Chapter 7

Capacity Building
Surveillance for
Prevention and Control
Capacity building for surveillance and control of *Taenia saginata*. The terms cysticercosis and taeniasis refer to food-borne zoonotic infections with larval and adult tapeworms, respectively. The important features of these Zoonoses are that the larvae are meat borne (generally beef or pork) and the adult stage develops only in the intestine of the human host (obligate). *Taenia saginata* (the beef tapeworm), *T. saginata asiatica* (Taiwan Taenia) and *T. solium* (the pork tape worm) are the most important causes of taeniasis in humans. Cysticercosis is a tissue infection with the larval cysticercus or metacestode stage, and occurs most commonly in pigs and cattle: *Taenia saginata* occurs only in beef, *T. saginata asiatica* in pig organs, and *T. solium* primarily in pork. Humans acquire the adult stage through eating improperly cooked infected meat.
Although the life cycle cannot be maintained in regions that have adequate sanitation and good animal husbandry practices, these regions are still vulnerable, owing to immigration of people from highly endemic regions carrying infections of the adult stage (taeniasis). Such introduced infections account for an increased global distribution to non-endemic regions such as in the United States and Europe. These human carriers can contaminate the environment of others, leading to secondary infections (Murrell, 2005; Pawlowski, Allan and Meinardi, 2005). Obviously, measures of cysticerciasis control in animals, for which man is the sole final host, i.e., the source of infection for the other surroundings, are impossible without coordination between veterinary and medical organizations. Private and public institutions and a large section of the entire population must take an active part in effecting these measures. However, despite the necessary close coordination in maintaining control measures for taeniasis and cysticercosis in man and cattle respectively, there are specific veterinary and medical aspects of the problem which must be dealt with and definite requirements established for the control of the helminth Zoonoses in question. In the choice of guiding measures, knowledge of epidemiological factors concerning taeniasis and cysticercosis is essential.

In Kashmir valley where the pigs are completely absent and majority (95%) human population are Muslims, Thus Taeniasis in this valley has been found only due to Taenia saginata and is an important public health problem, with a prevalence of 2.22- 4% in free living human population, thus on the basis of a general plan for measures against taeniasis saginata, definite plans must be made in cooperation with veterinary and medical workers. Data concerning local conditions throughout the given region, town, and district, and each part of the plan, should receive official approval by corresponding executive committees. The plans should specify details of veterinary and medical precautionary measures. Taenia saginata is an important zoonosis in many beef-eating countries and is usually associated with low social and economic development. The prevalence of T saginata infection varies greatly according to the regional level of sanitation, cattle husbandry practices and eating habits. It is very difficult to evaluate the prevalence of T saginata taeniasis because
the coproscopical methods used for survey are not completely adequate and usually cannot differentiate between *T. solium* and *T. saginata* infections (Dorny *et al.* 2003). Therefore data on prevalence of adult worm infections are generally considered very conservative. Similarly, prevalence data based on serological methods may overestimate infection rates because presence of antibody may be the result of exposure to eggs and early but unsuccessful infection (Dorny *et al.* 2003).

**Important risk factors in the epidemiology of *Taenia saginata* in Kashmir Valley**

The major risk factors related to transmission of *T. saginata* eggs to cattle can be summarized as follows:

- Extensive or free-range cattle rearing in households lacking latrines, and outdoor human defecation near or in cattle-rearing area.
- Connecting cattle yards/sheds to human latrines.
- Use of sewage effluent, sludge or "night soil" to irrigate and/or fertilize cattle pastures and food crops.
- Human carriers involved in cattle rearing and care.

The risk factors important to the transmission of cysticerci to humans are:

- Lack of comprehensive and satisfactory meat inspection at cattle slaughter.
- Clandestine marketing of cattle to avoid inspection.
- Cultural/habitual preferences for eating raw or improperly cooked beef, as also observed in this study.
- Extensive use of beef raw steaks mostly by men of all age groups, particularly teenage boys in Kashmir. Where as a good percentage have been found getting infected during handling beef while preparing it for various delicacies.
- Studies have shown that the problems of illegal slaughter and marketing are widespread and their solution will require substantial efforts in veterinary
control. The habit of eating raw or improperly cooked beef is also a very intractable trait, but hopefully, this can change through education.

**The way forward: specific capacities needed to implement control activities**

There is a consensus that from the standpoint of disease transmission to humans and maintenance of the parasite's life cycle, the adult tapeworm is of primary importance (Pawlowski, Allan & Meinardi, 2005; Pawlowski, 2002). The expertise needed to implement a control programme (detailed below) is diverse and must be provided through multidisciplinary cooperation between the medical, veterinary and public health sectors (and, perhaps, the education sector).

**Strategy for *T. saginata* infection control**

1. **Prevention of Taeniasis in humans**

   The prevention of environmental contamination with *Taenia* eggs is of paramount importance in both prevention and control schemes. The development of improved sanitation and hygiene practices have had a major impact on the occurrence of taeniasis in developed countries, and also among urban dwellers in the developing countries, because of their effect on the transmission of *Taenia* eggs (Pawlsowski, Allan and Meinardi, 2005; WHO, 1983). The installation of adequate sanitation and the adoption of safe animal husbandry practices, however, are very problematical in these resource-poor areas, and therefore, prevention strategies must rely on multiple approaches, tailoring each to the special features of the particular endemic area (Kyvsgaard and Murrell, 2005). In general, these strategies are:

   - Meat inspection to prevent human infection.
   - Improved farm management to ensure that cattle are protected from ingesting feed or water contaminated with human faeces to prevent cysticercosis in animals.
   - Screening of farm workers for taeniasis, 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 cattle marketing systems, including the provision of incentives to ensure owner compliance.
• Health education of both farmer and consumers.

**Major control elements dependent upon capacity building**

**Improvements in meat inspection**

Various studies have shown that improvement of the effectiveness of inspection staff depends upon such factors as training, rewards, motivation, psychological disposition, adequate lighting and improving methods of processing carcasses. These are important, but they do not overcome the problem that there is no specific site for examination that can be relied upon to detect all infected carcasses (Kyvsgaard, & Murrell, 2005)

Failures in the detection of cysticercosis during post-mortem inspection may be reduced if meat inspection is practiced by experienced and conscientious inspectors under optimal conditions; these should include adequate rest periods. These conditions also include good lighting, a low noise level and a system of inspection integrated with slaughtering procedures. Meat inspection manuals should be explicit in their directions for the examination of carcasses and organs for cysticerci. Meat inspection should be well planned, organized and managed at every slaughterhouse. It has been observed that the efficiency of meat inspection diminishes after two hours of routine work in a given position.

**Health education and training of professionals - "training of trainers"**

Education is crucial to any control effort, and must be given at all levels of a programme. All health education effort has to be planned and conducted through a
net of professionals who are working in the field or who have contacts with the public (Pawlowski, Allan & Meinardi, 2005; Kyvsgaard & Murrell, 2005).

**Meat inspectors**

Meat inspection in larger slaughterhouses is in most countries under the veterinary authority of the Agricultural Ministry. The authority and obligation to carry out meat inspection in the smaller towns and communities may vary between countries, belonging either to local municipal government, the Agricultural Ministry or to the Ministry of Health. Local police may even be involved when meat is condemned. The meat inspectors may have other duties and will often have very different educational backgrounds. Proper training is therefore crucial.

**The role of health workers**

The primary health worker plays a central role both in the identification of human carriers and in the promotion of better hygienic practices in the community.

**The role of schools**

Taeniasis/cysticercosis is an appropriate subject to be introduced into schools along with discussions on food hygiene, food habits, environmental sanitation, man/animal relationships, life cycles of the organisms and their zoonotic importance. In many endemic areas this is an important opportunity for education to reach isolated farms. The preparation of teachers to become active health educators should be encouraged.

**Training of health workers and schoolteachers**

As far as possible, health educators should be drawn from the community in which they will be working. Everyone involved directly or indirectly in preventing taeniasis in humans and cysticercosis in cattle must participate in carrying out public health education. It is, therefore, essential that this subject should have an important
place in staff training. Such training should be planned and preferably imparted by a specialist, who should also advise on the selection of appropriate educational methods and the preparation of educational material suited to local conditions and to the various phases of the programme. The general training that health workers may have received in schools of public health also needs to be supplemented with briefings on the various aspects of the local situation. It is useful to prepare and distribute a poster, booklet or manual dealing with the technical, administrative and educational aspects of the programme. This can then be used by all persons involved in the project, including lay members of committees or other groups set up to obtain public cooperation and support. A manual helps to avoid confusion caused by different answers to the same questions given by different people.

The role of pharmacists

Pharmacists play an important role locally, because they sell taenicides, often without medical prescription, and are asked to diagnose taeniasis. They can be actively involved in health education particularly in the supply of educational materials. The educational curriculum of pharmacists should include a course of lectures on diagnosis, treatment, prevention and control of taeniasis due to Taenia saginata in this Kashmir region.

Training of the public

Farmers

Farmers should be informed of the risks associated with allowing cattle to have access to human faeces, and the use of human sewage for fertilization and/or irrigation of pasture, and they should be instructed on the benefits of providing effective toilet facilities for their own and worker's families. Therefore, they should be convinced of the importance of: (i) having all cases of taeniasis reported and properly treated; and (ii) using effective toilets when available or, if not available, avoiding defecation in places either directly accessible to susceptible animals or with potential for contaminating their feed.
Cattle owners should be informed of the life cycle and the health risks to their families and to the consumers of the meat they produce. They should also be informed of the economic implications (possible closure of their small business by the health authorities and the loss of customers). Sometimes the best way to involve these animal owners is through their children, who can be taught the life cycle of these parasites and the means to prevent infection at school.

These animal owners should also be advised to have their animals inspected at slaughter, but if this is not possible, to learn how to detect cysticerci in the meat and to use the infected meat only if properly treated by cooking or freezing. They also must learn to clean all tools used to cut the meat, in order to prevent the transfer of cysticerci. They should also be persuaded to report and have treated all cases of taeniasis occurring to themselves or to their families.

Butchers

Butchers should be: (i) required to cooperate in the veterinary inspection to detect cysticerci; (ii) trained to detect cysticerci, and properly treat the infected meat, if veterinary inspection is not available; and (iii) required to avoid tasting, eating or selling suspect, untreated raw meat.

Food handlers and consumers

Food handlers should be educated to: (i) look for cysticerci and use infected meat only if it has been previously treated by freezing or cooking; (ii) use suspect (uninspected) meat only if it has been previously treated by freezing or thorough cooking; (iii) thoroughly clean hands, and all kitchen tools (e.g. knives, chopping-boards, etc.) which have been used in preparation of meat; and (iv) avoid tasting raw during grinding, kneading or insufficiently cooked, infected or suspect meat as, was found to be one of the main reasons in the areas of Kashmir Valley.
**Persons involved in home slaughtering**

Some people raise cattle for home slaughter and distribute meat to their families/relatives or to local consumers particularly on some special occasions like the holy Eid. This may create urban foci as well as act to disseminate infection to rural areas. This is one of the activities where education is most needed in the village situation, as it is probable, currently, that the carcasses have not been inspected.

**Community education or prevention**

All members of the community should be informed of the life cycles and of the public health and economic impacts of these parasites. They should be encouraged to: (i) report and have treated all cases of taeniasis; (ii) insist that proper public and private toilets with effective sewage disposal are made available and are used; (iii) keep cattle in well maintained cattle yards or behind fences; and (iv) insist on the adequate meat inspection services.

**Campers, Gujars, Bakerwals and Tourists**

These groups are often exposed to taeniasis because they may eat raw or improperly cooked meat. Because they frequently defecate in the fields/pastures/jungles or by the roadside they are an important group that should be informed about the life cycle of the parasite; and advised to: (i) refrain from eating unsafe raw beef in regions like Kashmir where cysticercosis in cattle is endemic, (ii) inspect their faeces for tapeworm proglottids and report for treatment; and (iii) use toilets when available; if these are not available, then they should avoid defecating in places accessible to cattle, or bury their faeces.

**Hunters**

They have responsibilities similar to campers and tourists in general, particularly in the use of uninspected meat from the killed animals of some
Prevention and Control

deer/antelope as food for their families or for local consumers. Hunters should be advised: (i) to have wild animal meat properly inspected and, if it is found to be infected, to have this meat properly treated by cooking or freezing; (ii) to learn how to detect cysticerci, if inspection is not feasible; and (iii) to cook the meat thoroughly and avoid tasting before it is cooked.

Exploiting media for local education programmes

The educational material used should take into full consideration the beliefs, perceptions, behaviour, expectations and needs of the people (felt and unfelt). This highlights the need to carry out preliminary cultural and socio-economic studies to ensure that the information imparted will be accepted by each target group (Sanchez & Fairfield, 2003). There is a need to measure the impact of each educational programme to ensure that it does meet the needs and cooperation capabilities of the target group.

A potentially powerful use of the electronic media for prevention and control education efforts is in training the educators in the project with interactive media presentations or tutorials. The use of such new technologies can greatly extend and enhance education materials traditionally employed in health education programmes. A recent project on porcine cysticercosis in The United Republic of Tanzania expanded the use of electronic media options by introducing an educational video to inform the rural communities of the health risks and prevention of *T solium* infections (Rimm, 2003). The product of this research was a video that could be taken to even very remote locations and presented to community members either as a VHS videotape (with television screen) or with a DVD player and an LCD projector.
Tasks for control programme staff, cooperators and stakeholders which reflect the skills and knowledge needed

Health policy-makers

- Collect all possible information on medical and economic importance of taeniasis/cysticercosis in a country and consider a need, priority and feasibility of undertaking control measures.
- Create a positive atmosphere from all interested bodies, including mass media, about the necessity of implementation of control measures against *Taenia saginata* taeniasis and cysticercosis.
- Select the optimal ways of implementation of the control measures in a country and designate person(s) responsible for its coordination and implementation.
- Regularly examine and evaluate the progress in control activities.

Public health officers

- Establish persons responsible for implementation of control measures and the mechanisms of periodical evaluation of control activities.
- Collect hard data on taeniasis/cysticercosis from medical, veterinary and research institutions and create or strengthen existing information system.
- Define endemic areas or foci of taeniasis/cysticercosis as well as local resources (personnel and funds) necessary for successful control.
- Train medical, laboratory and veterinary services in implementation of the control measures.
- Promote a cooperation of the medical, veterinary and non-medical institutions in implementation of control measures.
- Strengthen laboratory diagnostic base for identifying *Taenia* proglottids and/or finding specific coproantigens or *Taenia* eggs.
- Ensure the availability of effective and cheap taenicides listed in the essential drugs list and decide what to do if the drugs are not available, when needed.
Medical personnel

- Include training in diagnosis, treatment, prevention and control of *Taenia saginata* infections in academic curricula or postgraduate teaching, and organize special courses related to the control measures.
- Keep medical personnel informed about the basic rules of the control measures.
- Try to organize, in cooperation with veterinary services, an active search for human carriers in *Taenia saginata* foci and endemic areas.
- Ensure taenicide availability and their constant supply.
- Treat suspected and confirmed cases of fresh and resistant *Taenia saginata* infections. *We should all brush upon tape worms from time to time*............*Dave Barry (Bad habits).*
- Evaluate, in cooperation with veterinary services, the progress in local implementation of the control measures.
- Take part in educational activities addressed to the population in endemic areas.
- Inform health authorities if taenicide drugs are not available when needed and if not successfully working.
- Analyze the amount of taenicides being used in an area as one of the indicators of implementation of control measures.

Veterinary services

- Promote meat inspection and analyze the infection rate in cattle and the origin of cysticercotic cattle diagnosed locally.
- Try to organize examination of cattle for cysticerci before slaughter and instruct farmers and rural people what to do to avoid infection in humans and cattle.
- Identify local foci of taeniasis and ask medical services to treat the diagnosed or suspected tapeworm carriers.
Prevention and Control

- Inform veterinary authorities about the local epidemiological situation and control measures being undertaken.

**Education experts**

- Collect educational material (basic information on taeniasis/cysticercosis) as well as data on the occurrence of *Taenia saginata* taeniasis and cysticercosis, and frequency of infections.
- Distribute and use available educational materials and invite the mass media and schoolteachers to include taeniasis prevention and control measures in their health education activities.
- Ensure that anyone who wants to be involved in health education knows where educational materials and support can be obtained.

**Primary health workers**

- Get the support of the local community leaders for implementation of taeniasis/cysticercosis control measures.
- Collect information on taeniasis in cattle and cysticercosis in cattle and cases in the area and pass the information to the appropriate health authorities and control programme leaders.
- Identify, in cooperation with veterinary services, the local foci of *Taenia saginata* infection.
- Educate farmers how to prevent cysticercosis in cattle, emphasizing the risk of heavy economic losses.
Conclusion

Control of taeniasis in humans & cysticercosis in cattle from *T. saginata* infections will require a multidisciplinary and multilevel approach because of the complex nature of its epidemiology. A control programme will necessitate establishing a national organization that helps and guides the local effort. The control programme will also demand cooperation and participation by the veterinary, medical and public health sectors. This complex organization of experts and stakeholders must be provided with, in addition to resources, a solid understanding of the epidemiology and biology of the zoonosis, and the rationale for the control strategy that is to be pursued. In addition to basic parasitology of *T. saginata*, a good understanding of the risks associated animal husbandry and human behavioral practices, and the economics of cattle production and marketing is essential. Important to the success of a programme is attention to management and coordination of the various components of the control organization. Therefore, a good deal of effort and investment in training and indoctrination of all participants in the overall control programme will be required upfront. Even pilot or demonstration control projects will require substantial capacity building. Without this level of preparation, controlling this zoonosis, which is so dependent upon long-established risky animal rearing and cultural traits, will remain nearly intractable.