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HYDATIDOSIS CONTROL (MEDITERRANEAN COUNTRIES)

Report on a WHO Meeting

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1. Introduction

The European Meeting on Hydatidosis Control (Mediterranean Countries) was convened in Fez from 13 to 15 October 1980 by the WHO Regional Office for Europe, at the invitation of the Government of Morocco. The objectives of the Meeting were as follows:

- to report on the epidemiology and control of echinococcosis/hydatidosis in the Mediterranean countries and make a comparative review of the situation elsewhere in the world;
- to identify the constraints which have hampered control efforts up to now, and make recommendations for strengthening the national programmes according to the specific conditions in each country, with emphasis on general and specific surveillance measures and procedures for prevention and control;
- to discuss aspects of echinococcosis treatment in man, including diagnosis, chemotherapy and surgery;
- to assess the needs for international technical cooperation/coordination among countries, and specify the tasks of the UNDP/WHO Mediterranean Zoonosis Control Centre in Athens.

The Meeting was opened by Dr R. Rakhali, Minister of Public Health of Morocco, in the presence of Mr M. Mrani, Governor of the Province of Fez, and Dr Marsile, Director of Animal Husbandry, on behalf of the Minister of Agriculture.

There were 25 participants from 12 Mediterranean countries, 4 observers from Morocco and 5 representatives from other organizations. Technical support was provided by 3 temporary advisers/discussion leaders and 5 members of the secretariat (see Annex III). The participants presented statements on the epidemiology and control of echinococcosis/hydatidosis in their respective countries (see Annex II). A summary report for the Mediterranean area is attached as Annex I.

2. Distribution, prevalence and epidemiology in different parts of the world

2.1 Introduction

Echinococcosis, hydatidosis or hydatid disease are terms applied interchangeably to infection caused by the larval stages (metacestode) of members of the cestode genus Echinococcus.

2.2 General description of the parasite

Echinococcus species are small tapeworms, rarely attaining more than 7 mm in total length. The number of segments comprising the strobila varies from two to six according to species. The larval stage (metacestode) is a cyst with an acellular laminated layer and a thin germinal layer, which gives rise by asexual budding to brood capsules and then protoscoleces. Echinococcus species require two mammalian hosts for completion of their life cycle.

2.3 Species of the genus Echinococcus

Four species of the genus Echinococcus are recognized: Echinococcus granulosus, Echinococcus multilocularis, Echinococcus oligarthrus and Echinococcus vogeli.

2.4 Echinococcus granulosus

The adult worm varies between 2 and 7 mm in length and usually possesses three or four segments. The larval stage is usually a fluid-filled unilocular cyst, although not necessarily symmetrical, and its growth is expansive.

2.4.1 Distribution and host range

E. granulosus has the lowest intermediate host specificity of the four species, and hence it has a broad geographical distribution.

This species causes classical cystic hydatid disease in man. The life cycle is perpetuated primarily in a domestic cycle involving the dog (Canis familiaris) as the definitive host, and domestic ungulates (e.g. sheep, cattle, pigs, goats, horses, camels) as the intermediate host.

2.4.2 Strain differences

Populations of E. granulosus from different geographical regions show biological differences which may have important epidemiological implications. For example, a North American sylvatic strain does not readily infect domestic ungulates, but it occurs in wolves and wild ungulates. In Great Britain, a horse/dog strain of E. granulosus occurs, and in the Soviet Union parasites with a sheep/dog cycle or a pig/dog cycle occur.

In India, a dog/buffalo strain may occur, while in North Africa and the Middle East E. granulosus may be more highly adapted to camels than to other intermediate hosts.

Strain characteristics may influence local patterns of transmission and health significance; hence, it is important to demonstrate and characterize such strains.

2.4.3 Prevalence in animals

The adaptability of E. granulosus ensures a broad geographical distribution.

In Europe, the highest prevalence in animals (and humans) is in countries adjacent to the Mediterranean Sea (e.g. Greece, Italy, Spain, Yugoslavia) where the dog/sheep cycle is dominant. In parts of western Europe, Great Britain and Ireland, the cestode is prevalent in a dog/horse cycle, but appears to account for little human morbidity. A sheep/dog cycle is also present. In some countries of Europe (e.g. Belgium, Federal Republic of Germany, Switzerland), a dog/cattle cycle seems to predominate. A dog/pig cycle is prevalent in several eastern European countries (e.g. Hungary, Poland) and in the Soviet Union (e.g. Byelorussian SSR and Ukrainian SSR). The infection is widespread throughout the remainder of the Soviet Union in the dog/sheep cycle.

In most Middle Eastern countries, infection is hyperendemic in sheep, camels, goats and donkeys. High prevalence occurs in India, Iran, Nepal and Pakistan. In North Africa (e.g. Algeria, Egypt, Libya, Morocco and Tunisia), high prevalence is reported and host-parasite relationships are similar to those in the Middle East.

2.4.4 Prevalence in man

Few global prevalence data on human hydatid disease exist. A morbidity rate of 20.7 per 100 000 population indicates that Uruguay has the highest national morbidity rate for hydatid disease. Other high national figures include 12.9 per 100 000 in Cyprus (before the disease was controlled), 7.8 in Chile, 7.5-8.3 in Greece, 5.1-6.1 in Algeria and 3.7 in Yugoslavia. However, infection rates expressed at the national level do not reflect the true importance of the disease because all populations are not at equal risk.

The use of radiological and serological diagnostic methods shows that symptomatic hospital cases represent only a fraction of total infections.

2.5 Echinococcus multilocularis

The adult worm varies between 1.2 and 4.5 mm in length and possesses from two to six segments. The larval stage is a multivesicular infiltrative structure which proliferates by exogenous budding (alveolar hydatid).

2.5.1 Distribution and host range

E. multilocularis is limited largely to a holarctic distribution, but is spreading southward. Intermediate host specificity is relatively high and, apart from man, infection with the larval stage is confined to rodents. This species is mainly perpetuated in a primary sylvatic cycle involving foxes and rodents. Domestic dogs and cats occasionally enter into the cycle.

2.5.2 Prevalence in animals

E. multilocularis is limited to the northern hemisphere. An endemic region occurs in central Europe (southern and north-eastern France, Switzerland, southern Germany), Bulgaria and Turkey through to the Soviet Union and extending to several of the Japanese islands and western Australia. Recent reports now include Greece, Czechoslovakia, northern Iran and India.

In North America, the distribution corresponds closely to that of the arctic fox.

2.5.3 Prevalence in man

Few data exist. Cases occur in parts of the Soviet Union, northern Japan, western Alaska and central Europe. An annual mean incidence of autochthonous cases of 0.14 per 100 000 population during 1965-69 is reported from Switzerland.

2.6. Echinococcus oligarthrus

The adult worm is 1.9-2.9 mm in length and possesses three segments. The larval stage is polycystic.

2.6.1 Distribution and host range

E. oligarthrus occurs in central and South America and uses wild felids as definitive hosts. The agouti and possibly other rodents serve as intermediate hosts. No human infection due to E. oligarthrus has been reported.

2.7 Echinococcus vogeli

The adult worm is 3.9-5.6 mm in length and usually has three segments. The larval stage is similar to that of E. oligarthrus. E. vogeli occurs in the central and northern parts of South America, with the bush dog and the domestic dog as definitive hosts and pacas and possibly other rodents as intermediate hosts. The larval stage causes a polycystic form of hydatid disease in man.

2.8 Epidemiology

The life cycle of Echinococcus species is complex, involving two hosts and a free living egg stage. The dynamics of transmission of the parasite are determined by the interaction of factors associated with these two hosts and with the external environment.

2.8.1 Proglottids and eggs in the external environment

Under favourable conditions, expelled proglottids may remain active for a few days. They perform rhythmic contractions and relaxations that assist egg expulsion and may disperse the segments considerable distances from the faecal mass. The majority of eggs remain free in the faeces, but evidence is accumulating that considerable dispersion of eggs occurs within a short time of deposition. Eggs of T. hydatigena have been shown to spread up to 80 m in only 10 days, and other observations suggest that small numbers are dispersed much further. This dispersal enhances the chances of eggs being ingested. Agents responsible for this dispersion have not yet been identified. Wind may account for some movement of eggs, but birds, flies, beetles and ants would seem to be the most likely to be involved.

3. Evaluation of economic aspects of hydatid disease and its control

3.1 Introduction

It is advisable to secure reliable information on the prevalence of hydatidosis in humans and farm animals of the country or region concerned. These data should come, if possible, from official sources, but unofficial sources should be taken into consideration when available. If the problem is recognized as an important one, an attempt should be made to obtain a gross evaluation of the cost of the disease, so as to be able to determine its priority among the different health, economic and social problems affecting the area.

3.2 Cost of the disease in man

The cost of the disease in humans should be determined by considering the infected persons who have to be treated surgically, with consequent cost for surgical treatment, need for hospitalization (about two months per operated person) and pressure on the hospital system. The infected person also loses an average of four working months, and some mortality and varying degrees of permanent disability ensue.

3.3 Cost of the disease in animals

The cost of the disease in animals is high, and in highly infected areas may have a significant influence on the economy. Investments in echinococcosis/hydatidosis control must be seen not only as investments for health but also for the economy.

3.4 Control campaigns

A control campaign may be directed towards the human population in order to control dogs and farm animals. Even though all these actions are necessary for a complete programme, good results may be obtained by the application of one or a few of them.

Financial investment in health education is necessary for any control programme. A reduction of costs may be obtained by appropriate planning and by international cooperation.

Surveillance of the exposed human population may identify otherwise undetected cases, and the cost of treatment of such cases at an early stage may be reduced. Combination of the programme with other mass surveillance programmes could also reduce the cost of surveillance.

Control of the dog population is essential to the programme; registration/licensing fees may contribute to its funding.

Dog treatment with the new drugs offers new and less costly approaches to a control programme. Combination with other programmes may reduce costs and enlarge the possibilities of veterinary supervision.

Control programmes for echinococcosis/hydatidosis need a medium-term perspective to show their benefits and must be associated with continuing programmes to raise the health, agricultural and economic standards of the area. Side benefits of a control programme are often as important as the control itself.

4. Review of work carried out by WHO, FAO, UNEP and other international organizations

During the past few years, meetings, seminars and round-table conferences have been sponsored by WHO, FAO and, more recently, UNEP.

These meetings have brought together workers in research and control and thereby provided a means for collaboration between groups, particularly those previously working in isolation.

In addition, several field trials, pilot projects and control programmes have been successfully launched, and they now provide valuable information on methods and practices to be used in other countries after adaptation to local conditions and factors.

Echinococcosis/hydatidosis has been identified as one of the priority zoonoses within the Mediterranean zoonoses control programme.

4.1 Research

WHO is coordinating worldwide research in which more than 20 institutions participate and has published the results in its WHO Bulletin and other journals. In particular, it issued memoranda on research needs in echinococcosis/hydatidosis in 1968, and in taeniasis/cysticercosis in 1976.

Arrangements were under way for a World Congress on Hydatidology, to be convened in Algeria in 1981 by the International Association of Hydatidology, which is a nongovernmental organization in contact with WHO.

An FAO/UNEP/WHO expert consultation on cysticercosis/taeniasis and echinococcosis/hydatidosis surveillance, prevention and control (Warsaw, 1978) recommended that research projects be elaborated on the control of these diseases in East Africa and on the role of camels in human hydatidosis. The projects have been elaborated and are being used by research workers, but concerted action has not yet been initiated due to the lack of funds.

The Veterinary Public Health Unit of WHO headquarters has started a study on intersectoral cooperation as part of WHO health services research. It is being carried out in close cooperation with Portugal and other countries. The food hygiene and anti-zoonoses programmes will receive highest priority. Ministries of health, agriculture, trade, tourism, industry, etc., and their respective services are the target sectors. An application has been made for UNDP financial support for the period 1982-1986 and a positive response is expected. The research concerns the two most important sectors, namely health and agriculture, which will receive highest priority in UNDP plans in the future.

The results of the above research will become part of WHO efforts to elaborate principles of basic law on veterinary public health, which should be drafted in such a way that they can help in the elaboration of national laws and legislation in this field.

4.2 Practical guides for echinococcosis/hydatidosis control

As a follow-up to the World Health Assembly resolution WHA31.48 on the prevention and control of zoonoses and foodborne diseases, which, inter alia, requested the Director-General of WHO to continue "the development of national, regional and global strategies, and of methods for the surveillance, prevention and control of zoonoses", several practical guidelines have been or are being elaborated, namely: guidelines on surveillance, prevention and control of echinococcosis/hydatidosis; prevention of health risks caused by animals in urban areas; operation of small slaughter-houses and the handling of meat under primitive conditions in remote rural areas. Within the FAO/WHO food standards programme, codes of hygienic practice have been elaborated and adopted on fresh meat, processed meat, ante- and post-mortem meat inspection and judgement of meat.

4.3 Information system

There is an urgent need to improve the WHO information system in veterinary public health. The health sector is well informed through WHO official channels, but communication systems between WHO and directors of veterinary services, as well as schools and institutions, leave much to be desired. The WHO Weekly epidemiological record is increasingly used to report on veterinary public health activities, but a newsletter or similar publication in this field is highly needed.

5. Recent advances in biology of echinococcosis with reference to systematics, physiology and immunology

5.1 Systematics and strain differences

Studies of populations of E. granulosus recovered from different host species and in different geographical regions have demonstrated considerable intraspecific morphologic variation as well as biological differences, and these may have important epidemiological implications. Because of self-fertilization and polyembryony, mutations are more readily translated into new clones of organisms which may be established in "unusual" hosts.

5.2 Experimental transmission

The purpose of study in this field should be to determine if E. granulosus populations recovered from one intermediate host species will infect other intermediate host species. Hydatid cysts collected from one intermediate host species should be fed to dogs, and the gravid proglottids collected from them can then be used to infect animals of the same and other intermediate host species. For example, the following transfers should be carried out in an investigation of the relationship of camel and sheep hydatid:

	Camel
Camel - dog	Sheep
	Sheep
Sheep - dog	Camel

Such studies, however, are costly and time consuming and in vitro approaches are indicated.

5.3 In vitro growth and development

Recent work has shown that the "sheep" strain may be readily cultured to sexual maturity in vitro, using a disphasic culture system. However, when the identical culture system was used with the "horse" strain, the worms failed to differentiate into sexually mature forms although they survived in culture for long periods. This indicates a major basic difference between the "horse" and "sheep" strains, although the exact mechanism for the difference remains unknown.

Characterization of local strain differences among E. granulosus populations in North Africa and the Middle East using the in vitro growth techniques would be a useful approach to the study of strains of the organisms.

5.4 Biochemical studies

Another approach to the characterization of differences between E. granulosus strains has been comparison of the chemical components of homogenized protoscolices. Preliminary studies have demonstrated apparent differences between the "horse" and "sheep" strains in soluble proteins, isoenzymes of nonspecific esterases, polysaccharides, lipids, DNA and RNA. Carbohydrate

metabolisms of the two strains may also differ. It is not known, however, how much the age and metabolism of the hosts may influence the chemical composition and metabolism of the parasites and, therefore, further work is required to demonstrate the usefulness of this approach. Characterized *E. granulosus* strains in North Africa and the Middle East might be attempted with parasite material from cattle, camels, sheep and other animals.

5.5 Immunological studies

Improved serodiagnostic techniques such as ELISA, which use small amounts of antigen and are often more sensitive and specific than hitherto, offer better means of diagnosis. These, no doubt, will be applied increasingly in the diagnosis of human hydatidosis. Furthermore, the ELISA test is useful for other diseases, and it is relatively easy to adapt it for hydatidosis.

5.5.1 Immunization

With related species, *Taenia ovis* of sheep and *T. raginata* of cattle, good progress has been made in the stimulation of passive immunization and also active immunization of young animals. Antigens derived from activated embryos give high levels of immunity. It has now been demonstrated that heterologous antigens can be used, and it is possible that such approaches will in due time be applicable to hydatidosis.

6. Short review of successful projects

During the past 20 years, control programmes have been successfully introduced in Argentina, Bulgaria, Cyprus, the Falkland Islands, Iceland, New Zealand, Peru, Soviet Union (parts), Tasmania and Uruguay.

During this period, much new information has been accumulated and has increased the chances of control action being successful.

6.1 Structure of control programmes

The structure of different control programmes varies considerably. For instance, the creation of a special hydatid authority was the approach used in New Zealand and Uruguay, while development within existing governmental agencies was the approach used in Cyprus, the Falkland Islands and Tasmania.

Governments have established their priorities and targets by choosing between the following alternatives.

(a) Priorities

- Starting operations in a pilot area and then extending the programme (Latin America).
- Starting operations immediately on a national basis (Cyprus).

(b) Targets

- Development of slaughtering facilities (Latin America).
- "Arecoline surveillance" and construction of on-farm slaughtering facilities (New Zealand and Tasmania).
- Massive reduction of dogs and construction of village slaughter-houses (Cyprus).

Collection of baseline data is necessary for all programmes.

6.2 Current schemes

There are three main options:

- (a) prevention of dogs gaining access to infected offal;
- (b) reduction of the parasite biomass by reducing the overall and the infected dog population by:
 - reducing the number of surplus dogs (Cyprus);
 - killing infected dogs (Uruguay);
 - mass dog dosing with arecoline (Argentina and the Falkland Islands) and now with the more modern drugs that are available;
- (c) prevention of the introduction of disease to free countries or areas.

7. Collection of epidemiological baseline data prior to initiation of control programmes

7.1 Introduction

Surveys by medical, veterinary, social and anthropological scientists are of importance to obtain information upon which sound judgments can be made as to the significance of echinococcosis. The objectives of surveys include that of baseline data and an insight into the processes of transmission and the causal relationships.

7.2 Vital statistics on human and livestock populations and agricultural practices

Vital statistics that should be collected include data on:

(a) the total human and individual livestock populations:

- of the statistical divisions of the country or of those areas in the country where hydatidosis has been regularly observed;
- of the proposed (pilot) control area;
- of urban and rural areas;

(b) the relative frequency of human parasitosis and zoonoses prevalent in the country or in the selected control area;

(c) the number of:

- farms carrying out home slaughter;
- slaughter-houses and/or meat packing plants with and without veterinary inspection;

(d) the number and proportion of food animals of the different species that are sacrificed in slaughter-houses with official inspection;

(e) the estimated canine population and its geographical distribution.

7.3 Measurement of infection prevalence in man

The levels of infection in human populations can be measured from:

- hospital diagnosed cases;
- mass miniature radiography;
- autopsies;
- sero-epidemiological surveys.

Each method has limitations.

7.3.1 Hospital cases

An estimate of the public health problem of echinococcosis may be obtained by a survey of hospital cases. Although these represent only that proportion of infections that reaches medical attention, the annual rates of hospital cases, when properly compiled, provide useful data for assessing the significance of echinococcosis and, when measured continuously over several years, for detecting regional changes in infection incidence.

In some countries where hydatid disease is notifiable, the hospital disease reporting system may be sufficiently complete to allow the annual numbers of cases to be obtained from a central reporting organization. Examples are the data obtained from Cyprus, New Zealand and Tasmania. A practical method is to determine retrospectively and completely the annual number of cases that have occurred over several years. The retrospective survey must include visits to all hospitals and clinics in order to obtain a representative sampling.

The data can be expressed as the annual rate of new hospital cases (surgical cases only or total patients per 100 000 rural and/or total population). For epidemiological purposes, the rates should be broken down by age, sex, ethnic group, residence and occupation, etc. Groups can be identified in which transmission is well above the average and, once identified, causal relationships can be investigated. It is becoming increasingly evident that human behaviour plays an important part in the epidemiology of transmission of echinococcosis.

7.3.2 Mass miniature radiography (MMR)

Mass radiological surveys, though generally used only under special circumstances for other purposes, may be helpful to determine the prevalence of echinococcosis. Factors that complicate the interpretation and reduce the usefulness of MMR include its limitations in differentiating space-occupying lesions, and its use is restricted to the area covered by the plate. The real value of MMR is that it can serve as a primary screening tool in the detection, for example, of asymptomatic lung-cyst carriers. These can then be referred to medical centres for further evaluation and inclusion in hospital records following identification of the parasite.

7.3.3 Autopsy series

The true prevalence of echinococcosis within the human population can rarely be satisfactorily determined. However, with good autopsy surveillance, it is possible to obtain satisfactory retrospective approximations of the true prevalence from autopsy series. In countries where autopsies are mandatory, it is possible to determine retrospectively the true prevalence of the disease and, thus, the effectiveness of the control programme.

7.3.4 Sero-epidemiological surveys

Immunodiagnostic surveys are potentially useful for estimating the true prevalence of echinococcosis within specific populations. Not all cases will be positive in serodiagnostic tests, but, where hospital data are incomplete, they may be the only way of measuring prevalence. Good sampling procedures are very important.

The selection of any immunodiagnostic test as a screening tool to detect hydatid cases should be based on its simplicity, high sensitivity and specificity. It is generally recognized that intradermal (Casoni) tests using antigens from hydatid cyst fluid have very little, if any, value in epidemiological surveys on human echinococcosis. They should be replaced by more sensitive tests.

7.4 Measurement of infection prevalence in normal animal hosts

7.4.1 Livestock at commercial killing establishments

Surveys of prevalence of echinococcosis in livestock are important for making comparisons within and between regions and for determining the significance of each type of animal in the continuity of the life cycle. Examination of livers and lungs at autopsy remains the only practical way of obtaining the data. Good design and sampling procedures are important, and the samples should be large enough to ensure that appropriate comparisons can be made. The information required includes details of:

- geographical distribution;
- age-specific prevalence;
- liver/lung ratios;
- fertility of cysts.

Often, there is doubt concerning the origin of animals, and the data should then be excluded in the analysis of geographical distribution. Care must be taken to ensure that E. granulosus is positively identified. Of particular importance is the differentiation of E. granulosus from T. hydatigena in sheep livers.

7.5 Dogs

Surveys on E. granulosus in dogs are fundamental in determining the factors involved in transmission and causal relationships involving infection in man.

7.5.1 Autopsies

The most accurate indicator of prevalence and variation in the infection pattern of adult E. granulosus in dogs involves necropsy of the small intestine. However, it is often not possible to obtain sufficient animals of each class of dog to evaluate the epidemiological factors involved or causal relationships for infection in man. The method has most application as a survey tool where feral and unwanted dogs are available, provided these are the most important animals.

7.6 Arecoline surveys

The limitations and value of treating dogs with arecoline hydrobromide in surveys on echinococcosis are now well known.

Despite the limitations, these surveys, if combined with sociological surveys, can be very useful in determining the epidemiological and sociological factors involved in transmission and the causal relationships for varying infection rates between ethnic and other social groupings in the human population. Furthermore, an estimate of the infective pattern (variability in worm counts) may reveal groups of dogs which are highly susceptible to infection, thereby increasing the infection pressure above the average.

Standardization of the technique is important if comparisons are to be made between the various factors considered to be important. For the survey data to be meaningful, they should be accompanied, inter alia, by information on the following factors:

- methods used for treating the dogs;
- interval between treatments;
- the thoroughness with which doubtful samples have been eliminated from the analysis;
- the amount and type of material examined;
- the method used to separate worms from faeces;
- the visual aids used to examine the samples.

8. Prevention and control of infection

Prevention and control are based mainly on the following types of action.

8.1 Action on dogs

This includes dog census by category, control of stray and wild dogs, treatment of dogs, control of wolves (when advisable) and other carnivores.

8.2 Action on domestic food-producing animals

This includes proper disposal of infected offal from within and from outside slaughter-houses.

8.3 Action on wild animals

To avoid infection of wild animals, there should be proper disposal of infected offal and, when advisable, control of wild carnivores.

8.4 Action on humans

This should include serological or, where deemed essential, radiological screening of the population at risk (occupational, geographical, etc.); the education of butchers, dog owners, hunters and other persons who may have special responsibilities in the spread of the disease; the education of consumers (proper treatment of vegetables, risks in dog feeding, hand washing, etc.) and of school-teachers and children.

8.5 Action on health personnel

This should include measures to inform the medical profession on the importance of the disease in man; the veterinary profession on problems at the slaughter-house level, problems involving dogs, and occupational hazards; and dog-pound personnel on problems connected with dogs and occupational risks. For this purpose, butchers should be considered as health personnel.

8.6 Action at the political level

The attention of politicians and administrators should be drawn to the social consequences of echinococcosis/hydatidosis, the economic consequences, and the need for adequate slaughter-house and dog control systems. Additional improved health education programmes are necessary. Of particular importance is the need for an adequate veterinary public health system.

9. Safety precautions

The eggs of the Taenia echinococcus are highly resistant and may remain infective for long periods in the environment. Although several studies have assessed the action of numerous chemicals on the eggs, heat remains the only reliable and effective method for killing them. The eggs are killed by boiling water or dry heat and incineration.

All personnel handling dogs and other carnivores known or suspected to be final hosts of Echinococcus species in endemic areas should be aware of the health risk both to themselves and to the general public. This applies with special force to personnel involved in echinococcosis

surveys and control programmes. Concentration of eggs may occur on dog-dosing sites, in laboratories undertaking the diagnosis of tapeworm infections and in kennels which keep dogs infected with the organism. In these situations, physical methods for lowering the concentration of eggs must be applied. In addition, workers must be adequately protected with appropriate clothing.

Personnel engaged in echinococcosis surveys should at all times wear appropriate protective clothing, i.e. boots, gloves, masks and overalls. In situations in which faeces are being collected from potentially infected dogs following arecoline treatment, animals should be confined to a specific area. Subsequently, the ground from which faeces are collected should be dug over or thoroughly decontaminated by burning. Faeces should be rendered safe in the field by being boiled.

Animals autopsied in the field or in the laboratory should be buried deep or incinerated. Intestines of potential definitive hosts should be ligated before removal from the carcass in order to prevent the dissemination of infective material.

10. Prevention of infection in slaughtering animals

There is evidence that abattoirs have played an important and positive role in the control and eradication of many animal diseases including zoonoses, their original and primary task being to interrupt cycles of pathogenic agents and assure a wholesome supply of meat and other products to the community. On the other hand, when abattoirs are not properly operated and supervised, they may substantially contribute to a deterioration of the environment, for example through inadequate disposal of affected meat or sewage which has not been properly treated.

All hydatidosis control programmes regard the prevention of dogs gaining access to raw offal as a fundamental measure for the control of the disease. The methods which can be applied depend on the type of slaughtering, namely in large slaughter-houses, small village slaughter-houses or in farms and pastures. The requirements for meeting basic standards are well described in the document FAO/UNEP/WHO guidelines on echinococcosis/hydatidosis surveillance, prevention and control, Geneva, 1980 (VPH/80.23).

With regard to slaughtering, prevention of access of dogs to infested organs and safe disposal of this material, the following areas of collaboration between countries participating in the Mediterranean zoonoses control programme and WHO have been suggested.

(1) Improvement of slaughtering practices

- Development of plans for networks of slaughter-houses in a country.
- Collaboration in development of suitable plans for slaughter-house or slaughter-slab construction.
- Improvement of the quality of meat inspection.
- Collaboration in updating meat inspection legislation.
- Preparation of teaching aids.

(2) Campaigns to prevent the feeding of raw offal to dogs

- Preparation of teaching aids for the education and training of the public, butchers, etc.
- Assistance in preparing legislation.

(3) Safe disposal of condemned infected meat, organs and carcasses

- Collaboration in preparing plans for simple and rapid destruction or disposal practices of infected offal.
- Elaboration of teaching aids.
- Collaboration with countries in establishing complex rendering systems which would include safe collection of condemned offal or cadavers and their safe destruction (production of meat and bone meals for feeding purposes).
- Collaboration in preparing national legislation.

11. Dog control

11.1 Introduction

Stray or feral dogs are the most dangerous to man as regards transmission of diseases, but in some instances, although the number of dogs is large, these animals constitute no danger to man's health because they are properly looked after and well cared for by their owners. In the main, in these instances, all dogs have an owner. Problems arise only in those cases when dogs have no owners and have to cover large distances in order to find food.

11.2 Control of dogs for echinococcosis prevention

11.2.1 Elimination of stray or feral dogs

Strays are the main source of environmental contamination for hydatidosis and the reason for the perpetuation of this zoonosis in a country. There is no alternative but to destroy these dogs by euthanasia, since they serve no useful purpose. It is a responsibility of civilized man to protect himself and his fellow men from the dangers arising from the uncontrolled movement and feeding of these stray dogs. Euthanasia drugs offer a humane approach, but in some countries other ways of dealing with stray dogs have been advocated as, for example, rounding them up, keeping them in kennels and advertising in order to secure owners. These, however, have in most cases proved impractical and costly, and in the end it has been acknowledged that on-the-spot destruction of strays is the most satisfactory method. This holds particularly true in the case of developing countries, which cannot afford to finance people for catching dogs, maintaining them in kennels, advertising, etc. Even countries with advanced economies could not keep up this procedure for long. Thus, it is strongly indicated that, if the problem of echinococcosis is to be properly tackled, all strays have to go - and the most economical, practical and feasible means for this purpose is euthanasia. Special weapons are available, using a tranquillizing or euthanasing dart.

11.2.2 Control of dogs

Even owned dogs may get infected with echinococcosis, contaminate their surroundings and pass on the infection to the family to which they belong and particularly the children, who are more kindly disposed to these animals. The owners of dogs should always keep them under control and be made aware of the ways in which their dogs may acquire Echinococcus infection. Allowing dogs to stray may lead to infection by feeding upon discarded raw offal from slaughtered animals in the neighbourhood. This applies particularly to owned dogs in rural areas (e.g. in sheep production areas) where dead sheep may be discarded in fields or uncontrolled slaughter may be practised.

11.2.3 Birth control of dogs

The number of dogs can be kept at a minimum if stray dogs are destroyed - and thus have no chance to breed if owned bitches are not left unrestrained to wander and mate and if a large proportion of bitches are spayed. In Cyprus, a free-of-charge spaying scheme was initiated at the beginning of the anti-echinococcosis campaign. At present, about 40% of all female dogs are spayed; this has in part been achieved by education as to the increased responsibilities of a bitch owner (pregnancy of bitch, disposal of puppies, etc.) and by the imposition of a considerably higher registration fee for unspayed bitches.

11.2.4 Registration and licensing of dogs

Every dog should be registered and its owner should possess a certificate of registration. This may also be used for recording vaccinations. A fee may be charged for registration.

Special campaign teams are always on the alert, keeping a watch over owners of unspayed bitches, as well as dog owners in general, and ensuring that all dogs without exception are registered each year. These "registration teams" are helped in their task by the local community authorities (village president, teacher, rural constable, local police officers, etc.), who are in a position to know who owns a dog and what he has done with it.

11.3 Responsibilities of dog owners

Within the context of echinococcosis control, but also within that of a more general health protection programme, all dog owners ought to be aware of certain minimum responsibilities towards these animals. It would be useful for any prospective dog owner to be required to know about the most common and most serious diseases of dogs and particularly those transmitted to man from these animals.

11.4 Case study: dog control in Bulgaria

In Bulgaria, dog control is considered as a very important component of the echinococcosis control programme.

While the complete elimination of dogs would be the best solution of hydatid disease, this is generally impractical. The Bulgarian experience, however, shows that a reduction of their number is possible, bearing in mind especially that the number of dogs in rural areas far exceeds the needs. The conclusions to be drawn from this experience are as follows.

The first requirement is generally to provide for dog control by public health legislation, which could at the same time support a rabies control programme. Legislation is needed to ensure that the measures against dogs will be carried out universally and without interruption. In addition, the legislation should give some very important measures a compulsory character.

The principal measures to be carried out include the following.

(1) Registration of all dogs. The number and distribution of dogs must be established, and the necessary and permitted dogs should be identified. The legislation must oblige the owners of necessary and permitted dogs to register them, receiving from the appropriate veterinary public health authority a registration certificate. Owners should not be allowed to have more than one dog.

(2) Reduction of the total number of dogs. This activity should include:

- elimination of all stray dogs;
- elimination of surplus and unnecessary dogs;
- reduction of the number of sheep-dogs to a minimum.

These measures should be carried out very strictly in order to reduce the dog population several fold.

(3) Treatment of dogs. With the introduction of new anthelmintics, the chemotherapy of dogs has been greatly improved. Mass periodic treatment is justifiable to achieve a quick break in transmission in highly endemic situations. This measure must be combined with examination of dogs. Both treatment and examination should be recorded in the registration certificate. Possible contamination of the places where dog treatment and examination are performed should be borne in mind in order to avoid the risk of infection of people and animals. The results of the periodic examinations should be used for evaluation of the effectiveness of the measures carried out. However, comprehensive treatment on a periodic basis requires trained personnel supervised by veterinarians.

(4) Prevention of infection in dogs. Preventing dogs from gaining access to raw infected offal should be considered one of the most crucial measures in an echinococcosis control programme. Its aim is to break the epidemiological chain: intermediate host/definitive host. Hydatid disease would disappear if dogs were prevented from eating the raw viscera of sheep and other animals, so every effort should be made to interrupt transmission of infection from one host to another.

Measures for this purpose are generally on the following lines.

(a) Health education. Its main objective should be to point out to farmers, shepherds, livestock owners and workers at slaughter-houses the dangers of feeding infected offal to dogs.

(b) Restrictive measures:

- owners should not be allowed to have more than one dog;
- owners of permitted dogs should pay a tax which should be high enough to be a burden to most of them;
- owners of dogs with hydatidosis must pay a fee for treatment and diagnostic testing;
- necessary and permitted dogs must be locked up at home, kept in a kennel and taken out only on a leash;
- farm dogs must not approach buildings where sheep are slaughtered.

(c) Punitive measures:

- an owner who fails to register his dog must pay a fine;
- an owner who does not bring his dog for treatment or examination must also pay a fine;
- if on the second diagnostic testing the dog is again positive for hydatidosis, it must be killed.

12. Chemotherapy

12.1 Introduction

The limitations of arecoline hydrobromide as a treatment for adult Echinococcus in dogs have been recognized for some time. With the advent of the newer anthelmintics, especially the benzimidazoles, marked advances have been made in drug screening procedures. However, an understanding of the effectiveness and safety of cestocidal drugs and of the value and limitations of drugs in mass treatment programmes is necessary.

It has become evident that data collected in trials to establish the efficacy of a drug against Echinococcus species may be highly variable. The cestocidal effect of a test drug must be expressed in terms of the proportion of infected animals that have been freed from infection at particular dose rates; estimates can then be made of the dose-response curve. From this, dose rates and/or treatment schedules can be identified to achieve a specific level of effectiveness. In determining the most useful dose rate or treatment schedule, other factors, such as toxicity, must be taken into account. There is a need for general agreement that standard procedures for evaluation should be adopted. Estimates should be made of the 50% and 90% effective dose rates, bearing in mind toxicity.

12.2 Active compounds

Treatment schedules and dose rates required to achieve ED₉₀ against E. granulosus infections in dogs are as follows:

Drug	Number of treatments	Dose rate (mg/kg)
Praziquantel (oral)	1	5
Praziquantel (1/m)	1	5
Praziquantel (5/m)	1	20
Bunamidine hydroxynaphthoate (oral)	3	50
Bunamidine hydrochloride (oral)	3	50
Nitroscanate (oral)	3	250
Fospirate (oral)	3-4	40
Diuredosan (oral)	5	50
Bithionol sulphoxide (oral)	?	?
Streptothrin (oral)	?	?
Oxfendazole (oral)	?	?
Mebendazole (oral)	?	?

Note: "?" means active, but treatment schedules and dose rates not yet determined.

12.2.1 Comments on the more active benzimidazoles

Praziquantel (EMD 29810, EMBAY 8440, Droncit)

Praziquantel is reported to be markedly active against both adult and larval tapeworm infections. Extensive studies have now been made on the pharmacokinetic and other properties of the compound in vivo and in vitro. Investigations on acute, subacute and subchronic toxicity, including teratogenicity, embryotoxicity, perinatal and postnatal toxicity and mutagenicity have shown that it has no important side effects. Many reports confirm the consistently strong lethal effects against tapeworms in dogs and cats.

Estimates of the ED₉₀ for naturally acquired and experimentally induced 28-day-old infections of E. granulosus and E. multilocularis were similar at 2.3 and 2.7 mg/kg respectively. The drug is equally as effective against E. granulosus when administered by the intramuscular route as by the oral route. It is less effective, but still has useful activity, when injected by the subcutaneous route. Preliminary evidence indicates that the drug is effective when incorporated into dog biscuits. Praziquantel is not ovicidal. At present, praziquantel can be regarded as the drug of choice for the treatment of Echinococcus species infections in dogs.

Oxfendazole is active against E. granulosus, and the ED₅₀ is estimated to be 1 mg/kg. The ED₉₀ for mebendazole (micronized powder) is estimated to be 56 mg/kg. Mebendazole is a safe and virtually tasteless compound and has been found to be active when incorporated in food. No recommendations on the use of these two benzimidazoles in the treatment and control of canine echinococcosis can be made until the number of treatments required to achieve consistent activity has been determined.

12.2.2 Other compounds with activity

Fospirate dimethyl 3,5,6-tri-chlor-2-pyridyl phosphate

Two treatments of fospirate at a dose of 40 mg/kg are required to reach the ED₉₀ level. Due to its broad spectrum of activity, fospirate can be regarded as an advance in the treatment of cestodes, but, in view of the introduction of praziquantel, fospirate could not be regarded as the drug of choice in the treatment and control of canine echinococcosis.

Diuredosan (Uredofo, Sansalid, RH 565)

Three treatments at 25 mg/kg of this drug are necessary to control canine echinococcosis. An advantage of using diuredosan in the treatment of *E. granulosus* infections is its concurrent nematocidal activity. In view of the introduction of praziquantel, diuredosan cannot be regarded as a drug of choice for the treatment and control of canine echinococcosis.

Nitroscanate (Lopitol)

A variation in efficacy was observed between the various formulations in the treatment of *E. granulosus* infections. Three treatments are required to reach ED₉₀ with the micronized powder at 31.25 mg/kg. With the non-micronized powder, three treatments at 125 mg/kg or two treatments at 250 mg/kg are necessary to achieve ED₉₀. The introduction of nitroscanate can be regarded as an advance in veterinary medicine because of its broad spectrum of activity but, in view of the introduction of praziquantel, it cannot be considered the drug of choice in the treatment and control of canine echinococcosis.

12.2.3 Mass treatment programmes

With the introduction of new anthelmintics with improved efficacy against *E. granulosus*, there has been a shift in emphasis from "arecoline surveillance" to the mass treatment of dogs. This is an attractive alternative, but it is important that a continuing surveillance programme be established for livestock intermediate hosts and also final hosts.

Mass treatment programmes are justifiable to achieve a quick break in transmission in highly endemic areas. It is important to stress that the concern is not the number of dogs that are successfully treated, but rather the number that are unsuccessfully treated.

12.2.4 Medicated dog foods

Several attempts have been made to produce medicated dog foods for tapeworm control. So far, these have been unsuccessful either because the taste of the drug could not be successfully masked or because problems have been encountered in obtaining effective dispersal of the drug in the food. Praziquantel, because of the low dose rate required, may be incorporated in food in such a way that it is consistently accepted by dogs. Mass application under various feral and sylvatic situations might now be possible.

12.2.5 Chemotherapy of larval cestode infections

Hydatid disease has remained one of the few important helminth diseases for which there is no effective chemotherapy. Recently, several compounds of the benzimidazole group have been shown capable of inhibiting or destroying larval cestodes, including hydatid cysts. These encouraging results have stimulated research on other drugs active against larval cestodes and the use of some of them for the treatment of infected human beings.

13. Environmental disinfection

13.1 Introduction

Infection of intermediate hosts results from the ingestion of *Echinococcus* ova while grazing or being fed with roughage or hay. The contamination of such animal feed is the result of the defecation of infected dogs roaming in the grazing areas or on the farms where forage is grown. Any scheme for the control of echinococcosis should include measures that would ensure the elimination of the sources of environmental contamination, i.e. infected stray dogs.

13.2 Disinfection and uncontrolled dogs

It is thus evident that dogs should always be kept under control so that these animals do not become infected and contaminate the environment. Stray and ownerless dogs should be eliminated,

and the remaining owned dogs should not be allowed access to raw offal from slaughtered animals and should not be allowed to wander on the farm or in the neighbourhood.

Thus, the primary measure to be taken is to ensure that no infected dogs are present which might contaminate the environment.

13.3 Disinfection and abandonment of cadavers of sheep, goats, etc.

In order to ensure that sheep-dogs or stray dogs do not get infected, cadavers of sheep or goats in grazing areas should not be left in fields but should be burned on the spot or buried, so that they do not serve as food for dogs and particularly sheep-dogs. Shepherds and local authorities should be educated on this matter.

If any shepherd abandons a sheep cadaver in the field, he should be prosecuted and punished - as is the rule in Cyprus, for example.

13.4 Echinococcus ova viability in the field

Echinococcus ova have been shown to remain viable under various climatological conditions: they can remain viable for 12 days in water, for two years at a temperature of 20°C and for a short period at a temperature of -5°C.

13.5 Disinfection of dog testing sites (arecoline surveillance) or sites of drug treatment of dogs

Arecoline hydrobromide, used in most control programmes for collecting faecal specimens, is not a taeniocide nor an ovicide, and after use the testing site should be disinfected using a flame thrower. The same applies in the case of other drugs used, e.g. praziquantel which is a taeniocide but not an ovicide. Thus, after use of such drugs, the defecation site must be disinfected immediately by burning on the spot where the purge was voided.

14. Legislation and administrative organization

The first requirement is to assess the need for an echinococcosis/hydatidosis control programme, based on socioeconomic considerations, involvement of the political authorities and participation of the people.

Two possibilities may be available according to different local situations.

(a) The programme may have to be started ab initio; in this case, a specific authority may have to be created either inside the existing health or agricultural or other organization or independently from the existing organizations (if any).

(b) Some legislative and/or administrative organization may be available for one or more of the following: reporting of human cases; reporting of animal cases; dog control; slaughter-house control. The existing organization(s) should be evaluated specifically for their possible contributions, with three specific goals: complement the coverage which is insufficient inside each activity; create activities where they do not yet exist; coordinate the different activities so as to obtain a complete programme.

The final goal, whatever pattern is selected, is to obtain a specific service, able to work for many years. Naturally, most of the achievements will constitute the base of an efficient veterinary public health and animal health service, adequate for food hygiene, solution of dog-related problems, health education, medical-veterinary coordination, assessment of cost of animal diseases, etc.

Examples of patterns in different countries include the following.

(a) A specific control authority was created in New Zealand and Uruguay.

(b) Existing legislations have been unified on the following lines:

- programmes operating mainly on the basis of animal health acts, at the national level (e.g. Cyprus) or the regional level (e.g. Tasmania);
- programmes operating mainly on the basis of human health acts, at the national level (e.g. Iceland) or the regional level (e.g. Buenos Aires province in Argentina);
- a holistic approach, involving different public and private, national and local organizations (e.g. Peru).

In some countries, the veterinary service is under the health administration, and the control programmes were prepared by the medical and the veterinary departments of the administration (e.g. Italy). In other countries, an efficient veterinary public health service may be included in the health administration, and prepare the programme (no example known).

15. Diagnosis and treatment of hydatid disease in man

Diagnosis and treatment of hydatid disease in man are essential parts of all control programmes.

15.1 Diagnosis

Clinical diagnosis is based upon the presence of a slowly growing cystic tumour, history of residence in an endemic area and close association with dogs. There are numerous descriptions of diverse clinical manifestations of echinococcosis in the medical and surgical literature.

Parasitological diagnosis includes the finding of protoscolices, brood capsules or daughter cysts in the cyst after surgical removal or from a ruptured cyst in the sputum or urine.

Radiological diagnosis may be in the form of plain roentgenography, which permits the detection and location of hydatid cysts in the lungs. The use of radioisotopic scanning is now well established. Ultrasonic examination using high-frequency sound waves shows great promise. Computerized axial tomography is a complex radiological technique.

The most common use of immunological diagnosis is for the confirmation of a presumptive clinical diagnosis. When we have to determine the tests which should be used for the diagnosis of echinococcosis, some important criteria must be taken into consideration, the main ones being sensitivity and specificity.

The immunological test which has the highest degree of specificity is the immunoelectrophoresis (IEP) test. It is used for demonstrating the specific arc-5 of hydatid infection, which has been confirmed by several workers. It is easy to perform but requires some specialized equipment. Other disadvantages of this test are the length of time it takes to carry out and the large quantities of antigen and sera required. It is also necessary to concentrate the serum prior to testing. The indirect hemagglutination (IHA) test is now accepted as a method of first choice because of its very high sensitivity. Many variations of the test have been employed with success, using different stabilizing and coupling reagents such as tannic acid, glutaraldehyde, pyruvic aldehyde, formalin or chromic chloride.

Recent studies have indicated that high rates of nonspecific reaction could occur in patients with tissue parasitic infections, cirrhosis and cancer. Despite such cross-reactions, other parasitic infections do not present a significant problem. Thus, the IHA test can be useful for diagnostic purposes, but its specificity must be controlled very carefully.

Some workers recommend the latex agglutination (LA) or bentonite flocculation (BF) as methods of next choice to demonstrate a higher degree of specificity.

The indirect fluorescent antibody (IFA) test is used in many laboratories in the immunological diagnosis of echinococcosis. The test is, however, technically difficult to perform and requires a microscope with special facilities for ultraviolet light.

Among the immunoprecipitation tests employed, double diffusion in gel and immunoelectroosmophoresis merit special attention. Recent studies indicate that double diffusion in gel proved to be a very sensitive and specific diagnostic method.

Immunoelectroosmophoresis (IEOP) of countercurrent electrophoresis has all the advantages of the arc-5 double diffusion (DD5) test, with the added advantage that the reaction can be completed in 30 minutes. Another advantage of IEOP is that, compared to IEP, it requires less concentrated antigens and unconcentrated sera.

The intradermal test is used extensively in the immunological diagnosis of hydatid disease. The test has a high sensitivity but gives a great percentage of nonspecific results. This shortcoming of the test might lead to reservations regarding its use as a diagnostic procedure in echinococcosis, particularly when patients with other tissue parasitic infections are tested. This inconvenience could be overcome by using appropriate antigens with a low nitrogen concentration and by developing adequate criteria for interpreting the results. Another test which seems to be very promising is ELISA. This test, however, needs further evaluation.

15.2 Treatment

Definitive therapy in man remains the surgical removal of hydatid cysts, although effective chemotherapy treatments of echinococcosis have been developed recently.

Surgical treatment

If the patient is asymptomatic and the cyst has been discovered by chance, the location of the lesion, the age and the fitness of the patient must be considered. A small, calcified liver cyst in an asymptomatic patient requires only observation. It is generally agreed that pulmonary cysts warrant operation, even in asymptomatic patients, to prevent rupture, infection and complications.

Chemotherapy

Recently, experimental studies carried out in some laboratories have given encouraging results, showing mebendazole to be the first drug capable of destroying larval cestodes, including hydatid cysts.

- Mebendazole was given to four patients with hydatid cyst of the liver in increasing doses, up to a maximum of 400-600 mg three times a day, during courses of 21-30 days. The intrahepatic cysts completely regressed in 4-13 months, and the patients improved clinically.
- In a study of the effect of high-dosage therapy of five patients with cystic echinococcosis, the disintegration or dissolution of pulmonary cysts was observed within a few months of treatment.
- In a clinical study of 10 patients with primary hydatidosis and 6 with hydatid cysts that had accidentally ruptured during surgery, mebendazole was administered at a dosage of 16 to 36 mg/kg/day for 21 to 81 days in 8 cases and at a dosage of 50 mg/kg/day for 3 to 11-1/2 months in the remaining 8 cases. Echotomographic and computed tomographic controls showed a regression of the cyst picture in 8 cases of primary echinococcosis.
- Mebendazole was administered to four patients with echinococcosis. Two of them had confirmed multiple hydatid cysts in different organs, including liver, spleen and abdomen. A total daily dose of 1500 to 3000 mg was given for 20 to 30 days. Four to five courses were carried out. In two of the patients, one with multiple echinococcosis and the other with abdominal cysts, a complete curative effect was obtained.
- Mebendazole has been well tolerated even when high doses are used. No serious adverse effect has been observed in the human subject so far.

16. Education and training including public education

16.1 Introduction

It is a fact that, due to the nature of the life cycle of echinococcosis, it is very difficult for anyone, even the well educated, to understand how the problem has arisen and is perpetuated.

For the prevention and even control of the disease, it is imperative that every citizen cooperates when he comes to know about the disease, where the problem stands, what he ought to be careful of, what he ought to do, etc., in order to help ensure that the problem does not arise in the first instance or, if present, to help in its control.

Of even greater importance is the fact that all those who will take part in the implementation of the campaign ought to be well trained, and not only be aware of the nature of the disease themselves but also be able to pass their knowledge in a convincing way to the general public so that the latter may contribute in the efforts at control.

16.2 Public education

16.2.1 General

A campaign for the control of echinococcosis must include methods for educating the citizens as regards the disease. This measure is not so simple, and in many countries it has been greatly misunderstood and has not given positive results. The education must be carried out in a way that will stimulate the interest of the inhabitants so that they will not only protect themselves from infection through better hygiene but also so that they will wish to participate in the programme. This is not an easy task to be carried out merely by using posters, radio talks or films or lectures on television, etc.

Man faces today a variety of problems and - what is more - it is very difficult to change old established ways of life or attitudes from one day to the other. Consequently, the methods used must be such that they really have a meaning for the individual in a family or a community.

16.2.2 The experience in Cyprus

In Cyprus, an innovative method was used which ensured cooperation by the public at the outset, particularly by dog owners. It involved house-to-house visits of specially trained female extension workers who visited almost every house in the rural areas of the island and discussed the problem with the family and particularly the mothers. The extension workers explained to the household the care which they ought to give their dogs, the precautions which they ought to take so that the family and particularly the children would not get infected, the seriousness of the disease (they showed pictures of victims with scars on their bodies), etc. In this way, the interest of the people was stimulated, and they wanted to know as much as possible about the disease as well as the measures which they ought to take immediately in order to protect their children. It would be no exaggeration to state that about 80% of the families gave their dogs to be euthanized immediately because they were in no position to carry out all the measures and provide the necessary care to ensure that their dogs would not get infected and pass the disease on to them.

The above example was referred to as a method of education directed not only at gaining the attention of the people but also at getting them seriously concerned - especially the mothers, who subsequently cooperated with the campaign. Even after a decade of programme implementation in Cyprus, telephone calls are continuously being made to the campaign service from various people in towns or villages in order to report that they have seen a stray dog, to report that they have seen meat in a butcher's shop which was not stamped with the campaign seal, or to discuss other matters.

Education was not, however, based only on the above-stated method; other methods included personal visits to animal farmers, who were told of the consequences of the disease for the productivity of their animals and thereby became cooperative - particularly in the destruction of cadavers in the field by burning or burial, the use of head muzzles on their dogs, compliance with the farm-slaughter prohibition, etc.

The teaching of echinococcosis in schools during biology courses was another method used to ensure that people became more familiar with the problem. In some recruitment interviews for certain services, questions on the subject of echinococcosis in Cyprus are posed to prospective employees. In some television competitions, the subject of echinococcosis has also been brought up.

In other words, the Cyprus authorities repeat and stress not only the significance of the various methods used for education, but also the fact that the methods must be best suited to the conditions of each country or even areas so that maximum cooperation of the public is achieved.

16.2.3 Other methods

Due to the great importance of education of the public, the competent authorities must investigate very seriously the ways with which they will be able to disseminate the needed information and stimulate the interest and cooperation of the people.

In this effort, the issue of a relevant booklet should be of primary importance, and this is true for all countries. The book should be written in a simple, easy to understand language and include all information related to the disease, e.g. on the various stages of the life cycle of the parasite, the ways of infection and perpetuation of the disease, the stages in the life cycle at which the control authorities can act in order to disrupt it, etc. The book should end by posing a long list of questions, together with the correct answers, so that the reader may finally obtain all basic data and, through his action, promote not only his own protection but also the protection of his fellow men. The book would be useful not only for the general public but also for those who educate the public. In this way, education would be carried out everywhere in a uniform way.

Other methods of education should be used which would best suit the various groups also involved, e.g. hunters on the dangers of their dogs getting infected, butchers on the importance of the destruction of infected raw offal, etc. The educational methods must make use of the opportunities which appear from time to time, e.g. agricultural shows, visits to schools and education of pupils of all ages, and all occasions when the people can best be informed - not excluding house-to-house visits.

16.3 Training of staff

Staff must be selected who have a good personality, have the ability to pass on information, are able to discuss the subject with anyone in a sound and cordial way, do not get angry easily and are able to employ language and concepts appropriate to the standard of education of the people with whom they talk. Education should be adjusted according to the target group, i.e. the particular problems of each group should be stressed.

These persons, once selected, must be duly trained and informed on all details, not only on the technical aspects of echinococcosis but also on the control efforts, results or failures in their country and in other countries. Special significance must also be given to their training as regards losses to the national industry from echinococcosis and even the repercussions of the disease as a public health problem.

The education teams, apart from the knowledge which they acquire from their training, must closely watch the problems arising during the campaign and adjust their methods accordingly, e.g. in serious dog-infected areas methods of prevention of dog infection should be stressed. The monotonous and continuous repetition of education should be avoided.

There are cases when the education teams do not only inform but are also recipients of the public's knowledge, and get to know of their problems and even acquire new ideas for the campaign. Thus, the teams make use of the people's experiences and take heed of their opinions and ideas. Education should not be a passive procedure but a dynamic and progressive one, adjusted to the changing demands and progress of the campaign.

17. Evaluation of a control programme

17.1 Introduction

The availability of baseline information is essential in any control programme if progress is to be achieved over the years and is to be assessed satisfactorily. Baseline data on infection in dogs, sheep, goats, cattle and other intermediate hosts, and infection in man, will be the reference points. Knowing those levels, the control authority will be able to evaluate the results of its measures for control. A well organized system of collecting infection data in man and animals should be operative throughout the period when the campaign is implemented. Comparing data thus collected with baseline information will help evaluate the progress achieved.

17.2 Comparing infection in dogs before and after the campaign

The level of dog infection before or during the initial stages of the control scheme should be determined, preferably by dissection of the small intestine. Subsequently, after the dog population has been restricted to dogs having owners who keep them under full control, the dogs must be registered and taken to an examination centre or a mass drug treatment site. The examination of dogs is done using arecoline hydrobromide, despite the reported drawbacks of this drug. Thus, "arecoline surveillance" must serve as an indicator for infection in dogs in particular and the campaign in general.

17.3 Abattoir surveillance

Slaughtered animals should be inspected for the detection of infected carcasses, and young animals should be given special attention. In view of the passage of time and the disinfection of the environment, young animals, i.e. those born after the campaign was started, would be an indicator of real progress achieved. In Cyprus, sheep under two years became almost totally free from cysts three to four years after the start of the campaign, which indicated that the environment was, indeed, free of Echinococcus ova by that time.

Differentiation of the ages of slaughtered animals could also be a good indicator of progress achieved. In Cyprus, at present, the animals found most infected are those born before or during the first stages of the campaign.

17.4 Human surgical cases

As a campaign progresses, the number of human surgical cases will diminish, particularly in the younger age groups. Availability of human data will undoubtedly be a good indicator for the evaluation of any control programme. The disease must be given notifiable status as soon as possible. However, even if that is the case, the response of private clinics might still not be fully cooperative, yet every effort must be exercised to collect reliable human surgical data - retrospectively as well as subsequent to the start of the campaign.

17.5 Cooperation of the public

Reluctance of the public and specifically those more directly involved (dog owners, butchers, shepherds, etc.) to cooperate with the campaign authority indicates a negative attitude which hinders progress. On the other hand, cooperation by the public, and by those more directly involved, would indicate that the campaign is on a good foundation and can be said to have succeeded, since such cooperation is a must for every campaign. Cooperative shepherds, butchers, etc., are a great asset, and the campaign can in this case be favourably evaluated.

17.6 Conclusion

Evaluation of a programme is of utmost importance and is, in fact, a must if the control authority is to know where the problem stands during the various stages of the campaign. In this way, all the measures used will be assessed and new methods applied as the need arises.

Evaluation is of great importance also in informing the other government services charged with policy making and fund allocation. Last but not least, it allows the general public to know of progress achieved and benefits obtained for public health and the economy in general, and thus to have assurance that the state is successfully engaging itself in schemes directed at protecting the people from serious diseases and bolstering the economy.

18. Design of a national hydatid disease control programme

18.1 Introduction

The difficulty lies not with the actual drawing up of a programme for the control of echinococcosis but in determining which authority is best suited for its preparation. From observation of the situation worldwide, it is firmly believed that the power for this should be fully vested in that government service which is involved in zoonotic disease control, i.e. the veterinary or animal health service in which the government veterinarians serve.

18.2 The campaign plan

The plan for the control of echinococcosis must provide for the application of all those methods needed in an efficient and productive way. It should cover:

- (a) organization;
- (b) personnel;
- (c) methods of work.

18.2.1 Organization

Good organization is a necessity and must be given priority within the context of designing a campaign against echinococcosis. A number of committees must be set up for the efficient delegation of responsibilities from the highest authority to the field worker.

Central committee

Despite the fact that it has been repeatedly stated that the anti-echinococcosis campaign must be the sole responsibility and competency of veterinarians, it is also accepted that at the beginning a central committee can be set up in which representatives of various government services, private associations and organizations participate and contribute their influence to ensuring the success of the programme. The main members must be the director of veterinary services (who will be the chairman), the director of medical services and a representative from each of the following: public information office, ministry of education, ministry of the interior, society for the prevention of cruelty to animals, farmers' association, hunters' association, butchers' association and others as the local conditions warrant.

District committee

The campaign policies as well as the various activities to be undertaken ought to be the subject of study by the various competent services on a district or regional basis in a country. Thus, a district committee must be set up which will be the authority through which action against echinococcosis on a district level is taken. The terms of reference of this committee will be on the same lines as those of the central committee, with the difference that it will discuss the situation as presented on a district basis and, apart from implementing the policies of the central

committee, it will also examine and try to solve the various problems arising on a district level. To that effect, it will formulate local policy decisions after consulting and putting forward its conclusions to the central committee. Participants in the district committee will be the district veterinary officer (who will be the chairman), the district medical officer and local representatives of the same ministries, associations and organizations as in the central committee.

Local committee

The local committee will include members of the community, e.g. the community leader, the clergyman, the teacher, the rural constable and other persons in authority. This committee is very important due to its close association and contacts with the local inhabitants. Also, the various teams responsible for implementation of the measures will closely cooperate with the local committee on a continuous basis during all phases of the campaign.

18.2.2 Personnel

The personnel who man the various campaign teams must be carefully selected. These teams are the following: the education team, the team for the destruction of strays and control of the dog population, the abattoir control and carcass inspection team, the dog examination team and the team for statistical analysis and evaluation of the progress of the campaign. The teams are the main instruments by which the campaign measures are implemented on a continuous basis, fulfilling objectives set at various stages and in general being responsible for the uniform and smooth application of the campaign in all the districts of the country.

Education teams

These teams are made up of men or women who, after the necessary training, are in a position to undertake education on all levels necessary, in accordance with the programme. They cooperate with one another and with members of other teams in such a way that the entire work of the campaign, as implemented by the various teams, is aided and any problem arising resolved.

Stray dog elimination and dog population control teams

These teams are responsible not only for the destruction of stray dogs, something which they achieve through their being continuously on the move, but also for checking whether dogs in a community are registered and kept under control.

If unregistered dogs are found, the owner is reported to the nearest police station as well as to those responsible for the registration of dogs in the area. Also, the teams check on dogs being taken from one village to another (which is allowed after permission has been granted by the responsible campaign authority) and on any change in dog ownership.

Abattoir control and carcass inspection teams

These specially trained teams are responsible for the inspection of carcasses at abattoirs or other places set aside for this purpose at stated times in the communities. At the same time, statistics are collected on the degree of infection of the various kinds of animal and ages which are used for assessing the progress of the campaign.

The teams are also responsible for the inspection of slaughtering places and ensure that they fulfil certain minimum standards before permission is given for their use.

Another responsibility of these teams is checking that meat bears the official campaign stamp showing that the carcasses originated from inspected slaughter.

Dog testing teams

These teams are responsible for carrying out examinations of dogs at the set places and times. They are also responsible for measures aimed at getting all dogs tested without exception and, at the same time, making sure that the dog population of the community is kept under control.

Statistical analysis team

All the above teams carry out their work and in doing so collect relevant information, which they record on special forms and despatch to the campaign centre where a special team keeps a close watch on the work carried out and analyses the incoming data, thereby drawing pertinent conclusions on the progress of the campaign. Using this information as a basis, monthly, six-monthly and yearly reports are prepared and at times comprehensive reports are issued in which the progress to date is described regarding every aspect of the campaign.

18.3 Methods of work

The country must be divided into areas where the various teams will be able to apply the campaign measures, e.g. the education teams, the teams for the destruction of stray dogs, the teams for slaughter inspection, etc. The areas must be defined not at random but on the basis of specific data, so that the various teams can do their job as effectively as possible and continuously without any hindrance. The data for defining an area include the number of villages, the number of abattoirs, the number of animals slaughtered, the population of animal intermediate hosts, the population of registered dogs, the distances between villages, transportation facilities, etc. In each of the areas, the work of each group will be carried out within well defined time periods. For example, the examination of dogs should on no account be delayed or postponed. In this way, the cycle of echinococcosis could be broken. This would, indeed, be the case if all dogs were examined, the infected ones being destroyed or dewormed and the rest being properly looked after so that they have no access to the raw viscera of slaughtered animals.

Examination of dogs for Echinococcus must be repeated at specified periods, and in this way infected ones will be detected and either destroyed or dewormed, so that the environment does not get recontaminated and young animals born after the campaign do not get infected. Thus, the teams working in the various areas must make sure that all those measures necessary for the disruption of the life cycle of Echinococcus are implemented. In this way, old animals, which are usually infected, are eliminated by slaughter while young animals born after the campaign was started are kept free from infection.

It has been recently stated, quite often, that only certain islands have succeeded in controlling echinococcosis, and this success is attributed to the size of the islands. This, however, is not the real explanation. The size of a country has no relationship whatsoever to the extent of the difficulties encountered in tackling the disease; it simply means that, possibly, a smaller country will have a smaller number of areas and teams while a larger country will have a larger number. It is understood that the work in each area will come under the supervision of a district officer. He in turn will be administratively accountable to the central service of the campaign, which will be the competent authority for overseeing all the work carried out within the context of the programme, evaluating the results and problems arising, shaping future policies, etc.

18.4 Conclusion

A campaign directed against echinococcosis ought to be well organized throughout the ranks, i.e. from those involved in field application to those in authority, accountable to the central service. The campaign must be planned in a strict manner, and the employees should be firmly supervised and be on a 24-hour alert, ready to undertake any work whose nature calls for such readiness. Of course, some time lapse is needed before the campaign can exhibit some success.

From the above, it is concluded that, in drawing up a plan against echinococcosis, one should seriously consider all those factors and make use of all those methods which are needed, always adapted to the local conditions. The campaign should be under one supervising and guiding authority, and this authority, in the case of echinococcosis, should be none other than the veterinary service.

The design of a plan must cover, apart from the division of the territory into areas which facilitates work allocation, factors such as expected expenditures, detailed work procedures at field level, basic legislation governing all aspects of the campaign, provision of all necessary supplies, procurement of new laboratory equipment, vehicles, mobile clinics, etc. Consideration in the plan should also be given to the number of animals, food animals and dogs present in the various areas, the number of their owners, etc. The plan should include a time sequence for completion of the various activities, e.g. dog examination for each area separately, abattoir construction or improvement, and evaluation of the results from progress reports coming in from the various areas.

Of special significance is the description in the plan of the responsibilities and duties of the teams which will implement the scheme. Reference should be made to the special training of the various teams. The campaign plan must be drawn up in such a way that it serves as an easy aid in the form of a code for all those involved in the programme and, if possible, allows all the provisions to be followed exactly and the time stages for the completion of the various phases to be met. Also, the pertinent legislation should be described so that each citizen, whether a farmer or a person in authority, can discern his duties and obligations in this endeavour and comply with them.

19. Planning of national programmes for the control of zoonoses (sequence of events)

The following is a short description of the sequence of events which most frequently occur before a formal zoonosis control programme can be instituted.

Phase 1

There is increased awareness of the overall effects of a zoonosis to community health and economy.

Action. At the country level, discussions are initiated between physicians, public health workers, veterinarians, farmers, etc.

WHO and other international organizations may be asked to provide preliminary information on the situation relative to the disease in other countries.

Phase 2

Discussion groups are formed at the ministerial, university and research institution levels.

Action. WHO may be requested to provide more information, particularly with respect to successful projects in other countries and to constraints encountered in existing national projects. It may also be asked to provide publications on planning of national projects.

Phase 3

A committee is formed in which public health, veterinary and related groups are represented.

Action. The committee enters the early planning stage and discusses legislation and procedures.

It may request WHO to assist in manpower development (fellowships, exchange of scientific workers). Temporary advisers may be sent on request for collaboration in project planning.

Phase 4

The committee seeks preliminary information on factors such as prevalence of zoonoses in man and animals.

Action. The committee gives instructions to collect baseline data from available sources, and strengthens cooperation and collaboration between various sectors and professions.

WHO may be requested to advise on procedures for collection of data, laboratory procedures, evaluation of results and distribution to the persons concerned. The country may also request WHO to convene workshops on laboratory diagnosis and epidemiological practices and provide information on all aspects of the disease control. The country may contact neighbouring countries and exchange information. Intercountry cooperation may be initiated.

Phase 5

The committee collates information and starts discussions on:

- control structure;
- functions;
- funding;
- scope of operations;
- training;
- priorities and options based on local knowledge.

Action. An intensive educational programme is started, paying particular attention to obtaining community support. At this stage, the committee may decide, with the assistance of universities and other institutions, to introduce the control within a limited area - without recourse to further official government action but with departmental support.

WHO may be requested to provide educational aids.

Members of the committee may visit countries which have successful projects.

Phase 6

The committee decides to request the responsible authorities to undertake a full-scale formal control programme and draws up a plan of action with options. As a first step, only some components of the programme may be initiated.

Action. The committee submits a plan to the government department concerned. The country may seek assistance from WHO, particularly with respect to drafting a project document for possible submission to donors or international organizations for cooperation in its execution.

Principle areas of cooperation with WHO or other international organizations in hydatidosis control would be:

- preparation of educational and teaching aids;
- improvement of education and training of professional and auxiliary personnel;
- collaboration in updating legislation;
- collaboration in planning a network of slaughter-houses - large and small - which would meet the hygiene standards;
- collaboration in planning and execution of a control programme for the unwanted dog population;
- collaboration in developing plans for safe collection and disposal of condemned offal and cadavers and their processing in rendering plants into meat and bone-meal for feeding purposes.

Phase 7

The responsible authorities evaluate the plans, approve or return them for further elaboration and resubmission. Here, success may depend on the priority status of the zoonosis vis-à-vis other community health problems.

Action. If the plans are approved, the appropriate departments are instructed to proceed.

Phase 8

A director for the project is appointed by the appropriate government department; he appoints an advisory committee.

Action. Final plans are drawn up and implemented. The country may request WHO to collaborate as executing agency of the project or provide temporary advisers or consultants on specific aspects of the project.

20. Diagnosis and treatment of hydatid disease in man

As the clinical symptoms associated with echinococcosis are generally nonspecific and the majority of infections may be initially asymptomatic, the diagnosis cannot be based on the clinical picture alone. Radiological methods have wide application, but they are able to define only space-occupying lesions and cannot identify their parasitic nature. Therefore, the definitive diagnosis should be made by means of immunological methods. Both immunological and radiological methods should be used for active (symptomatic) case detection.

The participants agreed that the use of immunodiagnostic methods should centre on:

- diagnosis of suspected hydatid patients;
- detection of asymptomatic cases by sero-epidemiological surveys;
- immunological post-surgical and post-treatment follow-up of patients.

The participants outlined criteria for determining the usefulness of the tests available for immunodiagnostic purposes: sensitivity, specificity, simple, rapid, ease of performance, amount and cost of reagents required, reliability of results. The diagnostic value of immunological methods can be improved by the simultaneous application of two or more tests.

High priority should be given to the preparation and purification of standardized and highly specific hydatid antigens in order to ensure the specificity and reliability of diagnostic tests.

The choice of immunological tests applied and the interpretation of results obtained require consideration of many factors, including the distribution in a given area of other tissue parasitic diseases such as fasciolopsiasis, schistosomiasis, trichinellosis and cysticercosis. This is very important because of the risk of false positive reactions.

The indirect hemagglutination (IHC) and latex agglutination (LA)/bentonite flocculation (BF) tests are recommended as methods of first choice. They should be used for initial screening because they have been shown to be highly sensitive procedures and then, wherever possible, it is preferable to apply the immunoelectrophoresis (IEP) test, which is more specific. Other methods which could also be used as diagnostic tools are the double diffusion test for the arc-5 antigen and the intradermal test, the latter being most sensitive in lung echinococcosis.

In view of the importance of immunodiagnostic procedures and their further development, it is suggested to establish a bank of sera from patients operated on for echinococcosis.

The use of immunological methods, in addition to radiological ones, is recommended for determining the prognosis of hydatid disease following surgical treatment and chemotherapy, in studying the immune response and in conducting sero-epidemiological surveys.

It was noted that, although the definitive therapy in man remains the surgical removal of hydatid cysts, it is usually an extremely difficult procedure. At the same time, good results have been obtained recently in treatment with mebendazole, which has proved to be very effective against the larval stage of *E. granulosus*. It is efficacious not only against solitary cysts but also multiple cysts in the liver, abdomen and lung.

In view of the successful treatment of hydatid disease with mebendazole, it is recommended that chemotherapeutic trials should be carried out under strict supervision in patients with inoperable or multiple primary and secondary echinococcosis, as well as in cases with other cyst conditions if the risk of surgery is great.

In patients with hydatid cysts that accidentally ruptured during operation, it is recommended to use mebendazole in order to prevent secondary hydatidosis. In this respect, attention should be drawn to the possible advantage of using mebendazole before surgery. The danger of spillage could be removed by pre-operative cover with mebendazole.

Mebendazole must be given at a dosage of 40-50 mg/kg per day, the courses and duration of the therapy depending on the cyst conditions. Nevertheless, development of optimal administration regimens of the drug is still needed.

21. Recommendations

- (1) There is a need for exchange of information on successful and unsuccessful aspects of various attempts to control the disease.
- (2) There is increasing evidence that *E. multilocularis* is spreading in the Mediterranean area. There is an urgent need for increased surveillance, and it is recommended that Member States and their medical and veterinary authorities be alerted.
- (3) Collection of baseline data at national and regional levels should be coordinated.
- (4) There is a need for further development of studies on social and economic burdens due to disease and benefits of its control. For human infection, it is important not only to measure morbidity and mortality but also to consider human suffering.
- (5) In several Mediterranean countries, traditional animal husbandry practices are firmly established, but, nevertheless, such practices may contribute to maintenance of the hydatid cycle. Evidence exists in several countries that changes in traditional practices may dramatically affect the transmission, so that the infection is eliminated from certain localities. There is a need to study husbandry methods to identify practices which, if modified, may be pivotal in altering the incidence of infection.
- (6) The reports of the Member States indicate a variation in the importance of various intermediate host species (e.g. sheep versus cattle versus camel) even though the canine situation appears common to all. It is recommended that priority be given to a study of the factors involved. This might best be accomplished by a small research group concentrating on a specific series of examples in the Region.
- (7) There is a need for development of ovicidal drugs.
- (8) Research should continue on drugs with a wider spectrum of anthelmintic activity.
- (9) WHO, and the Mediterranean Zoonoses Control Centre in particular, should collect data on the availability and evaluation of new drugs and disseminate this information to Member States.

- (10) The Centre will provide the countries with information on dog population dynamics needed in campaigns aimed at the reduction of stray, feral and wild animals or at fertility control of dogs.
- (11) Studies on the feasibility of safe collection and removal of condemned offal and cadavers should be implemented without delay.
- (12) Help and advice should be given on the construction of small-scale slaughter-houses, incinerators and other safe means of disposal of condemned offal and cadavers.
- (13) Hydatidosis control should be based on legislation. Full use should be made of existing legislation concerned directly or indirectly with hydatidosis in man and animals. The Centre will provide assistance in this matter on request.
- (14) Further development by the pharmaceutical industry of drugs active against larval cestodes in man should be encouraged.
- (15) The Centre should convene a workshop on reprinting systems, registration of dogs, diagnostic methods for hydatidosis, dog population dynamics, rendering systems and possibly other topics.
- (16) WHO and the Centre should undertake the provision of short courses on immunodiagnosis and the preparation of guidelines on immunological tests.
- (17) The Centre should encourage and undertake the collection of existing models and the production and dissemination of audiovisual aid materials (such as folders, posters, slides, television film) for schoolchildren, teachers, medical and veterinary personnel, farmers, dog owners and other high-risk groups.
- (18) Provision of educational material should take into account ethnic, religious and other local circumstances and should be produced in a professional manner.
- (19) Control programmes for echinococcosis/hydatidosis are multifaceted, and the benefits derived affect a wide spectrum of public health and animal health endeavours. Greater publicity should be given to these beneficial effects and greater use be made of the media in promoting the programmes.
- (20) There is a need for provision of continuous technical cooperation in line with the WHO manpower development system, and for the provision of technical advice on specific problems.
- (21) There is a need for wider dissemination of information, using the WHO system or a means such as the Weekly epidemiological record, the information bulletin of the Centre, circulars of the International Office of Epizootics, etc. It is recognized that, at present, information fails to reach official veterinary authorities, and it is therefore recommended that ways be sought to remedy the situation.
- (22) Hydatid control, wherever possible, should be coordinated with rabies campaigns.
- (23) It was stressed that intersectoral cooperation is one of the important prerequisites for successful control of hydatidosis and other zoonoses. It is desirable to have a specific set-up for the control of zoonoses.
- (24) It is important to identify the priorities in the control efforts in order to avoid dispersal of resources.
- (25) Measurement of success is easier and more valid if the parameters are established beforehand.
- (26) Studies on wild animals to identify species and strains of echinococcosis should be undertaken for epidemiological purposes.
- (27) Consideration should be given to the possibility of establishing permanent collections of sera for future immunological studies, e.g. standardization of techniques and of antigens.

Annex I

SUMMARY REPORT FOR THE MEDITERRANEAN AREA

Introduction

Parasitic zoonoses and particularly echinococcosis/hydatidosis continue to have high morbidity rates and to cause much suffering in the countries of the Mediterranean zone, despite great advances in health sciences and technology and major efforts on the part of governments of the countries to eradicate or control this disease.

Occurrence in man

The prevalence of classic hydatidosis caused by E. granulosus varies considerably with geographic areas even within a given country. The highest infection rates are recorded in cattle-raising and especially sheep-raising countries. High infection rates are also recorded in camel-raising countries. It is essentially an infection of rural areas, although cases do occur in urban and peri-urban areas.

The common sources for determining the incidence of the disease are records of hospital surgical operations for hydatid cysts. Table 1 shows the rate of annual incidence of cases per 100 000 inhabitants and the total number of cases per year. Though useful indicators, these data still do not reflect the real incidence of the disease, since the denominator is not the rural population where the problem is more acute but the total population of each country. In some countries, there is a great difference between the non-notified operated cases and the recorded operated cases.

Table 1. Occurrence in man
(various years)

Country	Total recorded operated cases per year	Incidence per 100 000 inhabitants	Year of record
Algeria	752	4.6	1975
Bulgaria	168	1.6	1978
Cyprus	21	3	1979
Egypt	No data	No data	
France		4.5 ^a 5.3 ^b 13 ^c	1966-1970
Greece	1140	12.6	1978
Italy	33	-0.09	Average 1961-1965
Malta	1	-0.3	1970
Morocco	1488	7.6	1978-1979
Portugal	100	-1.1	1978
Spain	No data	No data	
Syria	125	-1.8	1975
Tunisia	289	2.2	1978
Turkey	No data	No data	

^a Information rate in five departments of south-eastern France

^b Pyrenees zone and South Pyrenees

^c Corsica

Occurrence in animals

In all of the areas where human infection is highly prevalent, a similarly high rate of parasitism in animals is present, in both intermediate and definitive hosts.

The highest rates are found in abattoirs where older animals are slaughtered. In countries using camels, high infection rates are observed in these animals.

Table 2 shows the incidence rate of hydatid cysts in different species of animals at abattoirs.

Table 2. Incidence of hydatid cysts in animals

Country	Species of animal						Year of record
	Sheep (%)	Goats (%)	Cattle (%)	Camels (%)	Pigs (%)	Equines (%)	
Algeria	20.3	12.3	11.2	40	0.7	1.5	1968-1970
Bulgaria	21	-	13.3	-	1.0	-	1977
Cyprus	7.3	0.2	5.4	-	-	-	1979
Egypt	0.3	0.85	0.03	10.3	5.2	-	1979
France	-	-	-	-	-	-	-
Greece	60.80	10.31	24.13	-	-	-	1978
Italy	8.1-15.2	3.7-8.9	1-2.3	-	0.7-1.9	0.4-0.9	1968-1978
Malta	-	-	NON-EXISTENT	-	-	-	-
Morocco	0.7 ^a -7 ^b	1.4 ^b	21 ^a -36 ^b	85 ^a	-	3.5	1979-1980
Portugal	-	-	-	-	-	-	-
Spain	6.04	1.11	3.56	-	5	-	1979
Syria	-	-	NO DATA	-	-	-	-
Tunisia	18	-	16.3	36	25	-	1978
Turkey	1.34 ^c -1.22 ^d	0.28-1.04	1.72-1.10	-	-	-	1979

^a Animals slaughtered in the town of Rabat

^b Animals slaughtered in souks of the Rabat region

^c Lungs infected by hydatid cysts

^d Liver infected by hydatid cysts

Table 3 shows clearly that, as far as the definitive host of the disease is concerned, too little or nothing has been done up to now in most of the countries, with the exception of Cyprus where the number of dogs is known and where the authorities report that the stray dog problem no longer exists.

Table 3. Dog populations and rates of infestation

Country	Dog population	Number of infested dogs	Incidence rate (%)	Year of record
Algeria	700 000 ^a	No data	No data	1980
Bulgaria	100 000	4 000	4	1978
Cyprus	12 481	89	0.07	1979
France	7-8 000 000 ^a	No data	No data	1980
Greece	550 000 ^a	No data	No data	1977
Italy	3 113 863	No data	No data	1980
Portugal	667 290 ^b	66 700	10	1979
Tunisia	1 000 000 ^a	No data	No data	1980

^a Approximately

^b Registered dogs

No data are available for the rest of the countries.

Socioeconomic consequences of hydatidosis

The financial losses caused every year to the livestock industry by hydatidosis and the annual expenditure for the care and treatment of operated persons has, unfortunately, not been estimated properly in most of the countries, though the expenditure required for the adoption of the most ambitious programme to combat echinococcosis would be several times less than the amount of the estimated losses.

Table 4. Socioeconomic consequences of hydatidosis (in US dollars)

Country	Annual losses of livestock industry due to hydatidosis	Annual economic losses for the entire country in terms of livestock, bed days of patients, etc.	Annual expenditure on treatment and absence from work for operated persons
Algeria	3 500 000 ^a	-	-
Bulgaria	-	22 000 000 ^a	-
Greece	10 000 000 ^a	-	3 000 000 ^a
Italy	8 700 000	16 400 000	7 700 000
Spain	1 250 000	-	-

^a Approximately

No data are available for the rest of the countries.

Annex II

COUNTRY REPORTS

Algeria

Cyprus

Egypt

France

Greece

Italy

Malta

Morocco

Portugal

Spain

Syria

Tunisia

Turkey

Algeria

1. Surveillance

1.1 Epidemiological data in man

The numbers of operated hydatid cysts in the country, according to retrospective studies for the years 1966 to 1975, were as follows:

First study	1966	1967	1968	1969	1970	TOTAL
(1966-1970)	365	273	412	559	474	2083
Second study	1971	1972	1973	1974	1975	Total
(1971-1975)	584	585	637	664	752	3222

One can see in this table that, from 1966 to 1975, the numbers of operated patients doubled. This is explained by the better distribution and establishment of surgery facilities on the national territory.

The rates of operated cases per 100 000 inhabitants were: 5.6 in 1963, 3.4 in 1966-1970 and 4.6 in 1971-1975. These figures may be doubled without any great risk of error because some surgeons do not cooperate properly with the researchers and many people with hydatid cysts do not consult a doctor. Female patients were slightly more numerous than male.

1.2 Epidemiological data in animals

Two retrospective surveys have been carried out: the first in slaughter-houses for four big towns (Algiers, Annaba, Constantine and Oran) on 6000 slaughtered animals; the second in the abattoirs of Algiers only from 1968 to 1970 on 1 748 062 slaughtered animals. The results were as follows:

Species of animal	Percentage of infestations	
	First survey	Second survey
Camels	40	40.2
Sheep	20.3) 15.5
Goats	12.3	
Bovines	11.2	5
Horses	1.5	1.3
Figs		0.7
Total		14.5% of animals were infected

The number of dogs infested by E. granulosus is not known.

2. Prevention and control

A programme of health education is in the course of elaboration (films, posters), but up to now only an educational flash on the mode of contamination is broadcast periodically on television.

No census of dogs has been done; their number is estimated to be 700 000, with 90% in rural areas. A system of dog fees does not exist. No restriction of the number of dogs per family is imposed. Kennels exist in big towns for the elimination of stray dogs, but this arrangement is inadequate. Sterilization is not applied.

Treatment of dogs is done on a private and individual basis.

3. Laboratory services

Services are provided by:

- Parasitology Unit of the Pasteur Institute of Algeria, rue du Docteur Laveran, Algiers;
- Unit of Veterinary Microbiology and Epizootology, Pasteur Institute of Algeria, rue Ahmed Cherifi, Kouba, Algiers.

4. Socioeconomic consequences

Losses in 1977 due to destruction of condemned meat amounted to US \$3 500 000.

5. Scientific publications

Kadi, A. Thèse, Alger (1915).

Senevet, G. & Witas, P. Enquête sur l'échinococcose en Algérie. Archives de l'Institut Pasteur d'Algérie, 3: 432-456 (1926).

Congrès mondial du kyste hydatique (Alger, 1951). Afrique française Chir., 4: 9 (1951).

Pampiglione, S. L'hydatidose. Bull. INSP Alger, 2(3): 416 (1965).

Mokhtari, L. Epidémiologie du kyste hydatique en Algérie. Place de la localisation pulmonaire. Algérie Méd. Chir., 3(3): 85-90 (1966).

Pampiglione, S. & Mokhtari, L. Epidémiologie du kyste hydatique en Algérie. Dédution d'une enquête en milieu chirurgical. Deuxièmes Journées Médicales Maghrébines (Alger, 1966).

Ammar Khodja, M. Les conséquences socio-économiques de l'hydatidose pulmonaire chez l'enfant algérien. Thèse, Alger (1974).

Larbaoui, D. et al. Etude épizootique et épidémiologique de l'échinococcose en Algérie. Rev. Serv. Santé ANP, 6: 37 (1973). Algérie Méd., 2(3): 65-80 (1975).

Larbaoui, D. & Alloula, R. Epidemiology approach to hydatidosis in Algeria, based on two retrospective ten-year studies. Eleventh International Congress on Hydatidosis (Athens, 1977).

Grima-Badoc, Fr. Résultats d'une enquête d'épidémiologie parasitaire en 1977, dans la Daïra de Tamanrasset. Thèse, Toulouse (1979).

Cyprus

1. Surveillance

1.1 Epidemiological data in man

The disease is notifiable in the island. In 1978, 17 surgical cases were reported to the Ministry of Health, giving an incidence of 3.4 per 100 000 population. Before the control campaign was started, the average rate of operations was 12.9/100 000 per year (1936-1938 according to Marnagos). Unreported cases are not significant because a good reporting system has been established.

Usually, the diagnosis is made upon clinical examination with the aid of X-rays, the Casoni intradermal test, the indirect hemagglutination test, etc.

1.2 Epidemiological data in animals

Infection in animals aged less than 7 years is almost non-existent; it is confined to animals being born before or at the time the campaign was started (1971-1972).

Infection rates in 1979 were 7.3% in sheep, 0.2% in goats and 5.4% in cattle. In pigs, the disease has been completely eradicated. During the first half of 1980, infection levels in older sheep, goats and cattle were respectively 5.2%, 0.15% and 2.7%.

In general, sheep and goat production is confined in the central and coastal plains while cattle raising is undertaken around the main towns. On the mountains, goat production is more predominant. Infection is still found in sheep-producing areas, but not in the mountains.

All dogs in Cyprus are regularly examined for echinococcosis. In 1979, the infection rate of dogs was 0.03%. By the end of 1979, there were in the island 12 481 dogs (7465 male and 5016 female). During the first examination of 1980, the infection rate was 0.02%.

Three hundred foxes (*Vulpes vulpes*), examined at times for possible presence of *E. multilocularis* did not carry this cestode. Also, a small number of moufflons were found free. No wild wolves or other large wild canines exist in Cyprus.

Slaughter is controlled, i.e. allowed only in approved abattoirs fulfilling certain minimum requirements, including a provision that they must be fenced (dog-proof) and possess a pit or furnace for the elimination of infected viscera.

2. Prevention and control

2.1 Public information

A booklet of 62 pages, containing all basic information on echinococcosis, was printed and distributed to the personnel of the campaign, to village clubs, village presidents and other persons who were in a position to assimilate the material and transfer the ideas to others.

Specially trained female extension workers paid house-to-house visits to almost every family in every village of Cyprus and discussed the problem of hydatidosis in all its aspects with all the family. They also distributed the above-mentioned booklet.

Newspapers, pamphlets and posters were used.

An "anti-echinococcosis bulletin" was published every four months, containing information on all aspects of the campaign, infection of dogs and slaughtered animals, the number of exterminated stray dogs and the number of spayed bitches; it also contained a short story, written in Cypriot "slang" language, describing an incident related to the disease, and a list of names and addresses of those who were found breaching the control legislation, e.g. butchers slaughtering in the open or farmers slaughtering on the farm or owners of dogs who had not brought them for testing when requested to do so.

Other educational methods included a "farmer's hour" broadcast on the radio twice weekly, a "farmer's programme" shown on television once a week with information on the disease and announcements of dog-testing schedules, group lectures at village clubs in the evenings, etc.

2.2 Control of the dog population

Registration of dogs and their owners was carried out in an accurate way with the help of the teams of extension workers during their educational visits.

No direct tax is levied upon "dog ownership" as such, but upon registration each owner has to pay £8 (about US \$20) for each unspayed bitch annually and £1 for spayed bitches and male dogs. Also, a special fee of £1 per dog has to be paid each year at first examination. Licensing and examination fees collected annually are enough to defray the cost of running the campaign. These measures exert an indirect restriction on the number of dogs per owner.

Before other control measures could be taken, the elimination of all stray dogs had to be given priority. Relevant legislation vested the Veterinary Department with power to do this. Special teams were organized which were provided with special weapons, licences and cars. These teams visited the countryside continuously and gave euthanasia to stray dogs, i.e. any dog found wandering. They also checked that sheep-dogs did not roam away from the flocks. From 1971 to 1979, 65 173 stray dogs were eliminated, and the total population of dogs in Cyprus fell to one fourth.

Free-of-charge spaying of bitches was provided. The idea was successful. In 1979, 1903 female dogs were spayed, i.e. 48.4% of the total female dog population.

Mass treatment of dogs has not been applied in Cyprus. All dogs are tested with arecoline hydrobromide for the detection of infected dogs by the flotation pan method. All infected dogs are euthanized immediately upon detection.

Proper feeding of dogs has been repeatedly explained to owners who no longer give them raw offal.

3. Laboratory services

Services are provided by a central echinococcosis laboratory for research purposes and four mobile laboratories for the testing of dogs in rural areas.

4. Legislation

The provisions include:

- Law on Contagious Diseases (Animals) of 1949;
- Order No. 41/1-7-1977 (amendment of Article 2 of Chapter 52 of the Dog Law);
- Order No. 280/4-11-1977 on sheep-dogs, proper feeding of dogs, disposal of animal carcasses.

5. Evaluation of control programme

Before the campaign (1971), the human hydatidosis problem in Cyprus was one of the worst in the world, ranking second after that in Uruguay. The presence of *Echinococcus* cysts on the liver or lungs of livestock was the rule, and Cypriot butchers and shepherds thought that they were normal water storage organs for the hot dry summers.

Stray dogs were everywhere in the island.

At present, there is no stray dog problem in Cyprus. In the period 1971-1979, 65 173 stray dogs were destroyed. A law requires sheep-dogs to be fitted with a special muzzle, otherwise they are destroyed.

In 1979, 50% of the female dog population consisted of spayed bitches.

The infection rate in dogs fell from 6.82% in 1972 to 0.02% in 1980, i.e. a reduction of 99.7%.

Existing abattoirs were modified and construction of new ones was encouraged through long-term, low-interest loans given by the state to the local authorities. Now there are approximately 200 abattoirs, and slaughtering in the open is not permitted by law.

The figures given above in Section 1.2 show the reduction (almost the elimination) of the infection in farm animals.

As described above, at present the general public and those more directly concerned with the problem have been made well aware of all the aspects of the disease through the educational scheme.

The reduction of human incidence to one fourth of the previous level has been explained. Almost no young person is affected any longer by the disease; human suffering and deaths from this cause will be a bad memory of the past.

6. Socioeconomic consequences

Comparing the 15 cases which were reported to the Ministry of Health in 1978 and in 1979 with the 60 cases per year from 1936 to 1970, we note a reduction of 45 cases a year, meaning that approximately 450 persons were protected from infection in this period.

The value of public health cannot, of course, be assessed only in the context of money saved, since human suffering cannot be expressed in such cold terms. However, this great contribution of the Veterinary Department to public health protection, if one thinks of the money saved from surgery, medical care, loss of working days, etc., would be quite substantial.

Human wellbeing has been promoted through the increased productivity of food animals and economic improvement of the individual stock-breeder and the animal industry as a whole.

The value of the increased production has been estimated at over £100 000 per year.

7. Scientific publications

Marnagos, G. Surgical treatment of complicated hydatid cysts of the liver. Bulletin of Cyprus Surgical Society, 4: 483-494 (1969).

Polydorou, K. Hydatid disease in Cyprus. Bull. Off. Int. Epiz., 76: 611-619 (1971).

Polydorou, K. The control of the dog population in Cyprus as the first objective of the anti-echinococcus campaign. Bull. Off. Int. Epiz., 86: 705-715 (1976).

Polydorou, K. The control of echinococcosis in Cyprus. FAO World Animal Review, 33: 19-25 (1980).

Egypt

1. Distribution

For hydatidosis in man, there are not enough data.

The population of animals in Egypt is as follows:

Bovines (including buffaloes)	4 315 000
Sheep	1 878 000
Goats	1 349 000
Swine	150 000
Camels	101 000

There are 277 slaughter-houses in the 25 governorates of the country.

The following table shows the number of slaughtered animals, infected cases and their percentage in 1979:

Kind of animal	Number slaughtered	Infected cases	Percentage
Bovines	991 869	361	0.03
Sheep	431 860	1 323	0.3
Goats	23 515	201	0.85
Swine	55 645	2 923	5.2
Camels	44 835	4 644	10.3

All these infections were in the lung and liver; two thirds of them were in the lung.

In dogs, studies are done and the preliminary results show an infection rate reaching 2.5% in dogs living in the vicinity of abattoirs.

2. Control

The number of dogs and cats destroyed and the number of dogs registered in the years 1975, 1976 and 1977 were as follows:

Year	Destroyed		Registered dogs
	Dogs	Cats	
1975	104 505	6 925	8 666
1976	132 766	8 031	10 453
1977	106 082	6 859	7 926

A project to minimize stray dogs in the Cairo and Giza provinces was started recently. Euthanizations in July and August totalled 1181 and 1239 in Cairo and 1350 and 625 in Giza.

Anthelmintic treatment of dogs will be undertaken as soon as trial and registration of the drug in Egypt is completed according to the law.

France

1. Distribution

Hydatidosis is not a notifiable disease in France, but epidemiological surveys have provided information on the disease.

Corsica is the most affected region of the country. In this island, each breeder has 5-6 dogs and 20% of slaughters are uncontrolled. The human infection rate in the years 1966-1970 was 13:100 000, and this situation continues. At the beginning of the century, Normandy was one of the principal zones of endemicity. Today, it is almost free of the disease since sheep are now kept in closed pens and the sheep-dogs no longer needed. Another reason is that the new breeds of sheep are suitable for slaughtering before the age of one year, and this has helped to eliminate the focus since the hydatid cyst needs months to be fertile.

Landes is another region which is no longer a zone of endemicity, but a focus is appearing or being discovered in the Pyrenees. Surveys showed the following human infestation rates in 1945-1954:

Landes	2.4:100 000
Atlantic Pyrenees	4.2:100 000
Pyrenees zone and South Pyrenees (south-west of Gave de Pan)	5.3:100 000

Recent surveys (1975) suggest that the focus today is in the Pyrenees and no longer in Landes.

A study of 564 operated patients in 1966-1971 in south-eastern France by usual place of residence showed the following distribution:

Continental France (mainly Bouche-du-Rhône)	30%
Corsica	35%
North Africa	30%
Other countries	5%

The infestation rate in the five departments of south-eastern France was 4.5/100 000. The expansion of the parasite in this region is due to the increase of sheep breeding and to secret slaughtering.

Isolated human cases exist in other departments also. Abdominal siting of cysts is more frequent (60%) than thoracic (36.5%). The liver is most affected (54%).

The main animal host is the dog. The usual intermediate host is the sheep, but in Corsica pigs were also noticed. In Corsica, the following infestation rates were found in 1948-1958: sheep 46%, cattle 22%, pigs 24%.

2. Laboratory diagnosis

Radiological investigations are used to detect a cystic tumour, including simple radiography, echotomography, tomodensitometry, scintigraphy.

Immunological techniques are used to confirm the hydatid nature of a cystic tumour and in following up hydatidosis patients after operation.

The following serological methods are used in France.

- (a) Complement fixation.
- (b) Agglutination by latex. Not specific; must be verified by other techniques.
- (c) Hemagglutination. Simple and quick; sensitivity between 66% and 100% according to different writers.

(d) Immunoelectrophoresis (IEP). It has been found that the presence of specific antibodies of hydatidosis is shown by the appearance of a specific precipitating system, the arc-5 of the electrophoretic picture. The presence of this arc is important, because it is characteristic of hydatidosis and does not involve cross-reactions with the other worms.

(e) Immunoelectrodifffusion. Simple and quick.

(f) ELISA or enzyme-linked immunoabsorbent assay. This method has many advantages. It needs only very small quantities of antigen (some micrograms per reaction) and small quantities of serum. It permits quantitative results from just one dilution of serum. It is absolutely specific on condition that only fraction 5 is utilized.

(g) Indirect immunofluorescence (IIF). Good sensibility and specificity; simple execution.

(h) Immunoenzymatic reaction (IER).

(i) Intradermal test of Casoni. Specificity and sensitivity questioned, with reference not only to technical conditions but also to the quality of the antigen used.

3. Prevention

In endemic regions, it is important to encourage personal hygiene in respect of hands, food and potable water. Dogs should be kept far from eating places and kitchens. Health education campaigns should be undertaken.

Measures for exposed workers, such as veterinarians and kennel staff, include wearing of gloves and sterilization of material and work clothes. Periodic screening of these occupational groups and of shepherds and animal breeders for early diagnosis of the disease seems indicated.

Animal prevention, an important requirement, is the responsibility of the Ministry of Agriculture.

Greece

1. Distribution

Hydatidosis is not a notifiable disease in Greece, and only hospitalized human cases are recorded. In 1978, these numbered 1140 (545 males, 595 females). The disease affects people of any age and any occupation. Human cases are distributed all over Greece, and no department of the country is free (see Tables 1-5).

Table 1. Patients hospitalized for hydatidosis in Greece, by place of permanent residence, 1973-1976

Place of residence	Number of patients				Total
	1973	1974	1975	1976	
Greater Athens	319	285	286	276	1166
Rest of central Greece and Eubea	243	177	170	199	789
Peloponnesos	197	176	162	147	682
Ionian Islands	34	22	14	13	83
Epirus	51	37	42	59	189
Thessaly	112	93	89	90	384
Macedonia	266	221	208	205	900
Thrace	70	50	63	32	215
Aegean Islands	46	36	42	36	160
Crete	49	34	45	47	175
Abroad	4	2	1	4	11
Not declared	40	26	49	51	166
Total	1431	1159	1171	1159	4920

Table 2. Distribution of 1392 human cases of hydatidosis from 42 prefectures of Greece, by the organs where the cysts were found

Year	Number of cases	Localization of cysts								
		Liver	Lung	Kidney	Liver and lung	Abdomen	Peritoneum	Spleen	Liver and stomach	Multiple
1965	249	107	113	3	6	7	2	5	1	3
1966	270	111	135	3	2	10	2	3	-	3
1967	281	121	134	1	5	10	-	4	1	4
1968	298	144	121	3	1	13	2	5	-	8
1969	294	160	105	4	5	9	2	-	2	4
Total	1392	643	608	14	19	49	8	17	4	22

Table 3. Patients hospitalized for hydatidosis in Greece,
by occupational group, 1973-1976

Year	Number of patients	Occupational group								
		Profes- sional, free and related jobs	Senior adminis- trators and managers	Cler- ical and rel- ated jobs	Tradesmen, sellers	Service workers	Farmers, breeders, fishers, loggers	Craftsmen, labourers (not in agricul- ture), transport jobs	Not class- ified	Other (inclu- ding children, students, retired, disabled)
1973	1431	16	1	48	20	14	187	147	25	973
1974	1159	10	-	56	17	15	152	118	20	771
1975	1171	20	2	38	30	12	151	96	30	792
1976	1159	9	1	64	12	22	157	109	39	746
Total	4920	55	4	206	79	63	647	470	114	3282

Table 4. Patients in the same occupational groups hospitalized for brucellosis
infectious diseases and all diseases

Type of disease	Number of patients	Occupational group								
		Profes- sional free and rela- ted jobs	Senior admin- istra- tors and mana- gers	Cler- ical and rel- ated jobs	Trades- men, sellers	Service workers	Farmers, breeders, fishers, loggers	Crafts- men, labour- ers fishers, loggers	Not class- ified	Other (inclu- ding chil- dren, stud- ents, retired, disabled)
Brucellosis	2 484	15	-	34	18	24	929	151	35	1 278
Infectious and parasitic diseases	44 509	479	28	1 263	385	545	3 901	3 498	848	33 548
All diseases	1 032 543	17 938	1 227	48 194	11 746	13 253	60 281	91 619	23 688	764 597

Table 5. Distribution of all patients hospitalized in Greece for hydatidosis, by sex and age, 1979-1976

Age groups	Male					Female					General total
	1973	1974	1975	1976	Total	1973	1974	1975	1976	Total	
0-29 days	1	-	-	-	1	-	-	-	-	0	1
1-11 months	-	-	-	-	0	1	1	-	-	2	2
1-4 years	7	2	6	6	21	11	7	1	2	21	42
5-9 years	38	28	19	30	115	16	15	11	12	54	169
10-14 years	38	33	23	20	114	22	18	17	10	67	181
15-19 years	41	21	38	25	125	27	6	21	13	67	192
20-29 years	72	68	65	72	277	66	66	60	40	232	509
30-39 years	68	65	73	44	250	85	70	74	73	302	552
40-49 years	128	110	106	132	476	163	122	118	99	502	978
50-59 years	101	81	74	100	356	122	97	105	109	433	789
60-69 years	117	81	97	110	405	110	124	113	121	468	873
70-79 years	73	58	55	53	239	80	59	61	58	258	497
80-89 years	10	7	15	10	42	19	12	12	12	55	97
90-99 years	-	1	1	1	3	2	1	-	1	4	7
Unknown age	5	5	3	3	16	8	1	3	3	15	31
Grand total	699	560	575	606	2440	732	599	596	553	2480	4920

A recent survey^a on the frequency of infection during meat inspection in slaughter-houses showed the following rates:

Bovines 2-3 years old	7.38%
Bovines over 3 years old	24.13%
Sheep 1-2 years old	12.21%
Sheep over 2 years old	60.80%
Goats 1-2 years old	1.09%
Goats over 2 years old	10.31%

Another investigation showed the following proportion of infected dogs in a small provincial town and 28 rural communities:

- 14.1% of dogs in the town;
- 28.9% of dogs in the rural communities;
- 50.4% of sheep-dogs.

2. Control

A national campaign has been formulated, providing for health education, collection of stray dogs, administration of anthelmintic drugs, destruction of condemned offal and other measures.

The relevant law (No. 829/1978) has been passed; 200 more veterinarians have been recruited; all veterinary stations have been supplied with anthelmintic drugs, anaesthetic guns, material for dog registration, etc.; and the necessary financing of each activity has been assured.

The first step of the campaign was a pilot programme in one island and the administration of anthelmintic drugs to all sheep-dogs under the supervision of the veterinary officers.

^a Pigs are less infected (approximately 1.8%). Eighty per cent of the slaughtered animals are inspected and contaminated offal is destroyed in slaughter-houses all over Greece.

Italy

1. Distribution

The total number of reported human cases of hydatidosis has oscillated annually between a maximum of 58 in 1965 and a minimum of 6 in 1961, with an average of 33 a year. The numbers are much lower than the 1000 cases recorded annually during the period preceding 1955. The difference between males and females is more obvious in the death rates (823 males versus 615 females from 1960 to 1974). All age groups are subject to the infection, including babies and very small children. As far as occupation is concerned, farmers, factory workers and housewives are more frequently affected. Although the disease occurs all over the country, a higher number of cases is reported from the regions of Latium and Sardinia. The distribution by month does not show any predilection for a particular month or season.

Despite the legal requirement to report the disease, the statistical data available to the Ministry of Health are incomplete. The inadequacy of reporting is shown by the difference between death rates and morbidity rates (see Table 1 and Fig. 1). A study on human echinococcosis in Sardinia in the period 1969-1973 showed a rate of 13.32 cases per 100 000 inhabitants, i.e. cases of carriers not necessarily suffering. In some areas, the percentage of infected persons reaches 0.5%. For diagnosis, all currently adopted methods are applied, including serological tests.

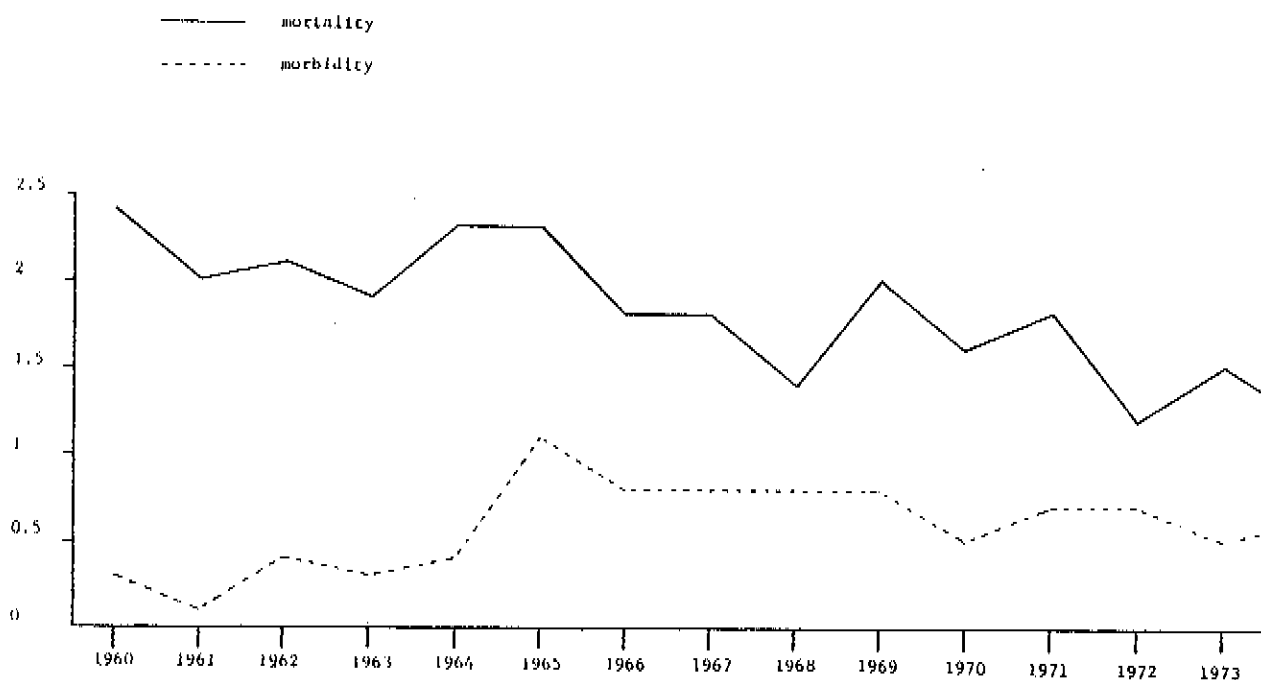
Table 1. Hydatidosis morbidity and mortality rates, classified by sex, Italy, 1960-1974

Year	Morbidity		Mortality	
	Male	Female	Male	Female
1960	0.3	0.3	2.8	2.0
1961	0.2	...	2.6	1.5
1962	0.4	0.4	2.9	1.4
1963	0.3	0.2	2.3	1.6
1964	0.6	0.2	2.7	2.0
1965	1.1	1.2	2.5	2.0
1966	0.9	0.7	2.2	1.4
1967	0.6	1.0	1.8	1.8
1968	0.9	0.7	1.3	1.4
1969	0.7	0.9	2.1	1.9
1970	0.5	0.4	1.9	1.2
1971	0.8	0.6	2.1	1.4
1972	0.9	0.5	1.4	1.0
1973	0.4	0.5	1.6	1.4
1974	0.6	0.6	1.2	1.2

The rates of slaughtered animals found infected with hydatid cysts in Italy in 1968-1978 ranged as follows: sheep, from 15.2% (1970) to 8.1% (1976); goats, from 8.9% (1978) to 3.7% (1968); cattle, from 2.3% (1969) to 1.0% (1977); pigs, from 1.9% to 0.7%; horses, from 0.9% to 0.4%.

Observing the geographical distribution of animal infection, one can see very great differences in infection of all receptive species between the various Italian regions. The percentages of hydatidosis positivity at slaughter oscillate in cattle from an average of 0.03% (Liguria) to 22% (Sardegna), and in sheep from an average (1972-1978) of 0.4% (Liguria) to 53.8% (Sardegna); the same happens with goats and pigs. The north-western regions (Piemonte, Valle d'Aosta, Liguria) are approximately free of the disease and the southern regions (Basilicata Sicilia, etc.) and Sardegna are heavily affected.

Fig. 1. Hydatidosis morbidity and mortality rates, Italy, 1960-1973



A total of 3 113 863 dogs was calculated for the whole country, distributed as follows: registered, 1 513 968; non-registered, 1 161 286; strays, 438 609. Out of this total, 5.8% of dogs were treated against echinococcosis.

There are no further data regarding the infection in dogs.

2. Laboratory services

Services are provided by:

- Institute of Pathological Anatomy of the Catholic University of Rome;
- Laboratory of the Hospital of Infectious Diseases of the University of Rome;
- Laboratory of Immunology of the Higher Institute of Health.

3. Legislation

The relevant provisions are Articles 53 and 58 of Law No. 833/1978 on establishment of the national health service.

4. Socioeconomic consequences

It has been calculated that hydatidosis is responsible for a total annual loss of 8-9 billion Italian lire for hospitalization, surgery and absenteeism.

Malta

1. Distribution

Only one to two human cases are recorded yearly. The diagnosis is made by clinical presentation and Casoni test. Unrecorded cases seem to be not significant.

In 1979, less than 10 animal cases were found at the abattoir. Geographical distribution is not applicable.

2. Control

A survey on dogs infected with E. granulosus is being carried out. Wildlife is practically non-existent. Slaughter is not done on farms. Any food intended for dogs is cooked. Control of imported animals is carried out.

No campaigns are done for public information. Registration (licensing) of all dogs is compulsory. A licence fee is paid. Unwanted and stray dogs are eliminated. Sterilization is carried out on request, especially on female dogs. Hormonal control is available on prescription by veterinary surgeons.

Mass treatment of dogs is not carried out.

3. Laboratory services

No laboratories specialized in hydatidosis research and control exist in Malta.

4. Legislation

There is no specific legislation. Under meat inspection regulations, it is illegal to slaughter any animal for human consumption except in a recognized slaughter-house where ante- and post-mortem inspection is carried out.

5. Socioeconomic consequences

The socioeconomic consequences are not at present of major importance. Serious consideration is, however, being given to a programme of total eradication of the disease.

Morocco

1. Surveillance

1.1 Epidemiological data in man

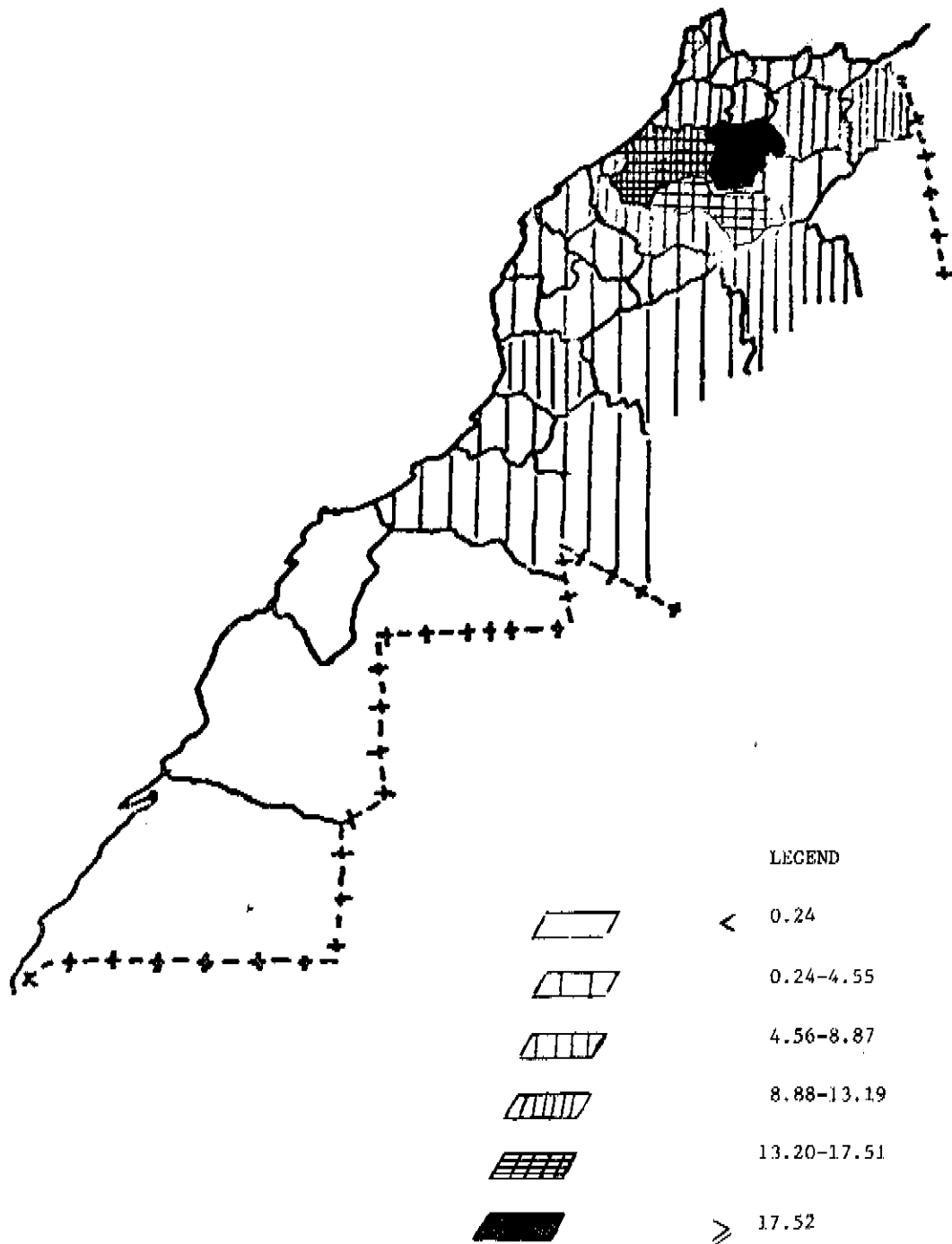
A survey done on a national scale to record every hospitalized case during the years 1978 and 1979 showed 1448 cases in these two years, giving an incidence rate of 7.76 per 100 000 population. The geographical distribution of these cases is presented in Table 1 and Fig. 1 and shows that:

- rates vary according to provinces from 0.24 to 21.84 per 100 000 population;
- the disease occurs mostly in the central-northern part of the country; Fès is the most heavily affected province.

Table 1. Retrospective survey on hydatidosis, 1978-1979:
incidence rates by province (per 100 000 population)

Province	Median population 1978-1979	Number of cases recorded	Incidence rate
Agadir	905 500	55	6.07
Al Hoceima	300 000	4	1.32
Azilal	392 000	1	0.24
Beni Mellal	579 000	45	7.76
Ben Slimane	153 900	18	11.68
Boujdour			
Boulemane	132 500	4	3.01
Casablanca	2 191 100	136	6.20
Chaouen	296 900	2	0.66
El Jadida	699 900	29	4.14
El Kelaa	564 600	13	2.30
Errachidia	401 000	19	4.72
Essaouira	430 000	10	2.32
Es-Semara			
Fès	769 000	168	21.84
Figuig	103 600		
Guelmim			
Kenitra	1 172 000	64	5.46
Khémisset	423 000	74	17.48
Khenifra	297 500	58	19.48
Khouribga	416 000	66	15.84
Laayoune			
Marrakech	1 204 000	47	3.90
Meknès			
(including Ifrane)	755 700	150	19.84
Nador	599 000	13	2.16
Ouarzazate	597 400	9	1.50
Oued-Eddahab			
Oujda	730 900	75	10.26
Rabat	825 000	144	17.44
Safi	647 600	23	3.54
Settat	717 600	42	5.84
Tanger	347 500	48	13.80
Tan-Tan	25 300	2	2.34
Taounate	521 000	3	0.57
Tata	149 900	1	0.66
Taza	647 400	46	7.10
Tetouan	663 500	33	4.96
Tiznit	399 700	5	1.24
Undetermined		81	
Whole country	19 152 000	1488	7.76

Fig. 1. Retrospective survey on hydatidosis, 1978-1979: incidence rates by province
(per 100 000 population)



Distribution by sex shows a predominance of female cases of 816:672.

Distribution of cases by age shows that the disease affected all ages from a girl one year old to a patient 85 years of age. The greatest morbidity is in the age group 40-45 years.

The sites of the cysts are found to be mainly in the liver and the lungs. Pulmonary cysts are more frequent, being present in 826 cases out of the 1488, but far more liver cysts were in female patients than in male (see Table 1 and Fig. 1).

1.2 Epidemiological data in animals

Table 2 gives the results of a survey done by the Parasitology Department of the Agricultural and Veterinary Institute Hassan II, Rabat, which showed infestation of stray dogs inside Rabat and in the open markets (souks) of this region.

Table 2. Infestation of stray dogs by E. granulosus

Origin of dogs	Number examined	Percentage infested	Average number of parasites
Town of Rabat	58	0	0
Souks of the region	49	24.5	38

Older dogs were more frequently infested.

1.3 Infestation of livestock

Table 3 shows the infestation of animals examined post-mortem in slaughter-houses of the town of Rabat and in the souks of the Rabat region according to another survey of the same Institute in 1979-1980.

Table 3. Infestation of slaughtered animals

Kind of animal	Number examined in:		Percentage found infested in:	
	abattoirs	souks	abattoirs	souks
Bovines	2163	418	21	36
Sheep	1733	513	0.7	0.7
Goats	-	510	-	1.4
Camels	35	-	85	-
Equines	500	-	3.5	-

Robert, in 1927, found 85% of bovines and 23% of sheep infested, while Briouga, in 1974, found 34.8% and 1.2% rates respectively.

Though the infestation rate of camels and equines is relatively high, these animals seem to play a less important role in the epidemiology of the disease, because they are slaughtered in the slaughter-houses of Rabat where the sanitary regulations are respected, whereas the souks, where the other animals are slaughtered, are frequented by dogs which obtain parasite-infested organs before any sanitary inspection.

2. Control

The elimination of unwanted and stray dogs is the principal measure.

3. Laboratory services

Services are provided by the Laboratory of Parasitology and Parasitic Diseases, Agricultural and Veterinary Institute Hassan II, PO Box 704, Rabat.

4. Legislation

According to Article 5 of the Decree of Visir (29 July 1927), stray dogs must be destroyed by shooting and their carcasses must be buried.

5. Scientific publications

Robert, E. Le Kyste hydatique au Maroc. Thèse Doct. Vétérinaire, Toulouse (1927).

Briouga, J. Echinococcose hydatique au Maroc: épidémiologie et prophylaxie. Thèse Doct. Vétérinaire, Alfort (1974).

Portugal

1. Distribution

From 1972 to 1978, 80-100 persons were operated per year. In the years 1970-1975, 83 persons died from the disease (average 14 yearly).

According to statistical data from slaughter-houses in 1977, the following quantities of meat and viscera in kilos were rejected:

Bovines	19 216
Sheep	10 459
Goats	834
Pigs	44 665
Total	75 174

Major incidence was found in the districts of Portalegre, Evora and Beja.

As far as dogs are concerned, we presume, based on different surveys, that in the zones of greater incidence the proportion of infested dogs is about 10%.

2. Control

Many plans for the information of the public in general and of special groups (physicians, veterinarians, meat workers, teachers, policemen, children) exist.

Dogs are registered and a licence is given to owners. In 1979, the number of registered dogs in the country was 667 290. Fees are paid annually according to the use of each dog. Licences for luxury dogs cost more than for hounds, and these more than licences for guard dogs.

Municipal services capture stray dogs and cats: 9208 dogs and 2283 cats were seized in 1979.

For mass treatment of dogs, anthelmintics of the type of praziquantel and bunamidine were used in the campaign of 1979.

3. Laboratory services

Laboratories specialized in hydatidosis research and control are:

- Evora Laboratory, National Institute of Veterinary Medicine, 70001 Evora Codex;
- Parasitology Centre, Veterinary Faculty, Technical University of Lisbon, Rua Gomes Freire, 1100 Lisbon.

4. Legislation

The provisions include:

- (a) General Regulation of Animal Health (1889);
- (b) Provisions on sanitary control and registration of dogs with special attention to prevention of rabies, contained in:
 - Decree No. 11241 of 16 November 1925;
 - Decree No. 18725 of 2 August 1930;
 - Decree No. 28467 of 14 February 1938 (importation control);
- (c) a further act on dog control, now in preparation.

5. Scientific publications

Silva Leitao, J.L. Estudos sobre equinococose. A parasitose em Portugal, sua extensao e importancia (1947).

Gomes Dias, R. Elementos para uma campanha contra a hidatidose (1959).

- Silva Leitao, J.L. Referencia à equinococose em Portugal (1960).
- Alves da Cruz e Carvalho Varela. L'échinococose-hydatidose au Portugal. Contribution à l'étude de la maladie chez les ovins et porcins. Distribution géographique nationale (1960).
- Acerca da equinococose em Portugal. Relatório de Estágio da Escola Superior de Medicina Veterinária de Francisco Palma Garrito (1970).
- Ferreira, L. Alguns aspectos da patologia da equinococose-hidatidose em Moçambique (1972).
- Silva Leitao, J.L. & Cruz e Silva, J.A. Acerca de quatro antroponoses parasitárias em Portugal metropolitano: leishmaniose canina, toxoplasmose canina, equinococose (*E. granulosus*) e larvas migratórias viscerais (*Toxocara* spp.) (1972).
- Borges Ferreira, L. Subsídio para o estudo de uma campanha contra a equinococose-hidatidose (1973).
- Borges Ferreira, L. Aspecto formal de uma campanha contra a equinococose-hidatidose (1975).
- Borges Ferreira, L. Hidatidose (Homem e animais) (1975).
- Cruz e Silva, J.A. A equinococose-hidatidose (1975).
- Borges Ferreira, L. A colaboração das populações no combate ao quisto hidático (1976).
- Borges Ferreira, L. & Teixeira, M. A equinococose-hidatidose em Portugal. Suas incidências na economia pecuária e na Saúde Pública (1978).
- Borges Ferreira, L. A equinococose-hidatidose nos animais (1978).
- Borges Ferreira, L. Profilaxia da equinococose-hidatidose (1979).
- Borges Ferreira, L. As campanhas de luta contra a equinococose-hidatidose em Portugal (1979).
- Borges Ferreira, L. O plano Artigas na luta contra a equinococose-hidatidose no uruguaí e a sua possível aplicação em Portugal (1980).
- Borges Ferreira, L. A equinococose-hidatidose na região do Alto Alentejo. Epidemiologia e clínica (de colaboração com J. David de Moraes) (1980).
- Borges Ferreira, L. A importância da educação sanitária das populações nos programas de luta contra a equinococose-hidatidose (1980).

Spain

1. Distribution

Spanish legislation does not impose an obligation to notify cases of human hydatidosis. The available figures are only approximate, but they demonstrate that 87% of studied cases are of rural origin.

The rates of infestation in the different animal species are:

	<u>Young</u>	<u>Adult</u>
Sheep	1.12	6.04
Goats	0.19	1.11
Bovines	0.12	3.56

Pigs are infested in a proportion of 5%

Goats and pigs are more affected in Andalusia, sheep in Castilla and bovines in Valencia.

The average infestation rate in dogs is 5%-6%, taking into account great differences between dogs in urban and rural areas. Research is carried out in three Spanish provinces to isolate E. granulosus from the intestines of dogs through post-mortem autopsy.

2. Control

Official dog control campaigns are organized twice a year among all registered dogs. The spring campaign is combined with rabies vaccination, but all dogs are not, in fact, registered. In the official laboratories of the regional delegations of the Ministry of Health and Social Security, a faeces test is done on 5% of treated animals. Treatment is offered free, using praziquantel. For control of infestation, bromhydrate of arecoline is used.

Before each campaign, intense work in public health education is accomplished, through communication media (meetings, posters and information of schoolchildren). For future campaigns, television, radio and the press will be used.

Intensified educational efforts are made to reach the rural population and ensure that infected animal parts are incinerated.

3. Socioeconomic consequences

In 1979, the budget to combat hydatidosis in dogs amounted to 60 million pesetas.

Losses due to condemned meat in 1970 were 111 million pesetas.

Syria

1. Distribution

Hydatidosis is a public health problem in Syria, although it is not considered the major one for the time being.

2. Control

According to the figures obtained from the public health services, 125 cases were operated during the year 1975 in the different hospitals of the country; 52% of these cases occurred among people less than 40 years old. Three patients died after operation.

Among the 125 human cases, 74 had cysts located in the liver (27 with multiple cysts), 47 had extra-hepatic cysts (9 with multiple cysts) and 4 had cysts in the liver and other organs.

There is no reliable information about the prevalence of the disease in animal herds. Some losses are caused by condemning infected viscera (particularly livers) in slaughter-houses.

3. Control

The following measures are taken in cooperation with the competent authorities:

- treatment of owned dogs;
- destruction of stray dogs;
- incineration of infested viscera;
- administrative measures;
- regular registration as a base for statistical studies.

Dog keeping in Syria is limited to certain families and foreigners. The Syrians are not accustomed to keeping dogs and some people dislike them. This may help to keep the cycle dormant and the rate of incidence more or less low.

Tunisia

1. Surveillance

1.1 Epidemiological data in man

Notified human cases in 1976-1978 were as follows:

Year	1976	1977	1978	Total
Cases	177	258	289	724

The regions of greater incidence in these years and the percentages of the respective cases in relation to those in the country as a whole were as follows:

Region (governorate)	Total cases in region 1976-1978	Percentage in relation to country as a whole
Tunis	145	20
Zaghouan	18	2.6
Bizerte	72	10
Nabeul	32	4.5
Sousse	48	6.6
Monastir	30	4
Mahdia	40	5.5
Beja	23	3
Jendoub	18	2.5
Le Kef	87	12
Siliana	28	4
Kairouan	120	16.5
Kasser	34	4.7
Sfax	14	2
Gafsa	7	1
S. Bouzid	5	0.7
Gabes	-	-
Medenine	3	0.4
Total	724	100

It seems that the regions with the greatest concentration of patients with hydatid cysts are those where, by tradition, breeding of small ruminants takes place. Tunis, the capital, does not reflect the real situation because of the rural exodus of the last years and the number of patients who live with their families in Tunis.

The diagnostic methods used are clinical and radiographic.

There are more non-notified than recorded cases, because physicians do not inform the health services properly. In fact, a survey carried out for the years 1973-1975 gave the following results:

Year	Real number of operated cases (A)	Notified cases (B)	Percentage (B:A)
1973	599	161	27
1974	612	177	29
1975	630	179	28
Total	1841	517	28

Thus, the official figures represent only 28% of the actual operated cases. Of course, more patients without obvious symptoms do not go for consultation.

1.2 Epidemiological data in animals

The following data about animal infestations were collected from veterinary inspectors in slaughter-houses:

Slaughtered animals				Infected animals			
Bovines	Sheep	Camels	Pigs	Bovines	Sheep	Camels	Pigs
31 882	297 930	89	210	5 200 (16.3%)	52 702 (18%)	32 (36%)	53 (25%)

No study on the percentage of dogs infected by E. granulosus is known. It is thought that wild canines do not play any major role in human infection.

2. Control

2.1 Public information

Every year during Aïd El Kebir (the feast when families slaughter sheep), a small information campaign is made on radio and in newspapers. Occasionally, other measures are taken in the field of health education on hydatid cysts. A round-table discussion was organized on television, with a film projection and participation of the spectators.

2.2 Measures relating to dogs

The canine population is controlled through the destruction of stray dogs.

Every veterinary officer who receives a dog for vaccination prescribes before immunization an anthelmintic (piperazine salts) against intestinal worms, but nothing specific against E. granulosus.

3. Laboratory services

Services are provided by the Pasteur Institute of Tunis (research).

4. Scientific publications

Ben Osman, F. Considerations épidémiologiques sur l'hydatidose animale en Tunisie.

Brahmi, C. Hydatidose humaine et animale en Tunisie. Thèse de doctorat vétérinaire.

Turkey

Echinococcosis/hydatidosis is a notifiable disease in Turkey. Post-mortem examination of animals in slaughter-houses is done by veterinarians, and the affected organs (lungs, liver, etc.) are burned in slaughter-houses where incinerators exist or otherwise buried in the ground and not allowed to be eaten by dogs. However, in slaughtering done in the countryside, this precaution is not observed and the diseased organs are fed to dogs. The veterinarians are trying to prevent this by public education and training of animal owners in the countryside.

As in rabies control, unowned dogs are killed by municipalities or muhtar authorities in villages, and dog control in respect of hydatidosis is also carried out.

Confirmed number of echinococcosis cases in animals in slaughter-houses, 1979

Species of animal	Number slaughtered	Cases of hydatid infestation	
		Lungs	Liver
Sheep	6 229 351	83 692 (1.34%)	76 193 (1.22%)
Goats	948 595	2 670 (0.28%)	9 953 (1.04%)
Cattle	2 188 275	37 845 (1.72%)	24 149 (1.10%)

Annex III

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