MEETING OF THE SCIENTIFIC WORKING GROUP ON ADVANCES IN THE PREVENTION, CONTROL, AND TREATMENT OF HYDATIDOSIS
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FINAL REPORT

Montevideo, Uruguay
26 - 28 October, 1994
I. BACKGROUND

Echinococcosis/hydatidosis is a parasitic infection of dogs, livestock animals, and humans. Recognized in antiquity, it still occurs commonly in rural populations throughout most of the world. The cestode causative agents, *Echinococcus* spp., occur as tapeworms in the intestines of dogs and other carnivores, and as larval cysts in the internal organs of humans and animal intermediate hosts. Four species of *Echinococcus* are known to exist: *E. granulosus*, *E. multilocularis*, *E. oligarthus*, and *E. vogeli*. Nevertheless, *E. granulosus*, whose life cycle involves dogs, sheep, cattle, pigs, and numerous other ungulate animals, is by far the most widely prevalent and economically important agent of disease. This parasite occurs throughout the world, wherever the presence of dogs and livestock animals combine with the ignorance or irresponsibility of humans to allow perpetuation of its life cycle. The Andean and Southern Cone countries of South America have long been recognized as regions where the infection exists in a heavy toll in terms of human and animal infection.

Application of control measures, including health education, control of stray dogs, and greater control and/or treatment of working dogs, have eliminated or significantly reduced transmission in a number of regions where the infection was endemic, most notably on island states such as Iceland, New Zealand, Tasmania, and Cyprus. In some other regions, use of similar measures have not been as effective and, in most areas, control efforts have not even been implemented. In 1981, consultants of the World Health Organization reviewed the global status of this disease and published guidelines for surveillance, control and prevention (FAO, UNEP, WHO, 1981). These emphasized the importance of developing surveillance systems to document the distribution, prevalence, and risk factors for the disease and assessment of economic and public health losses.

Recent research, especially the application of modern methods of molecular biology and immunology, have improved our understanding of this cestode, its biology and modes of transmissions, and have improved the technology applicable for diagnosis, treatment, and control. Analysis of the cestodes genetic material has provided tools to distinguish variation
with the genus *Echinococcus*. Today we know that infraspecific varieties, exist within the species *E. granulosus* with significant differences in their host range and modes of transmission. The effectiveness of intervention programs requires knowledge of these differences with appropriate modifications of intervention methods. Improved immunologic tests provide greater diagnostic sensitivity and specificity. These, combined with modern diagnostic imaging methods, permit more accurate diagnosis and patient evaluation. Portable ultrasound has been shown to be useful for screening populations at risk for infection, resulting in early diagnosis and improved survival. Benzimidazole and praziquantel chemotherapy, ultrasound guided puncture and aspiration, and other medical approaches to treatment of human hydatid disease have provided improved means of medical management of human cases, supplementing traditional surgical approaches to treatment.

Several of the above aspects needed greater investigation and comprehension with the on going activities of the national control programs. The President of Uruguay, your Excellency Luis Alberto Lacalle, concerned with the situation of hydatidosis in his country and having knowledge of new developments, requested the Director of PAHO, Dr. Carlyle Guerra de Macedo to convoke a meeting of experts in order to actualize knowledge on prevention, control and treatment of hydatidosis.

**PURPOSE**

The purpose of this meeting was to review the scientific advances on prevention, control, diagnosis, and treatment of hydatidosis and to develop an effective strategy for control and eventual elimination from areas of Latin America where the disease is endemic.

**METHODOLOGY**

The Meeting was developed in three modules: General review on echinococcosis hydatidosis; Control programs overview and country reports and Development of plan of action. The scientists invited to the meeting delivered oral presentations and hold a forum of related topics.

**PARTICIPANTS**

There were 50 participants. among experts, directors of national programs, representatives of International Organizations, observers and the secretariat. The list of participants is showed in Annex No. 1
The meeting was opened by Dr. Juan Carlos Veronelli, Representative of the Pan American Health Organization (PAHO) in Uruguay, who welcomed the participants and observers and underlined the importance of this meeting to the solution of the problem in Uruguay. Dr. Primo Arambulo, Coordinator of the Program of Veterinary Public Health, PAHO, outlined the objectives and methodology of the meeting.

Professor Johannes Eckert, Director of the Institute of Parasitology, University of Zurich, was elected President of the Working Group, Dr. Macarena Vidal, from the Ministry of Agriculture, Santiago, Chile, was elected Vice-President, and Dr. Peter Schantz, Centers for Disease Control and Prevention, Atlanta, Georgia, was elected Rapporteur.

The first module was a general review of echinococcosis/hydatidosis by international experts. Professor Johannes Eckert, University of Zurich, reviewed the current knowledge of the biology of *Echinococcus* spp. Developments of most significance to understanding of the disease are those related to characterization of strains within the species *Echinococcus granulosus*. Application of modern molecular techniques have recently demonstrated multiple distinct genetic variants within the species, thus supporting earlier morphological, biological, biochemical, and other observations that had suggested infraspecific variant populations. Thus far, at least 7 genetically-distinct variants are recognized that differ in characteristics of significance in the epidemiology and control of hydatid disease. For example, it is evident that the sheep, cattle and cervid strains are infective for humans; the horse, camel and some other strains, however, appear to be less or non-infective to humans. Documentation of genetic variation is relatively limited in most geographic regions and there is a need for further investigation. Several molecular techniques are now available which allow the identification of strains using genetic markers. Application of these techniques should allow a relatively rapid clarification of the epidemiological situation. This work would be facilitated by the establishment of reference laboratories.

Dr. Marshal Lightowlers of the University of Melbourne, Australia, reviewed knowledge of the immune response to *E. granulosus* infection and the recent development of a vaccine. Collaboration between scientists in Australia and New Zealand has resulted in an experimental vaccine against cystic echinococcosis in sheep. Two vaccine trials have achieved 96% and 97% protection, respectively, against egg-induced infection. The vaccine, known as EG95, uses a protein antigen from *E. granulosus* oncospheres produced in *Escherichia coli* bacteria using recombinant DNA methods and, therefore, can be produced in large quantities with exact quality control. Additional information is needed concerning
the duration of immunity afforded by the vaccine and other characteristics before it can be considered as an additional tool for use in control campaigns.

Prof. Philip Craig, of Salford University, U.K., provided an overview and update on current developments on immunodiagnosis. For immunodiagnosis of human disease the ELISA test has become widely adopted, using crude hydatid cyst fluid antigen and, to a lesser extent, purified antigen, e.g., antigen B and antigen 5. Overall sensitivity is around 70-80%. Immunoblot for antigen B low MWt subunits has been adapted in some laboratories as a secondary confirmatory test, though the importance of the arc 5 double-diffusion test was recognized in this role, especially in more basic laboratory settings, i.e., provincial hospitals. The most efficient approach to screening should combine ultrasound (US) with serology - ideally, initial first screening with ultrasound, and then, serologic confirmation of image positives. Serologic testing for clinical diagnosis should involve a first test of high sensitivity followed by a test of high specificity (e.g., ELISA with arc 5 or immunoblot). Immunodiagnosis of ovine hydatidosis has not progressed significantly to warrant recommendation for general application. A significant advance in diagnosis of canine echinococcosis was recognized with the advent of coproantigen detection ELISA. Current tests are genus specific and based on either polyclonal anti-somatic or anti-ES adult *E. granulosus* capture antibodies. The former test has now been assessed in 169 dogs (including 126 with necropsy and 43 by arecoline positivity). Overall specificity was 94.8% and sensitivity, 75.3%. Sensitivity is 100% in dogs with worm burdens or purge counts >50. Faecal samples may be collected per rectum or after deposition and can be fixed in 5% formal saline. The logistics and practicality of undertaking a coproantigen test are far less formidable and apparently more cost effective than arecoline testing and further evaluation may lead to the replacement of arecoline testing by coproantigen assays.

Prof. Zbigniew Pawlowski, Medical Academy of Poznan, Poland, discussed clinical aspects of diagnosis and treatment. Clinical diagnosis of hydatid cysts are now made most efficiently with a combination of imaging and serologic tests. Ultrasound is a highly efficient, non-invasive, and relatively inexpensive imaging technique that, because of its availability in portable models, can also be used for active screening of populations at high risk. Computerized tomography (CT) and magnetic resonance (MR) imaging is more sensitive than ultrasound and often yields additional clinical data but due to their expense they are limited in their availability. Imaging diagnosis of hydatid cysts can usually be confirmed by antibody detection, however, seronegative cases may require percutaneous aspiration to demonstrate protoscolices, membrane or *Echinococcus* antigens. The latter procedure, when carried out with ultrasound guidance, and anticipation of a possible allergic reaction, is now
widely accepted as safe and effective. Chest roentgenogram is still useful for detection of pulmonary cysts.

Chemotherapy with benzimidazole anthelmintics (albendazole and mebendazole) and puncture/aspiration procedures (denoted PAIR) have supplemented, and to some extent replaced, surgery as the preferred treatment of hydatid disease. Use of benzimidazole drugs in extensive trials has resulted in cure or improvement in 60-90%, but is ineffective in the remainder. Cyst puncture, aspiration of contents, injection of protoscolicidal chemicals, followed by re-aspiration (denoted PAIR) has been used with reported efficacy and safety, however, further evaluation of PAIR is required to evaluate long-term efficacy and safety. It is clear, then, that multiple, effective treatment modalities, in addition to traditional surgical approaches, are now available and may be used according to the unique clinical characteristics of each case. Regional programs should include provisions to educate clinicians about the range of possibilities and to provide necessary facilities and laboratory support to put them into practice.

Dr. Peter Schantz, CDC, Atlanta, reviewed the current world distribution of *E. granulosus* infection and the associated public health problems. It was noted that the cestode occurs in virtually all geographic regions from the tundra zones of Eurasia and North America to the southernmost parts of Africa, Oceania, and South America. Within those vast regions the parasite is transmitted within a great variety of definitive and intermediate hosts, often reflecting genetic, or strain differences in the cestode. With few exceptions the greatest frequency of transmission to humans occurs with the sheep strain in life cycles involving dogs and sheep. The common association of humans with sheep and shepherd dogs, the near universal rural practice of feeding dogs offal of home-butchered animals, coupled with inadequate sanitary facilities and poor personal hygiene create opportunities for frequent exposure of human populations. Highest diagnostic incidence is reported from southern and western Europe, most countries of the Middle East, North Africa, Central Asia, including China, and the southern part of South America. At least 20-25 thousand cases are diagnosed each year, however, this is considered a conservative estimate as there is widespread lack of/or under-reporting of the disease. The visibility of hydatid disease has always been a function of the local availability of diagnostic facilities and surgical care, enforcement of requirements for reporting the disease, and traditions of publishing such information. There is an important need for development of simple, but comprehensive surveillance systems.

In the second module about Control Programs, Dr. K. Polydorou, Nicosia, Cyprus, described the successful experience of his country in controlling hydatidosis. Before the
1970s, the surgical rate for hydatidosis in humans was 12.9 cases per 100,000 per year. At the time, this placed Cyprus in the group of countries with the worst Echinococcus problem worldwide. Slaughter was carried out by anyone, anywhere and infected viscera thrown nearby were easily accessible to the abundant stray dogs, found everywhere all over the island, which in turn contaminated grazing areas and human habitat alike. There was no village with no victims and often 3-4 members of the same family were affected. Between 50-100% of sheep, goats, cattle and pigs were infected as well as 40%-100% of the estimated 60,000 dogs, all strays. For years, spasmodic, unco-ordinated, short-lived methods to deal with this problem achieved little. In 1970, the Director, Department of Veterinary Services, prepared an all-inclusive plan for stray-dog control, slaughter-control, education and dog-testing. Special teams exterminated all stray-dogs, rural abattoirs were constructed, people educated by personal visits, the radio, press and T.V. and an arecoline dog-testing programme was started and carried out three times each year throughout the 15-years of the Campaign. From 1971-85, over 85,000 stray dogs were exterminated, about 14,000 bitches spayed, over 345,000 dog examinations for Echinococcus carried out, with about 2,300 dogs found infected, all euthanized immediately, and 210 rural abattoirs contracted or renovated. All owned dogs are now registered and responsibly kept. The cycle of this disease was completely interrupted: infection in sheep in 1985 was less than 0.05%, no dogs were found infected since 1983, and there have been no human surgeries since 1984. The 15-year Campaign was officially ended in 1985 but maintenance activities -slaughter-control, dog surveillance and stray-dog control- are continuing.

Dr. Michael Gemmell, Cambridge University, United Kingdom, reviewed existing experiences in hydatidosis control and highlighted those factors associated with successful programs. In the past, most programmes for Echinococcosis (Echinococcus granulosus) control were initiated in complete ignorance of their duration, cost or outcome. Some succeeded, others did not. Where failure occurred it usually resulted from loss of financial support from the legislature. Experience has shown that there are four phases. These are the "Planning", "Attack", "Consolidation" and "Maintenance of Eradication" phases. The "Planning" phase is essential to estimate the resources needed and identify funding sources to implement and sustain a programme. To achieve this, planning includes: (a) definition of the human health problem; (b) quantification of the transmission dynamics between animals; (c) selection of appropriate control options with estimates of duration and (d) testing feasibility by field trial in a benefit-cost approach to control. The "Attack" phase is very costly as it now usually includes a frequent dog-dosing programme applied by technicians. The objective, therefore, through an effective surveillance programme in food animals is to reach rapidly the "consolidation" phase, where quarantine of infected premises is applied
followed by the "Maintenance of Eradication" phase on islands, where the parasite can be eradicated sensu strictu.

Three administrative structures have been applied. These are (a) a "Council" or "Commission" working under a specific act of parliament; (b), Ministry of Health and (c) Ministry of Agriculture. The first-named almost invariably relies on funding from the dog licenser to implement the plan; whereas the government authorities rely mainly on funding from the legislature. This results in different emphasis being placed on control activities and time spent in the "Attack" phase. Nevertheless, a strong "Attack" on the parasite in animals irrespective of structure invariably leads to an early reduction of echinococcosis in children and adults, thereby giving an early benefit for the whole community. Councils tend to place emphasis on dog dosing and measure progress with arecoline surveillance but, with limited access to animal health legislation can rarely implement surveillance of the parasite in food animals and cannot transform from the "Attack" to the "Consolidation" phase. Consequently, the "Attack" phase may last for 30 to 50 years (e.g., New Zealand). Policies applied by a Ministry of Health involve dog dosing but, utilize some of the resources on surveillance of human echinococcosis and with limited access to animal health legislation may also have similar difficulties in transforming from the "Attack" phase (e.g., Province of Rio Negro, Argentina). With respect to control applied by a Ministry of Agriculture, the resources are firstly directed to dog testing (e.g., Tasmania, Cyprus) or dosing (e.g., Region XII, Chile) with surveillance of the parasite in food animals and an early transformation from the "Attack" to the "Consolidation" phase and quarantine of infected premises. Here, the "Attack" phase can be completed in 10 to 15 years when (a) a positive euthanasia policy is applied to dogs (e.g., Cyprus) and when (b) a 6-weekly dog-dosing programme is implemented (e.g., Region XII, Chile). Gemmell concluded that base-line surveys in humans and animals leading to a benefit-cost approach to control in the "Planning" phase together with an accurate surveillance programme in humans and food animals in the "Attack" phase is essential if support is to be generated and then retained by the Legislature to fund the programme until the "Consolidation" or "Maintenance of Eradication" phases have been reached.

Cost-effectiveness analysis can be an important and useful tool for planners of echinococcosis control programs. Dr. Schantz read a paper prepared with colleagues at CDC in which they argued that the objective of planners should not be to just ensure a financially feasible control program but rather to choose the best control program from various possible alternatives. Cost-effectiveness analysis provides quantitative information for the planning process. It makes explicit the alternatives available and the assumptions made in the planning process. Cost-effectiveness analysis can also be used for on-going evaluation of control
programs to identify potential improvements in efficiency or effectiveness. A cost-effectiveness study of control programs should consider all costs regardless of who pays for them (i.e., a societal perspective); the net cost of control will equal the cost of the control program itself minus the cost of disease prevented by the control program. In an era when resources are very limited and governments desire to use their resources more wisely, cost-effectiveness analysis can play an important role in highlighting those programs that achieve the most for the resources expended.

Country Reports

Dr. Daniel F. Orlando, Director, National Honorary Commission of Hydatid Disease Control, Montevideo, pointed out that the annual diagnostic incidence of human hydatid disease in Uruguay, based on review of all hospitals in 1993 was 12.4 per 100,000 population. This is down from an average of 18-21 per 100,000 in the 1960s; however, the incidence in 6 departments in the rural interior is still greater than 20. The program of the Commission was expanded in 1991. Examination of a nationally representative sample of dogs revealed infection in 10.7%. Recent infection rate in adult sheep was 33.9%. The country was divided into 5 regions which were prioritized according to prevalence and need for intervention. Intensified activities include praziquantel treatment of all dogs every 30 days. These activities are supported by strong health education and funded by increased revenue from more complete dog registration.

In Argentina, for many years, the national incidence of human hydatid disease has varied from 1 to 2 per 100,000 population; three regions of the country have been noted to have a much higher rate of infection: Patagonia, the humid pampa, and the littoral region. In these regions, incidence in humans varies from 32 to 66 per 100,000. Dr. Edmundo Larrieu, Chief of Zoonoses Control, Rio Negro Province, described the current status of control programs. Nearly two thirds of the "hyperendemic" areas are now subject to control programs, however, most have been initiated only recently. In Rio Negro Province, from 1979-1991, control intervention implemented by the health department included systematic praziquantel treatment of dogs every 6 weeks, administered by public health sanitarians. The results of the program were monitored by surveillance in dogs (arecoline purge test), sheep and other animal intermediate host (in slaughter houses), and humans (active screening and case notification). Since initiation of control activities, canine echinococcosis has been reduced 90%, hydatidosis in sheep by 79% and, in children to age 10, by 93%.

In Chile, the national incidence of human hydatid disease has been rather stable in recent decades at about 7-8 cases per 100,000 population. The incidence in southern regions
of the country was much higher than the national average: between 50 and 72 per 100,000 and from 60-80% of sheep were reported infected at slaughter. Dr. Macarena Vidal of the Ministry of Agriculture, Santiago, described the progress in control programs initiated during the 1980s in the XII and XI regions of southern Chile. These programs, covering regions which contain about two thirds of the nation's sheep, were implemented by the Federal Ministry of Agriculture and were based on treatment of all dogs every 45 days by veterinary staff. Control of animal slaughter on individual farms and commercial abattoirs, and health education. In the XII regions, the prevalence in adult sheep declined from 60% to 5%; infection in dogs declined 71% to 5% in areas of highest initial rates of transmission. In the XI region, prevalence in adult sheep declined from 100% to 53% and in dogs from 54% to 6.5% in the 8 years since initiation of the program (1982-1989). These programs have now entered the consolidation phase with extended intervals between dog treatments and careful surveillance to monitor the situation.

Dr. Salgueira Nunes, Ministry of Agriculture, State of Rio Grande do Sul, Brazil, reported that hydatidosis occurs sporadically in many parts of the country but is most highly prevalent in the major livestock producing region in the state of Rio Grande do Sul. This state has about 9 million sheep, which is nearly half of Brazil's total ovine population. From 1977 to 1993 the rate among 5.7 million slaughtered sheep was 19% and, among 14.6 million cattle, was 31%. The economic losses due to condemnation of cattle livers average $564,532 U.S. dollars per year. A survey of about 5000 dogs in 1983 using arecoline purge tests revealed echinococcosis in 26%; at least 1 dog was found positive in 37% of properties. Human infection is also concentrated in this state; between 1973-84 an average of 47 cases were reported each year. In 1993 a control program was initiated in 30 highly endemic municipalities, mostly along the border with Uruguay. Activities were planned and coordinated by a Commission composed of representatives of the state public health, animal health and education services and are aimed at educating the population and promoting active involvement of the community in parasite transmission.

Dr. Cesar Naquira, "D.A. Carrion" Institute of Tropical Medicine, Lima, reported that the national incidence of human cases averaged 2.4 per 100,000 population between 1988 and 1992, which is similar to that of several decades ago. Zones of highest transmission are the Central and Southern Sierra where infection rates in dogs range from 8% to 37% and hydatid cysts are detected at slaughter in 5% to 29% of sheep, 3% to 50% of cattle, and 3% to 9% in pigs. Initiation of control programs in two localities in the Central Sierra in the mid-1970s appeared to have been somewhat successful in reducing transmission, however, they were discontinued due to political violence.
In the third module, a plan of action for the Americas was presented and discussed.

RECOMMENDATIONS

1. **Surveillance of dog populations for *E. granulosus***

   Arecoline dosing of dogs and subsequent examination of the purge for adult worms is currently the most widely used method for the ante mortem diagnosis of canine echinococcus. This method has a variable and sometimes very low sensitivity of about 40%, it is time consuming, stressful for the dogs and poses a biohazard for the persons involved in the examination. Coproantigen detection by ELISA has a high specificity of over 95% for the genus *Echinococcus*. The overall sensitivity is around 75%, and increases to over 90% in dogs with worm burdens of over 100. This technique is simple to perform, and the biohazard risk is low. Detection of serum antibodies (IgG) by ELISA has a low sensitivity of about 35% and is not correlated with the number of worms in the intestine.

   The group recommends the performance of a study in the initial phase of the control programme for the comparative evaluation of arecoline testing and coproantigen detection. The results of this study will allow programs to choose whether to continue using arecoline purgation or to adopt coproantigen assays. Further serological studies might be of interest for assessing *Echinococcus* exposure of dog populations.

2. **Role of screening for human hydatid disease in control programs.**

   Great improvement in methods for screening human population for echinococcosis have been achieved. The current method of choice is portable ultrasound which provides the most sensitive and specific non-invasive diagnosis available and provides useful information on prevalence of human echinococcosis. Serologic techniques are very useful for further confirmation of ultrasound findings. Used by themselves, serologic techniques, specifically screening with a standardized ELISA later confirmed by more specific tests such as immunoblot assays or tests for arc 5, also provide a useful measure of exposure to echinococcosis; additional clinical examinations are necessary, however, to determine the actual presence of cysts. Whatever methods are used, screening must be performed with full regard for prevailing ethical standards and with provision for further clinical diagnostic studies and treatment of detected cases. Screening techniques are useful tools for prevalence...
surveys and epidemiologic studies. They also have potential value for monitoring the results of control programs, for screening cases of early, asymptomatic infection, and for evaluating efficacy of treatment of detected cases. The decision to include screening as part of a control program should be made carefully, taking into consideration the total resources available program and the costs and benefits associated with this activity.

3. Quality Control of Praziquantel

With recent proliferation of manufacturers of praziquantel, the Programs must be aware of the need for official or reference laboratory quality control of the drug to assure efficacy of new products used in the program.

4. Organization of Epidemiological Data

Epidemiological and operational data handled by Echinococcus Programs need to be uniformly and systematically collected and analyzed to allow comparable evaluation. Instead of developing new and parallel systems, consideration should be given to adapting these systems already in place. For example, a geographic information system based on cartographic quadrants has been developed for epidemiological surveillance of foot-and-mouth disease and other animal diseases in Latin America and the Caribbean. The system is currently operational in countries where echinococcosis is endemic.

5. Characterization of Local Strains of *Echinococcus granulosus*

Genomic characterization of strains of *Echinococcus granulosus* is an important component of epidemiological surveillance when control programs are initiated. The use of these techniques in the Region requires the development of a reference laboratory, with the responsibility for development of the techniques and training.

6. Inter-Sectorial Collaboration in Control Programs

Control of cystic echinococcosis requires joint multidisciplinary efforts, therefore, it is strongly recommended that Control Programs are organized and conducted with inter-sectorial and inter-institutional participation, particularly between health and agricultural agencies.
7. Operational Research Requirements

The ongoing activities of echinococcosis control require, clarification of diverse epidemiological and operational aspects. At present, research is recommended in the following:

- Characterization of the role of local stray dogs in transmission of echinococcosis.
- Identification of socio-cultural factors that could hamper progress of control programs.
- Identification and evaluation of new ways of dog population control, including chemical sterilization, induction of autoimmunity to hypothalamic hormone, and others.
- Alternative schedules of drug administration to dogs under different dog management.
- Evaluation in field trials of EG95 and other candidate vaccines for echinococcosis.
- Cost/benefit and cost/effectiveness analysis for program planning and operation.
- Definition, through field investigation aided by mathematical modelling, of the epidemiological status of echinococcosis in animals during the "planning" phase so that the most cost-effective control measures can be determined.

8. Promote Involvement of Local Academic Personnel in Research

Having established priorities for operational research needed to support the planned intervention strategy, the echinococcus Program should encourage and promote the involvement of local universities and academic personnel in collaborative research projects, thus maximizing the efficiency of the research process.
AGENDA

October 26
- Opening ceremony.
- Objectives and methodology

FIRST MODULE: General Review on Echinococcosis/Hydatidosis.
- Echinococcus spp.: biology and strain variation (Prof. J. Eckert)
- Immunobiology and vaccination. (Dr. M.W. Lightowlers)
- Immunodiagnosis. (Dr. P. Craig)
- Clinical diagnosis and treatment. (Dr. Z. Pawlowski)
- Epidemiology: Global distribution and modes of transmission. (Dr. P.M. Schantz)

October 27

SECOND MODULE: Control Programs Overview and Country Reports.
- The Cyprus model. (Dr. K. Polydorou).
- North and Central America. (Dr. P. Schantz)
- Argentina. (Dr. E. Larrieu)
- Brazil (Dr. S. Silveira)
- Chile (Dr. M. Vidal)
- Peru (Dr. C. Náquira)
- Uruguay (Dr. R. Ugarte y Dr. R. Perdomo)

October 28

THIRD MODULE: Development of Plan of Action
- Overview of successful approaches to control of Echinococcosis. (Dr. M.A. Gemmell)
• Prevention and control: Analysis of costs and benefits. (Dr. M.A. Gemmell, A. Haddix)
• Proposed strategic plan. (Dr. E. Larrieu)

- Conclusions, and recommendations.
- Presentation of final report.
- Closing ceremony.
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