health Code* (*Terrestrial Code*) (23). Briefly, these measures include:

– rearing pigs in secure, controlled housing

– constructing buildings and environmental barriers to prevent exposure to rodents and wild animals

– implementing rodent control programmes

– providing safe feed and adequate feed storage

– ensuring the safe disposal of dead animals

– introducing only pigs from *Trichinella*-free sources onto the farm.

Raising pigs outdoors (e.g. free-range) presents challenges in minimising the risk of exposure to *Trichinella* and the requirements stated above for controlled housing of pigs should be applied to the maximum extent possible.

Surveillance and monitoring of *Trichinella* in domestic pigs

The objective of surveillance is to demonstrate the absence of autochthonous *Trichinella* infection in domestic pigs, which requires the development of rules guided by policy. This is exemplified by the adoption in Europe of European Commission Regulation No. 2075/2005, which provides that pigs kept solely for fattening and slaughter can be exempted from abattoir *Trichinella* examination if produced in holdings that have been recognised by the Competent Authority to be free from infection; this exemption may also apply to pigs produced in a region where the risk of *Trichinella* infection in domestic pigs is officially recognised

as a 'negligible risk' (1, 10). However, a clear definition of negligible risk is lacking, and this has led to some uncertainty and a need for clarity. In addition, countries that do not have ten years' or more of ante-mortem data on the national herd status may not be able to achieve negligible-risk status without extensive testing. Therefore, attempts to develop risk-based surveillance standards that would satisfy this need in a less onerous manner are being pursued. A recent proposal to accomplish this requirement for the designation of a negligible-risk country is summarised in Table II; the original publication should be consulted for details (1). However, negligible risk conditions at the farm level depend on the establishment of necessary biosecurity measures (as described above), which are most feasible for pigs reared under controlled housing; this programme must be regulated by the Veterinary Authority of the country. Those farms which meet these biosecurity conditions could then collectively be considered a negligible-risk compartment.

A programme designed for surveillance and monitoring of *Trichinella* infection in domestic pigs in a country, zone, compartment, or herd should include the following features:

– *Trichinella* infection in all animals (domestic animals and wildlife) should be notifiable in the whole territory

– an animal identification and traceability system for domestic pigs should be implemented in accordance with the provisions of the OIE *Terrestrial Code,* Chapters 4.1. and 4.2. (20, 21).

– appropriate provisions should be in place for tracing meat from wild animals harvested for human consumption under commercial conditions

– the Veterinary Authority should have current knowledge of, and authority over, all domestic pigs in the country, compartment, or zone

– the Veterinary Authority should have current knowledge of the population and habitat of wild and feral pigs in the country, zone or compartment

– although not critical to the establishment and maintenance of biosecurity in controlled housing conditions, appropriate surveillance technology capable of detecting the presence and genotype of *Trichinella* infection in feral pigs, and other susceptible wildlife, may be of value.

Surveillance measures for trichinellosis can be instituted at the producer, abattoir (slaughter and processing) or consumer level (8, 9, 10). For many countries in which trichinellosis is endemic, the requirement for post-mortem inspection of pig carcasses is mandatory (e.g. Europe, Russia, Argentina) and this can provide valuable surveillance data, provided an identification system is employed to permit traceback of infected animals (9, 10, 17).

The implementation of surveillance schemes for risk-based assessment of *T. spiralis* status is also described in Chapter 8.13. of the OIE *Terrestrial Code* (23), in which guidance for the Veterinary Authority includes requirements to:

– justify the choice of design, prevalence and confidence levels based on the objectives of surveillance and the epidemiological situation, in accordance with the OIE *Terrestrial Code*, Chapter 1.4. (19) (the design should consider the prevailing, or historical, epidemiological situation, as appropriate)

– ensure that slaughter pigs not reared in approved controlled housing (or a negligible-risk compartment), and all domestic pigs exposed to outdoor environments, are tested as described in the *Manual of Diagnostic tests for Terrestrial Animals* (*Terrestrial Manual*) (22) (an exception would be pigs raised under biosecure, controlled conditions, and regulated by the Veterinary Authority)

Table II

Achieving negligible-risk status for *Trichinella spiralis*: proposed European Union framework for the surveillance and sampling of fattening pigs produced in controlled housing (adapted from Alban *et al.* [1])

Surveillance in endemic countries Class 1[a]	Criteria to move class[*]	Surveillance in low-risk countries Class 2[b]	Criteria to move class	Surveillance in negligible-risk countries Class 3[c]
All pigs must be tested	No positives within previous five years	A proportionate sample of pigs must be tested to demonstrate surveillance sensitivity of ≥ 95% to detect ≥1 case/million	No positive findings in country for an additional two years to demonstrate surveillance sensitivity of ≥ 99%	No testing required

a) endemic for *Trichinella*
b) low risk to pigs reared in controlled housing
c) less than one pig infection/million
* Historical data may be used

– ensure that all wild and feral pigs slaughtered for human consumption are tested as described in the *Terrestrial Manual*

– subject findings of *Trichinella* infection in wildlife, including wild and feral pigs, to an epidemiological investigation

– obtain data on *Trichinella* infection in wildlife through targeted surveillance or using samples collected for other purposes, such as hunted wild game, wild animal control programmes, studies of road kill, and independent research.

Because assessing the risk to domestic pigs from wild animal reservoirs in endemic countries can be important, a monitoring programme is needed. The use of geographic information systems (GIS) should be considered an adjunct for this purpose, particularly for identifying potential locations of high risk for exposure of domestic pigs to *T. spiralis* from wildlife reservoir hosts. For example, the rapid growth in free-range and ecological farms in the United States has raised concerns about an increased risk for pigs of exposure to *T. spiralis* from sylvatic hosts. In one experiment, GIS tools were used to identify the location of farms where wild animal and/or pig infections had been reported. This map was then 'overlaid' onto a map of current outdoor pig operations. This revealed numerous 'hot spots' of potential exposure risk and yielded information that the Veterinary Authority could use to focus monitoring efforts (2).

Cysticercosis and taeniosis

The terms 'cysticercosis' and 'taeniosis' refer to foodborne zoonotic infections with larval and adult tapeworms, respectively, of the genus *Taenia*. The important feature of these tapeworms is that the larvae are meat-borne (beef or pork) and the adult stage is an obligate parasite of the human intestine (Table I) (12). *Taenia solium* (pork tapeworm), *T. saginata* (beef tapeworm), and *T. asiatica* ('Taiwan *Taenia*') are the most important causes of taeniosis in humans (7). When humans ingest meat with a cysticercus, the cyst evaginates in the gastrointestinal tract and grows a large series of reproductive segments or proglottids, each of which produces a large number of eggs that reach the environment in the faeces. Cysticercosis is the term for the tissue infection in pigs and cattle. In the case of *T. solium*, however, humans are unique in that they may also serve as an intermediate host in which the larval or cysticercus stage can also develop (Fig. 2). When a pig or cow, or humans in the case of *T. solium*, ingests an egg, an onchosphere is released which penetrates the intestinal tissue and enters the bloodstream, where it circulates until filtering out into striated and cardiac muscle; *T. solium* cysticerci may also invade the eye or the central nervous system (CNS). When cysticerci invade the CNS, neurocysticercosis may result; this zoonosis is now receiving greater attention in

sub-Saharan Africa because of the growing recognition of the importance of neurocysticercosis as a cause of epilepsy (1, 15).

Taenia solium has a cosmopolitan distribution and is highly endemic in Latin America, Africa and Asia, where poverty, poor sanitation, and close contact between humans and livestock are commonplace. It has been estimated that 2.5 million people worldwide are infected with adult *T. solium* (carriers) and that 20 million are infected with cysticerci (12). Human carriers (egg shedders) are major targets of control efforts. The rapid expansion of smallholder pig production in Africa and elsewhere has led to a significant increase in cysticercosis in pigs and humans, presenting governments with an important challenge as they seek to increase livestock production and rural incomes.

The other two species, *T. saginata* and *T. asiatica*, cause only taeniosis (adult tapeworm stage) in humans and the clinical problems are mainly minor. Human carriers are also, however, responsible for infections in cattle (bovine cysticercosis), which can have an economic impact because of meat condemnations at slaughterhouse inspections.

Major risk factors

Taenia solium

Transmission from pigs to people

The major source of infection for humans is the consumption of pork containing viable cysticerci. The major risk factors for people in endemic countries are (12):

– lack of comprehensive and satisfactory meat inspection at pig slaughter

– clandestine marketing of pigs to avoid inspection

– cultural preferences for eating raw or improperly cooked pork.

As discussed above, humans are unique in that they may also serve as an intermediate host for *T. solium*, in which the larval or cysticercus stage may develop after the ingestion of *T. solium* eggs shed by people with adult worms; autoinfection may also occur (7, 12).

Transmission from people to pigs

The major risk factors related to transmission of eggs from people to pigs can be summarised as follows (12):

– extensive or free-range pig rearing in households lacking latrines and outdoor human defecation near or in pig-rearing areas
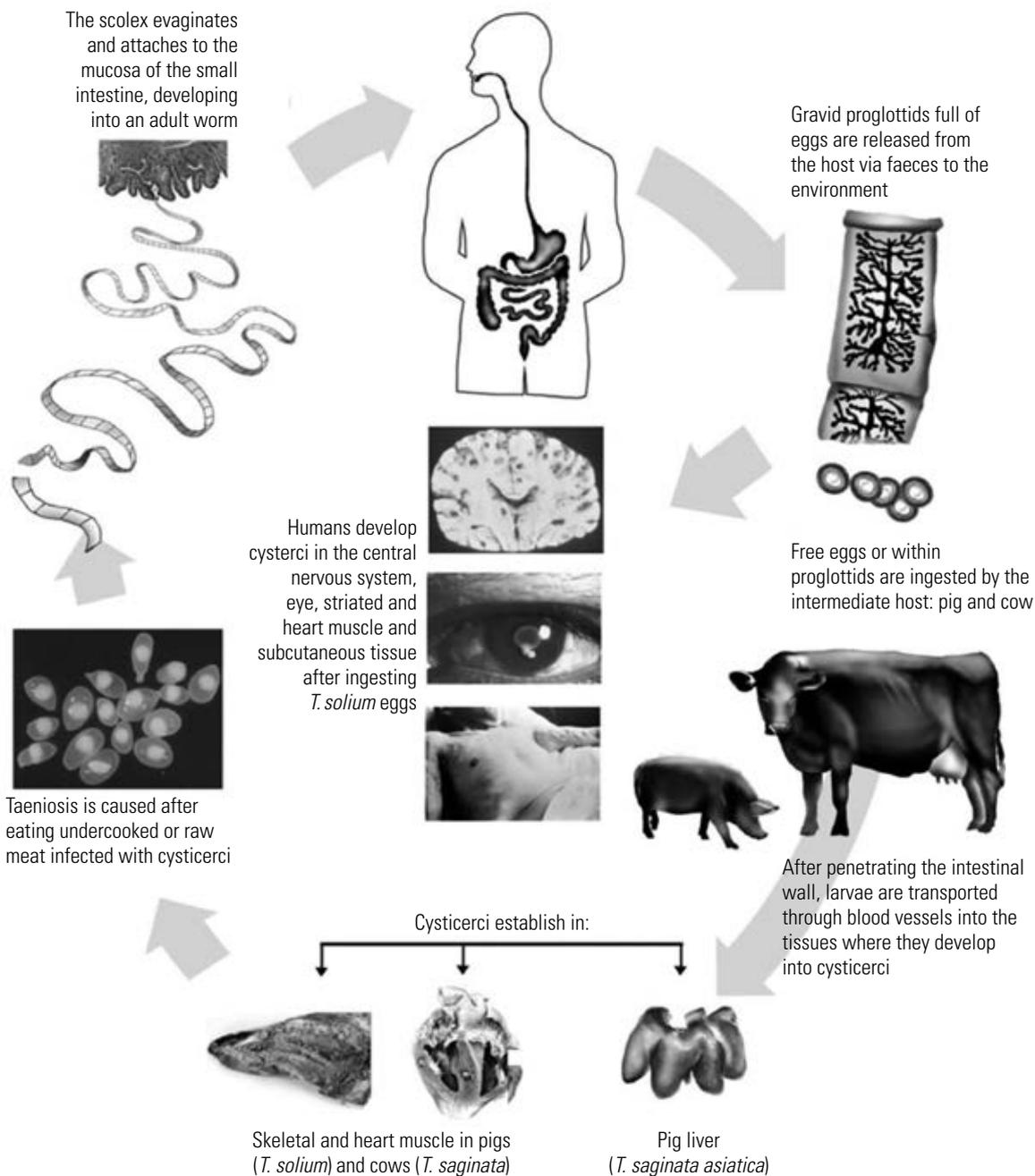
Fig. 2
Life cycle and host ranges for *Taenia solium* and *Taenia saginata*
Adapted from Fig. 1.2 in Chapter 1 of the *WHO/FAO/OIE Guidelines for the surveillance, prevention and control of taeniosis/cyticercosis* (7)

– exposure of pigs to human faeces

– use of sewage effluent, sludge or 'night soil' to irrigate and/or fertilise pig pastures and food crops

– human carriers involved in pig rearing and care.

Taenia saginata

The major risk factors for infections with beef tapeworm (*T. saginata* taeniosis/cysticercosis) are similar to those for *T. solium* infections.

Transmission from cattle to people

The major risk factor is the consumption of raw or inadequately cooked beef. The lack of satisfactory meat inspection (veterinary control) is also a risk factor.

Transmission from people to cattle

The principal risk factors are:

– outdoor defecation in or near cattle-rearing facilities or pastures

– lack of effective fly and bird control around cattle facilities

– use of sewage effluent, sludge or untreated human faeces to irrigate and or fertilise feed crops and pastures

– the involvement of human carriers in the rearing and care of cattle

– indiscriminate deposition of faeces by tourists on camping grounds, along highways, and along rail tracks.

Taenia asiatica

The epidemiology of this recently recognised zoonotic tapeworm is not well characterised, but it shares features similar to both *T. saginata* and *T. solium*. The risk factors associated with transmission of eggs to pigs are similar to those discussed above for *T. solium*. However, there is no evidence that this *Taenia* species causes cysticercosis in humans (7).

Current approaches to prevention and control of taeniosis and cysticercosis

Taenia solium
Prevention of transmission from pigs to humans

Meat inspection

In many endemic countries tongue inspection of pigs for cysts is carried out by the local population in order to identify infected animals (11). If carried out correctly (both palpation and visual inspection throughout the base of the tongue) by experienced people, the specificity of this technique can be high, although the sensitivity of the method is low in lightly infected animals (4).

The procedures for the detection of *T. solium* cysticercosis during conventional meat inspection vary widely from one country to the other (11). In some countries, only visual inspection is carried out, while in other countries regulations also require incisions in one or several so-called predilection sites, such as the heart, diaphragm, masseter muscles, tongue, neck, shoulder and intercostal and abdominal muscles. The efficacy of meat inspection will depend not only on the thoroughness of the inspection methods, but also on the degree of infection in the pigs (5).

Serological techniques

Immunodiagnostic methods for *T. solium* cysticercosis are often used in prevalence surveys, community-based surveys and in intervention studies. The tests used vary in the type of antigen used and the configuration of the test procedure.

Although the tests perform well for human testing (4), problems may be encountered in using serological methods on pigs, and their use in commercial ante-mortem testing has not been adopted.

Taenia asiatica

Pigs are the most important intermediate hosts of *T. asiatica*. Unlike the cysticerci of *T. solium*, which are only rarely present in the organs, the predilection site of the cysts of *T. asiatica* is the liver or, sometimes, the lungs, or they are attached to the omentum or the serosa of the colon. In naturally infected animals the cysts of *T. asiatica* are often degenerated and have to be distinguished from the liver lesions caused by *Ascaris suum* larvae ('white spots'). Both antibody- and antigen-detecting assays may be used for the diagnosis of *T. asiatica* (4), but with the same caveats as for *T. solium*.

Taenia saginata

Meat inspection

In many countries the 'knife and eye' visual method is used, whereby the predilection sites (heart, tongue, masseter muscles, oesophagus and diaphragm) are visually examined and/or incised to detect cysticercosis (11). However, several studies have shown that, except for the heart, none of the muscles can be considered as true predilection sites. Importantly, routine meat inspection detects only the more heavily infected animals and underestimates the real prevalence of bovine cysticercosis by a factor of at least three to ten (4).

Serological techniques

Immunodiagnosis of bovine cysticercosis has been utilised in epidemiological studies and for individual and herd diagnosis (4). Both antibody- and antigen-detecting tests have been developed, the first to measure exposure to the parasite, the latter to detect active infections, with ELISA being the most popular test. As with all potential ante-mortem diagnostic serology for zoonotic helminth parasites, low sensitivity is a problem in mild infections. A serological test may be most effective when applied as a screening test at the herd level, rather than as a diagnostic test for an individual animal.

Prevention and control of cysticercosis in pigs and cattle

It is important to strengthen Veterinary Services to enhance efforts to control infections in livestock. It is also necessary to develop legally enforceable safe slaughter and meat inspection capability, especially in developing countries, and to assign foodborne infections higher priority in food safety programmes (11).

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Likewise, for consumers, health education and training programmes are important, along with access to free diagnosis and anthelmintic treatment in endemic areas.

Potential intervention points for preventing transmission of *Taenia* are shown in Figure 3. The major prevention and control interventions are:

– comprehensive meat inspection to prevent human infection

– improved farm management to ensure that pigs and cattle are protected from ingesting feed or water contaminated with human faeces

– screening farm workers for taeniosis, and treatment if warranted

– proper treatment of sewage effluent and sludge to kill *Taenia* eggs, and regulation of the use of effluent and sludge for agricultural purposes

– control of pig and cattle marketing systems, including the provision of incentives to ensure owner compliance

– health education of both farmer and consumer, especially on the importance of cooking meat in endemic areas.

Approaches and recommendations are described in detail in the *WHO/FAO/OIE Guidelines for the Surveillance, Prevention and Control of Taeniosis/Cysticercosis*, which highlights the important obstacles to developing effective control programmes (12). For example, in many countries, unless improvements in safe slaughter and meat inspection are addressed seriously by governments, it will be difficult to interrupt the parasite's transmission cycle and remove cysticerci from the food chain.
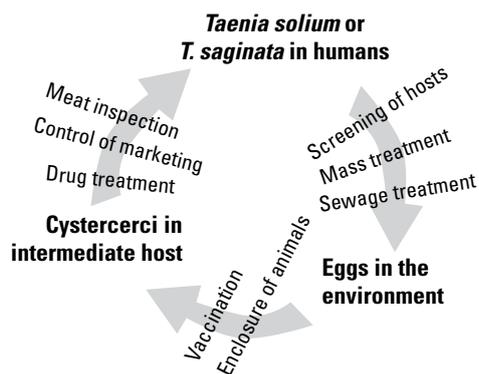

Fig. 3
Potential intervention points for preventing transmission of *Taenia*
Adapted from Fig. 5.1 in Chapter 5 of the *WHO/FAO/OIE Guidelines for surveillance, prevention and control of taeniosis/cysticercosis* (7)

Integration of veterinary and public health responsibilities

Integration of veterinary and public health efforts is needed to monitor these foodborne parasites and to develop a comprehensive food safety programme for these zoonotic diseases. This joining of different authorities and expertise in a collaborative effort can be far more effective in controlling these parasites than when each sector deals independently with the disease when it lands in their traditional sphere of responsibility. The foundation of this collaboration must be the establishment of policy at the highest levels that mandates joint activities. The next vital step is the development of communication procedures that veterinary and public health agencies can rely on to keep each other informed of human outbreaks and of animal cases discovered in veterinary monitoring and abattoir activities. The traceback of human cases is extremely important for the ability of Veterinary Services to carry out the investigations needed to identify sources of animal infection and to take the measures necessary to eliminate the infection. In turn, Veterinary Services should regularly inform public health agencies about data obtained from the surveillance and monitoring activities for meat-borne parasites in livestock. This information transfer can enhance awareness of the risk of infections and help focus efforts on appropriate preventive and mitigation actions to protect people. An example of the value of this cooperation is, in the author's experience, the communication on trichinellosis between the food safety agencies of the Centers for Disease Control and Prevention (CDC) and the United States Department of Agriculture (USDA). Sharing of data and regular communication helped to form rapid responses by the USDA when CDC received medical reports on *Trichinella* outbreaks (trichinellosis is a reportable disease). These responses very often led to the identification of the source of infected pigs or wild animals and the conduct of epidemiological studies that greatly increased the knowledge on risk factors in pig husbandry, the genetic complexity of *Trichinella* spp., and the role of wild animal reservoirs. Other examples abound of the benefits to a country from close communication and collaboration between its veterinary and public health resources.

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Les parasites zoonotiques transmissibles par les aliments et leur surveillance

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Résumé

Parmi les nombreuses maladies zoonotiques dues à des helminthes d'origine alimentaire transmissibles à l'homme, certaines, comme la trichinellose ou la cysticercose encéphalique, sont des maladies graves entraînant parfois la mort, tandis que d'autres ne provoquent qu'une affection chronique sans gravité (par exemple, la téniasis intestinale). La maladie est généralement contractée par ingestion du parasite présent dans des denrées alimentaires dérivées d'un de ses hôtes naturels (par exemple la viande). Les risques d'infestation par ces parasites sont d'autant plus élevés que les populations manquent d'informations sur le processus de contamination et méconnaissent les règles d'hygiène, que les pratiques d'élevage sont médiocres et que la gestion ou l'élimination des déchets d'origine animale ou humaine se font dans des conditions de sécurité sanitaire inappropriées. Les stratégies de surveillance et de contrôle des diverses espèces de parasites d'origine alimentaire et la participation des autorités en charge de la santé animale et de la santé publique sont extrêmement variables selon les cas, ce qui s'explique par la diversité des cycles de vie des parasites et de leurs caractéristiques épidémiologiques. En ce qui concerne le principal agent de la trichinellose chez l'homme, *Trichinella spiralis*, l'infestation est généralement due à l'ingestion de viande de porc contaminée, ou, de plus en plus souvent, de viande de gibier. La cysticercose humaine est exclusivement due à la consommation de viande de porc (*Taenia solium*) et de bœuf (*T. saginata*) contaminée. La consommation de viande mal cuisinée est le principal facteur de risque d'infestation humaine par ces parasites. En revanche, chez les porcs et les bovins, les facteurs de risque d'infestation par *Trichinella* et *Taenia* sont très différents. Chez les porcs, la principale source de contamination par *T. spiralis* est l'exposition à des viandes issues d'animaux parasités (porteurs de larves contaminantes), tandis que les deux espèces de *Taenia* sont transmises via des matières fécales humaines contenant les œufs libérés par le ténia adulte présent dans l'intestin de l'hôte. D'où la diversité des méthodes appliquées pour prévenir l'exposition des porcs et des bovins aux stades contaminants de *T. spiralis*, *T. solium*, et *T. saginata*, notamment les mesures de biosécurité au niveau des exploitations. L'auteur examine les stratégies et les méthodes de surveillance de ces parasites chez les animaux d'élevage, y compris les mesures réglementaires indispensables et la collaboration à mettre en place entre les secteurs de la médecine vétérinaire et de la médecine humaine pour réaliser un programme national de notification et de prophylaxie de ces maladies.

Mots-clés

Cysticercosis – Parasite – Surveillance – *Taenia* – *Trichinella* – Trichinellose – Zoonose.

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Los parásitos zoonóticos transmitidos por los alimentos y su vigilancia

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Resumen

El ser humano padece varias enfermedades zoonóticas causadas por helmintos que se transmiten por los alimentos, algunas de las cuales pueden ser mortales (como la triquinelosis o la cisticercosis cerebral), mientras que otras son crónicas y causan solo dolencias leves (como la teniasis intestinal). Normalmente una persona se ve infestada tras ingerir el hospedador natural del parásito como parte de su alimentación (por ejemplo, su carne). El riesgo de infestación por estos parásitos es máximo cuando las personas no conocen lo bastante la infección y las reglas de higiene, se utilizan técnicas deficientes de producción animal o se gestionan y eliminan los residuos humanos y animales sin las debidas precauciones sanitarias. La concepción de estrategias de vigilancia y control de los distintos parásitos transmitidos por los alimentos, al igual que la participación de los organismos veterinarios y de salud pública, difieren considerablemente según la especie de que se trate, pues cada parásito presenta ciclos vitales y características epidemiológicas diferentes. *Trichinella spiralis*, que causa la mayoría de los casos de triquinelosis humana, se contrae al ingerir carne de cerdo, aunque cada vez hay más casos resultantes del consumo de caza salvaje. Para que el hombre contraiga la cisticercosis, en cambio, las únicas vías de infestación son la carne de cerdo *(Taenia solium)* y de vacuno (*T. saginata*). El principal factor de riesgo de infestación humana por estos parásitos reside en el consumo de carne indebidamente cocinada. En los cerdos o vacas, sin embargo, los factores de riesgo difieren sensiblemente entre *Trichinella* y *Taenia.* En el caso de *T. spiralis,* la principal vía de infección de los cerdos es la exposición a carne de animales infestados (que contiene el estadio larval infeccioso), mientras que las dos especies de *Taenia* se transmiten por materias fecales humanas contaminadas con los huevos que ha puesto la forma intestinal adulta de la tenia. De ahí que los medios para prevenir la exposición de cerdos y vacunos a las formas infecciosas de *T. spiralis*, *T. solium* y *T. saginata* sean sensiblemente distintos, en especial los requisitos para garantizar la bioseguridad de esos animales en las explotaciones. Los autores examinan los métodos y estrategias necesarios para vigilar la presencia de estos parásitos en el ganado, lo que incluye las necesarias medidas normativas y la indispensable colaboración entre los sectores veterinario y médico para poner en marcha un programa nacional de notificación y control.

Palabras clave

Cisticercosis – Parásito – *Taenia* – *Trichinella* – Triquinelosis – Vigilancia – Zoonosis.

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