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ANNEX 1 List of participants                                           31
1. INTRODUCTION

The World Health Organization discussed the feasibility of a global or regional approach for rabies elimination from urban areas at a consultation held in Geneva from 11-13 December 1989. Dr T. Bektimirov, Assistant Director-General, welcomed the participants (see Annex 1) in the name of Dr Hiroshi Nakajima, Director-General of the World Health Organization. He described the potentials for international cooperation in urban rabies elimination and stressed the need for a critical assessment of resources and management for elimination of this infection. Dr J. Blancou was elected Chairman and Dr H. Koprowski Vice-Chairman of the meeting. Drs M. Frith and W.A. Millinga served as Rapporteurs.

In about 90 countries and territories, rabies is still prevalent in its most dangerous reservoir, the dog population. About 2.8 billion people live in these areas, where, in each year, about 30 million doses of vaccine are administered to people after exposure, the number of deaths due to rabies transmitted from dogs is estimated to be around 30,000. Transmission from dogs represents more than 99% of all human cases reported worldwide. Moreover, more than 90% of all persons receiving rabies postexposure treatment in the world live in areas of canine rabies.

In view of the significance of this disease, especially for developing countries, zoonoses control programmes of WHO have for many years coordinated research and field work on canine rabies control. This has principally concerned the development of adequate technologies and their transfer, improvement in surveillance, vaccine development, dog ecology, economics, management guidelines and systems research on intersectoral cooperation and community participation (list of documents Annex 2). Operational research has been launched by WHO in a number of countries.

Whereas it seems that the necessary knowledge and methodology for eliminating the disease are available, it remains a critical question as to whether the elimination of the infection from its canine reservoir in urban areas is feasible at this stage, not only from a national point of view but on a regional or even a global scale and what its impact would be on the rabies problem in general (for example, wildlife rabies).

The overview of the current rabies situation by country shows that some progress has been made in Latin American countries and in a few areas of the other regions, whereas Europe (except for Turkey) is free of urban rabies. Rabies has been spreading through canine populations in wide areas of Africa during the past two decades and its incidence is increasing in other continents in conjunction with increasing urbanization, density and mobility of human populations. Control programmes are inadequate in the absence of national schemes aiming at the elimination of the infection. Thus the number of persons requiring rabies treatment after animal bites is increasing. In some countries these figures have almost doubled over the past 10 years, which must be seen in connection with the improvement of safety, potency and increasing costs of vaccines and immunoglobulins.
The consultation based its analyses on the following pre-conditions and principles. That:

1. communities cooperate by providing personnel and the means to assist veterinary and public health services in public education and vaccination programmes;

2. government or community institutions bear the expense of vaccine and its application. Dog owners may bear, or share, the cost of vaccine and its application only when it can be assumed that this does not decrease the willingness of the people to cooperate and the percentage of dogs vaccinated;

3. the community is actively involved in dog vaccination (i.e. responsible for the presentation of dogs for vaccination) and in the surveillance of rabies;

4. dog population management adapted to social conditions is a desirable component of the programme. Dog elimination in this connection is not to be considered as a useful component of dog rabies control unless ecological studies prove its effectiveness in reducing the dog population density and the contact rates without impairing the cooperation of the public in the programme;

5. urban dog rabies control programmes are only viable and effective if sustainability is ensured from the earliest stages; and

6. projects are planned for rabies-free status in areas sufficiently large to guarantee the desired benefits, including a significant reduction in human postexposure treatments.
2. APPROPRIATE TECHNOLOGIES FOR GLOBAL CONTROL AND ELIMINATION OF URBAN RABIES

The group agreed that the technological pre-requisites consist of the following:

a. Potent vaccine
b. Mass dog vaccination procedures
c. Dog population management techniques
d. Adequate rabies diagnostic techniques
e. National, regional and global surveillance systems

2.1. Vaccine Types, Production or Procurement Methodologies

2.1.1 Current situation

In most countries where canine rabies is endemic, modified live virus (MLV) and inactivated brain tissue are the vaccines most commonly produced. However, most countries are moving from MLV to inactivated virus vaccines. These vaccines are available today either at country level or on the international market for biologicals. The situation is presented in Table 1, by continent/sub-continents.
<table>
<thead>
<tr>
<th>Currently available vaccines</th>
<th>Inactivated virus vaccines</th>
<th>Modified live virus vaccines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nervous tissue transfer</td>
<td>Production technology</td>
</tr>
<tr>
<td></td>
<td>' + ' North</td>
<td>Chick embryo</td>
</tr>
<tr>
<td>Asia</td>
<td>Possible</td>
<td>Possible</td>
</tr>
<tr>
<td>Africa</td>
<td>Possible</td>
<td>Chick embryo</td>
</tr>
<tr>
<td>Latin America and Caribbean</td>
<td>Possible</td>
<td>Cell culture</td>
</tr>
<tr>
<td>+</td>
<td>Possible</td>
<td>+</td>
</tr>
<tr>
<td>Europe</td>
<td>Possible</td>
<td>+</td>
</tr>
<tr>
<td>Canada/USA</td>
<td>Possible</td>
<td>+</td>
</tr>
</tbody>
</table>

Possible: indicates the level of production
Difficult: refers to the possibility and ease of technology transfer
+ means that technology transfer would be difficult.
There are a number of countries which do not produce vaccines. Although local vaccine production and transfer of vaccine production technology to countries and regions is sometimes desirable, under certain circumstances these countries may consider the importation of vaccines from other countries or from regional centres more desirable than the establishment of a production plant. In addition, within the framework of WHO and WHO/Rockefeller Foundation programmes, projects for the transfer of technology for rabies vaccine production are under way in selected countries in Latin America and Africa. The technologies transferred are either conventional (multiplication of virus on cells in bottles or in fermentors) or may represent a possible breakthrough in this field through virus production (by continuous perfusion of cell culture medium in small bioreactors) which would allow the production of huge quantities of vaccine with minimum investments.

For mass vaccination, oral vaccination of dogs may ultimately also need to be considered. There are urban areas in the world where either because of a large number of stray dogs or because of inadequate infrastructures, it is impossible to undertake mass vaccination with the vaccines available for immunization of individual animals. For mass vaccination campaigns in such areas it would be necessary to use rabies vaccine orally administered in a bait. Although such vaccines already exist for immunization in wildlife such as foxes and raccoons, there is as yet no oral rabies vaccine available which is known to immunize all breeds of dog in a bait consumed only by dogs and which is not attractive to people, especially children.

2.1.2 Technical considerations

Among the five basic elements of any control programme for urban rabies effective immunization is considered of crucial importance. The current situation regarding different types of vaccines, production facilities, quality control, storage and distribution of antirabies vaccines is the following:

(i) Procurement

Two main types of vaccines are commonly used throughout the world to immunize animals via the parenteral route: modified live virus and inactivated virus vaccines.

(ii) Modified live virus (MLV) versus inactivated vaccine. Most of the vaccines used for animals contain the Flury strain, either as Low or High Egg Passage virus (LEP/HEP), the Street Alabama Dufferin (SAD) strain and its derivatives ERA or Vnukovo. Genetic engineered vaccines (e.g. recombinant vaccinia virus) or SAG vaccine (derived from SAD by using monoclonal antibodies) have also proven immunogenic but, to date, have been studied only for oral vaccination purposes. They are presently under investigation for possible use in canine rabies control. When properly produced and administered, MLV vaccines without adjuvants usually provide a long lasting immunity in animals after a single injection. Many countries are still accustomed to the use of such vaccines and can produce MLV in satisfactory conditions and at low cost. Nevertheless, MLV vaccines share the general disadvantage of any live virus vaccine: thermosensitivity. Inactivated virus vaccines are derived from rabies virus that is grown either in vivo (brain tissue) or in vitro (cell culture) and then completely inactivated. Inactivated virus vaccines are much more thermo resistant.

(iii) Production costs

Production costs vary depending on whether the vaccine is of cell culture origin or neurogenic origin, as well as whether they are modified live or inactivated vaccines. The prices which are usually offered fall within the range of US$0.3-1.0 per dose of inactivated vaccines, and from US$0.2-0.6 for MLV vaccines.
(iv) Quality control

Quality control of rabies vaccines is of the utmost importance and is generally conducted at two levels: by the manufacturer and by a national control authority. MLV and inactivated vaccines must be tested for strain identification, safety and potency, respectively, as described in the 3rd edition of "Laboratory Techniques in Rabies" (Kaplan and Koprowski, 1973). Standard potency tests for MLV and inactivated vaccines and the general principles underlying them are described in the above publication, and are detailed in "Guidelines for Dog Rabies Control (unpublished WHO document VPH/83.43, Rev.1).

(v) Storage and distribution

The continuous supply of vaccine is very important during mass vaccination campaigns. In both instances the national government generally has direct control of the quantities of rabies vaccines (both those manufactured in the country and those imported) required by the national rabies control programme. Proper storage conditions for both categories of vaccines are specified in the Guidelines for Dog Rabies control (unpublished WHO document VPH/83.43, Rev.1).

2.2 Mass Dog Vaccination

2.2.1 Current situation

Table 2 gives an overall idea of the present status of mass vaccination activities in major urban centres of countries belonging to the three continent/sub-continents under consideration. Whereas mass dog vaccination is a common practice in Latin America and the Caribbean, where a regional programme for urban rabies elimination was launched in 1983, this type of activity has been carried out only in limited areas of Africa and Asia.

<table>
<thead>
<tr>
<th>TABLE 2</th>
</tr>
</thead>
</table>

**Mass vaccination in urban areas with endemic canine rabies**

<table>
<thead>
<tr>
<th></th>
<th>Pilot Project</th>
<th></th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Done</td>
<td>Success</td>
<td>Done</td>
</tr>
<tr>
<td><strong>AFRICA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In some urban areas of a very limited number of countries</td>
<td>+</td>
<td>?</td>
<td>+</td>
</tr>
<tr>
<td><strong>ASIA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some urban areas of a few countries</td>
<td>+</td>
<td>?</td>
<td>+</td>
</tr>
<tr>
<td><strong>LATIN AMERICA &amp; CARIBBEAN</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most large urban areas in all countries</td>
<td>++</td>
<td>General successful</td>
<td></td>
</tr>
</tbody>
</table>

Success is based on reduction of canine rabies.
2.2.2 Technical considerations for the implementation of mass vaccination campaigns

(i) Objectives

Mass vaccination campaigns are directed towards breaking the dog-to-dog endemic transmission cycles. In countries in which dogs are the sole maintaining reservoir hosts, the elimination of transmission in the dog has repeatedly been shown to eliminate the disease from other pets.

The objective of these vaccination campaigns is to achieve and maintain an immunization coverage of at least 75% of the dog population. Usually each country plans, organizes and implements its mass vaccination programme on the basis of the information available on the epidemiology of the disease, the structure of its urban and rural society, and the resources available.

(ii) Methods

The most suitable method, or a combination of different methods, should be selected on the basis of the community studies or known sociocultural factors.

Different methods are applied:

(a) Continual dog vaccination at private or government veterinary clinics to which dog owners take their dogs. The advantage of this method is that little government effort is needed. The disadvantages are that it fails to reach many owned and all unowned dogs, and coverage of the dog population is sporadic and uncertain.

(b) Dog vaccination campaigns lasting days to weeks through neighbourhood vaccination centres. The advantage of this method is that vaccination centres are more conveniently located for most dog owners than are veterinary clinics. The disadvantage is that transportation to vaccination centres still relies on owner initiative.

(c) One-day campaigns covering whole municipalities or states. For example, in Brazil, these reach 8 million dogs in one day. The advantage is that sectors which are not involved in that type of programme can be mobilized in view of the extremely short duration of their involvement. It is also easier to mobilize the public over a short period of time.

(d) House-to-house dog vaccination. The main advantage of this method is that it usually results in a sufficient percentage (75%) of all dogs in a community being vaccinated. Another advantage is that there is only minimal disruption of normal community functions. A possible disadvantage, especially where pre-vaccination activities in the community have been inadequate, is that householders may consider a house-to-house campaign to be an invasion of privacy.

(e) Vaccination by the oral route. Oral vaccination of dogs could prove useful under certain conditions but still needs to be carefully studied by WHO experts. At this stage vaccines and vaccine administration methods remain experimental, as discussed in a WHO consultation held in March 1989 (unpublished document WHO/Rab.Res./89.32).

(iii) Evaluation

The results of a vaccination programme are evaluated in order to establish the cost-benefit of campaigns in the country and to obtain further evidence for the maintenance phase. Countries may consider one or more of the following:
(a) the percentage of animals (dogs or other pets) vaccinated during the campaign;

(b) sero-conversion in a randomly-selected sample (50 individuals) of the dog population;

(c) the evaluation of the epidemiological situation.

Taken all together, this information permits an overall appreciation of the effects of mass vaccination and helps to decide on its benefit for the country.

2.3 Dog Population Management Techniques

2.3.1 Current situation

Of the four approaches to dog population management (movement restriction, reproduction control, habitat control, dog removal) only dog removal has been extensively evaluated. The other three conceptual approaches are far more complex in their execution and have not been implemented in recent projects in ways to allow assessment of their effectiveness.

The extent of the use of these approaches in the three continents/subcontinents was assessed and is shown in Table 3. Large-scale dog removal campaigns are widely used in Asia and to some extent in Africa. Such activities have been abandoned in Latin America and the Caribbean because large-scale dog reproduction control and habitat control are not in practice anywhere. Ecology studies have been used only in a very limited number of areas.

It has become clear that efficient dog population management has to rely on the active participation of dog owners - be they individuals or communities.

2.3.2 Technical considerations

(i) Movement restriction

In many of the countries where dog rabies is still endemic, a large portion of the dog population is only temporarily subject to movement restrictions, if at all (see WHO/Rab.Res./88.25). This may partially be due to functions assigned to dogs (e.g. guard dogs), but also to the status of many "family" and "neighbourhood" dogs, the movements of which are not under permanent human control)

(ii) Reproduction control

Reproductive success is best in the segment of the family and neighbourhood dogs: they can usually take profit of shelter provided by humans, allowing them to whelp and successfully raise puppies. The reproduction of the well supervised ("family") dogs is generally under permanent control, or these dogs are spayed. The contribution of feral dogs, defined as totally independant and unrestricted, to the overall reproductive output of the population is usually low, as these dogs lack appropriate shelter for the successful rearing of puppies.

Confinement of females in heat is the most efficient and cheapest way of avoiding surplus offspring. To be successful, it requires the owner's consent and also his initiative. Surgical sterilization and hormonal control of reproduction do not reach a sufficiently high percentage of a dog population to have an impact on the overall reproductive rate of a dog population. Reproduction control alone, although an important support for all other control efforts, will not be able to limit the size of a dog population.
(iii) Habitat control

Successful dog population reduction can most efficiently be attained through habitat control, i.e. reduction of the carrying capacity of the environment. The carrying capacity depends on the abundance, availability, and distribution of resources such as food, water, and shelter. As man is mainly responsible for providing these resources, education and community participation are the keys to success. Food sources must be controlled by garbage collection, sanitary waste disposal, provision of slaughterhouses, collection of slaughter-house and fishing waste, control of dump sites, control of market places, etc. Habitat control is only attainable over years of continuing efforts. But as it will bring additional benefits to the human population by increasing hygienic standards, it should receive support from sectors not directly involved in rabies control. However, until today, respective efforts directly related to rabies control programmes have not yet been made.

(iv) Dog removal

The high reproductive potential of dogs allows for rapid replacement of losses due to elimination campaigns. In fact, no elimination campaign so far known has met the goal of significantly reducing the dog population over a prolonged period, which requires an annual removal of 50-80% of the total dog population to attain a lasting reduction of it.

In comparison with vaccination campaigns, dog elimination campaigns are highly inefficient from manpower and cost perspectives and create animosity towards any dog rabies control and vaccination efforts. They also disrupt the naturally established social organization in the population. As a result the contact rate between dogs will increase as the remaining dogs take over the space formerly occupied by another individual.

(v) Dog population census techniques

Census techniques used so far include questionnaire surveys, direct counting, as well as methods based on marking and reobservation of dogs (Peterson/Lincoln-Index). When used correctly, questionnaires and the Peterson/Lincoln-Index-method provide adequate estimates of the size of a dog population. It has become clear, that population figures are extremely valuable, not only for the planning but also for the evaluation of mass vaccination campaigns.

(vi) Dog ecology studies

Dog ecology studies carried out within the framework of the AGFUND/WHO projects for human and canine rabies control in Ecuador, Sri Lanka and Tunisia have mainly been done in pilot studies in each country. In addition to the techniques described in the previous paragraph, extended questionnaires were used and studies involving individual marking and direct observation of dogs were carried out. These studies provided valuable information about reproductive success, turnover rates, man-dog relationships, use and function of dogs as well as interaction between dogs, movements within dog populations, use of food sources, etc. The insights gained helped in assessing the respective control programmes and in identifying local peculiarities to be considered.
<table>
<thead>
<tr>
<th></th>
<th>AFRICA</th>
<th>ASIA</th>
<th>LATIN AMERICA CARIBBEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-scale dog removal</td>
<td>+</td>
<td>++</td>
<td>(-)</td>
</tr>
<tr>
<td>Dog restrictions</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Large-scale dog</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reproduction control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitat control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Census techniques</td>
<td>(+)</td>
<td>(+)</td>
<td>+</td>
</tr>
<tr>
<td>Population studies</td>
<td>(+/-)</td>
<td>(+/-)</td>
<td>(+/-)</td>
</tr>
</tbody>
</table>

+ = Used in some countries  
++ = Used in most countries  
(-) = Used under exceptional circumstances  
- = Not used  
(+) = Used in limited areas  
(+/-) = Used in a very limited number of countries
2.4. **Diagnostic Techniques**

As dogs are the most important transmitters of urban rabies to man it is of paramount importance in the prevention of the spread of rabies to man and other pet animals to be able to detect the disease as early as possible in animals and establish reliable surveillance.

2.4.1 **Current situation**

The availability of the most common techniques for rabies diagnosis, classified by level of sophistication, was assessed and is presented in the Table.

**Table 4**

<table>
<thead>
<tr>
<th>Technology transfer</th>
<th>Histological techniques</th>
<th>Immuno-fluor.</th>
<th>Mouse inoculation</th>
<th>Cell culture</th>
<th>ELISA or RIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFRICA</td>
<td>+</td>
<td>(+)</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ASIA</td>
<td>+</td>
<td>(+)</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LATIN AMERICA</td>
<td>(+)</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CANADA/USA</td>
<td>++</td>
<td>(+)</td>
<td>+</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>EUROPE</td>
<td>++</td>
<td>(+)</td>
<td>+</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>Technology transfer</td>
<td>Easy</td>
<td>Possibly¹</td>
<td>Easy</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

(+) = Used in a limited number of countries

+ = Used in a large number of countries

++ = Used in most countries

1 = Relatively costly and technologically sophisticated

2 = Host laboratory must be competent in cell-culture techniques

3 = Kit/reagents only available at a cost of about US$2 per specimen examined
The way each technique can be transferred was also evaluated. It was underlined that Sellers and MIT are easy to transfer, whereas ELISA/RIA will be difficult to transfer under present conditions; immunofluorescence is intermediate.

2.4.2 Technical considerations

Clinical diagnosis: in many countries this is the only diagnosis.

Laboratory diagnosis: the number of laboratories for the diagnosis of rabies in a country depends on the size of the country and how well developed its communications and transportation systems are.

The techniques usually available are capable of detecting: Negri bodies in brain tissues; viral antigen in the cells of various tissues; infectious virus in organs such as the brain and salivary glands.

Detection of Negri bodies

Negri bodies may be detected by the microscopic examination of smears, or impressions of fresh material stained by the Sellers or Mann methods, or by the examination of fixed material, or histopathological examination. Many countries still use these techniques, despite their lesser sensitivity than that of other tests cited below.

Detection of infectious virus by Mouse Intracerebral Inoculation test (MIT)

In conjunction with the FAT or microscopic examination of brain tissues for Negri bodies, the MIT procedure is still one of the most widely used and most effective tests in laboratory diagnosis.

Demonstration of viral antigen

Rabies antigen in cells of an infected animal may be detected by the fluorescent antibody test (FAT). In this test the antibody, which is tagged with a fluorescent dye (fluorescein isothiocyanate), reacts with the specific antigen. It is used throughout the world but requires a fluorescence microscope and the permanent availability of a reliable conjugate.

The immunoperoxidase reaction

The antibody is attached to an enzyme (peroxidase) and reacts with the specific antigen. It is rarely used.

The rapid rabies enzyme immunodiagnosis (RREID)

This technique is performed in microplates which have been previously sensitized with IgG to purified antinucleocapsids. RREID does not require a UV light microscope and nor is a photometer essential. It is a useful and simple technique for the routine laboratory diagnosis of rabies. However, reagents and expandable equipment (microplates...) have to be supplied or purchased. A kit is commercially available.

Remark - Use of monoclonal antibodies.

Antigenic variation among rabies viruses has been shown to exclude the use of monoclonal antibodies. Investigations are usually carried out in specially trained and equipped laboratories of the WHO Collaborating Centres.

Detection in Neuroblastoma cells

Inoculation in neuroblastoma cells, which have been shown to highly sensitive to street rabies strains, is used as a routine diagnosis procedure in many laboratories. The laboratory must be competent in tissue culture techniques.
2.5 Surveillance Systems

More than in any other zoonosis, surveillance in rabies has become essential not only for the application of control measures in animals but also for prevention in man.

2.5.1 Present situation

The availability of national/regional surveillance systems by continent/subcontinent was assessed and is presented in Table 5:

### Availability of rabies surveillance systems at national and regional levels by continent and subcontinent

<table>
<thead>
<tr>
<th>Region</th>
<th>National</th>
<th>Regional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>(+)</td>
<td>-/+</td>
</tr>
<tr>
<td>Asia</td>
<td>(+)</td>
<td>-</td>
</tr>
<tr>
<td>Latin America</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Canada/USA</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Europe</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

-/- need considerable strengthening
(-) inexistent
(+) inadequate surveillance
+ adequate surveillance
++ sophisticated systems
2.5.2 Technical considerations

(i) Rabies diagnostic laboratories

Technical procedures ensure the examination of specimens of:
- domestic and wild animals that have caused a human exposure. This has highest priority and the result is immediately transmitted to veterinary and public health services.
- domestic animals (farm animals and susceptible pets) that have not exposed a human. The results are immediately transmitted to local services since examination of human exposure is often initiated following a positive diagnosis in animals.
- wildlife animals that have not exposed a human (purely of interest for surveillance and control) have the lowest priority.

(ii) Reporting to national and international centres

The means of communication in reporting are telegram, telex, facsimile, telephone, radio and report forms.

The steps involved are divided into five categories, irrespective of whether the data are processed by hand or through an electronic data processing unit. The steps are:

(a) Data preparation, (b) Entry of data into the computer or into handwritten files, (c) Data editing, (d) Data analysis: simple or complex analyses (mapping, multivariate statistics, time-series resolutions) and (e) Output: data are usually presented in various forms (tables, maps) for use in routine reports, epidemiological analyses and statistics etc.).

2.6 Specific Problems Related to Technological Prerequisites

2.6.1 Vaccines

The availability of efficient veterinary vaccines in adequate quantities is of the utmost importance to achieve our goal of global control and elimination of urban rabies. Vaccines are available in most countries; however, whether locally produced or imported, the quantities are often grossly insufficient.

The technologies for mass production of inactivated brain tissue vaccines are available in at least some laboratories in each region (Table 1). The transfer of this technology to other countries within the same region was considered possible in the medium term by the group, whereas the transfer of sophisticated technologies such as cell culture vaccine production would be more difficult and require more time.

In countries where vaccines are acquired mainly by importation, money is often the main constraint for the acquisition of adequate quantities of vaccines. Resources should be sought to provide canine vaccine free of charge at minimal cost where required in developing countries.
2.6.2 Mass Vaccination

For mass vaccination to be successful, more than 75% of the dog population must be vaccinated. In urban areas of most countries, the vaccination coverage has been below this target. This may be due to two groups of constraints. The first group relates mainly to the weakness of some components of the programme such as lack of human resources, means of transportation, and the lack of community participation. It should be underlined here that the lack of human resources and means of transportation is often due to an insufficient commitment towards rabies control by the national or provincial governments. The second group of constraints relates to a low level of accessibility of the dog population due to a high proportion of feral dogs. However, this may be a major constraint only in a very limited number of countries.

2.6.3 Dog population management techniques

For appropriate dog population management information on dog abundance, distribution, population dynamics as well as the role of dogs in human societies is needed. Additional data on feeding habits with respect to the habitat, together with information on dog movement, activity patterns and the social organization of the dog population would often help to design more efficient rabies control programmes.

Today we often lack adequate information, not only for areas where mass vaccination programmes have not yet been started, but also for regions where such activities have already been initiated.

The main reason may be the authorities’ lack of interest in the collection of significant data, the fear that dog ecology studies would unduly delay the start of a vaccination campaign, and the absence of trained personnel able to produce and evaluate relevant data within short time periods, at minimal costs, and in a way that allows for generalisation within the same socio-ecological setting.

2.6.4 Diagnosis and surveillance systems

In many countries, only one central rabies diagnostic laboratory is operational and the major problem usually lies in the low number of samples reaching diagnostic laboratories. Decentralization of the diagnostic capabilities has not always been successful in increasing the number of samples submitted for laboratory examination. At laboratory level when the immunofluorescence test is used, the maintenance/servicing of the equipment is often inadequate. Other constraints identified are the lack of trained personnel, lack of equipment and lack of standardized reagents. Furthermore, notification of the disease at the local (sub-district) level is not always done systematically enough. Surveillance is therefore poor in many countries, and is consequently below reasonable standards at the regional and global levels.
3. MANAGEMENT AND MANPOWER FOR URBAN RABIES CONTROL PROGRAMMES

3.1 Manpower Development and Training

3.1.1 Personnel skills

The personnel needs for urban rabies control programmes should be considered in terms of the different skills needed at community, provincial and national levels.

A general personnel organization plan for rabies control at community level must include the skills for both the continuous and cyclical aspects of programming. Skills needed on a continuous basis, some of which already exist and some of which must be developed by training, must be provided by persons permanently in the community. These include:

(a) Community participation;
(b) Surveillance;
(c) Maintenance;
(d) Education; and
(e) Organization.

The personnel is composed of staff from various sectors: employees, volunteers, students, and in some communities, casual workers who should work together in close collaboration. The "cyclical skills" should build on those included in the continuous aspects of the community programming by adding:

(a) Community study;
(b) Planning;
(c) Procurement;
(d) Vaccination and
(e) Evaluation.

The "cyclical skills" i.e. skills which are used cyclically may be conceived of as forming a wheel which rolls on the track composed of the continuous skills: (see Figure 1)
FIGURE 1: CONTINUOUS AND CYCLICAL SKILLS NEEDED TO INITIATE AND MAINTAIN URBAN RABIES CONTROL PROGRAMMES AT COMMUNITY LEVELS

CONTINUOUS SKILLS

- Community participation (Control requires community action)
- Surveillance (Diagnosis records, epidemiology)
- Maintenance (Vaccine supply, focal control)
- Education (Communication)
- Organization (Health Systems Research)

CYCLICAL SKILLS

- Planning (pre-study)
- Procurement, resource assignment and CYCLICAL SKILLS infrastructures (logistics)
- Studying the community (needs assessment)
- Conducting mass campaigns (vaccination, registration, mobilization)
- Evaluation of the programme (post study)
Thus, within urban rabies control programmes at community level, management, planning, operational, educational and research skills are needed, each representing a composite of capabilities. Community personnel should be community residents. At community level training should be provided to its members in the following fields:

(i) Management

1. Staffing (assignment, volunteers, short-term employees)
2. Coordination (community to province)
3. Collaboration (intersectoral - at local level)
4. Finances (local availability of programme funds)
5. Physical resources acquisition (ordering of materials)
6. Record keeping (compiling and reporting)
7. Accounting (careful attention to all use of supplies & funds)
8. Evaluation

(ii) Planning

1. Strategy selection (based on socio-ecology)
2. Scheduling (depends on approaches; correlated with other programmes)
3. Physical resources allocation (movement of materials to programme sites)
4. Financial allocation (local allocation of funds)

(iii) Implementation

1. Dog population management (food and harborage control)
2. Vaccination (may be same as survey skills)
3. Vaccination certification (completion of certificates)
4. Animal marking (usually some type of collar)

(iv) Education

1. Training (usually an outside person)
2. Communication (verbal best - printed in local language - vaccination effective)

(v) Research

1. Diagnosis (clinical and specimen selection)
2. Epidemiological investigation (community initiates; provincial personnel)
3. Participatory research (community describes itself)
4. Socio-ecological research (volunteer personnel usually)
5. Data gathering (surveillance, clinical records, vaccination)
6. Data analysis/interpretation (based on community records - report to province)
7. Health systems research (community evaluation of programme)

At provincial levels, many of the community level skills are repeated at a higher skill level. The coordinator and educator may be full-time employees, but other required skills can often be provided by provincial personnel if integrated into their normal responsibilities. The skills which should need to be developed/strengthened are the following:

a. Programme coordination
b. Education
c. Diagnosis and Epidemiological investigation
d. Infrastructure coordination
e. Financial allocation
f. Evaluation
At the national level, the programme coordinator must be a well-trained, competent employee. Educational activities at the national level guide and serve the needs of the provincial level. Vaccine supply may be a major operation, with personnel training needed at many levels. Procurement and financing activities may be integrated into ministry procurement, budgeting, accounting and payment systems. At national level skills should be reinforced in the field of:

a. Programme design and coordination
b. Educational materials
c. Vaccine supply
d. Infrastructure
e. Financial allocation
f. Evaluation

Rabies control committees should represent the participating sectors and function at national and provincial as well as local levels.

3.1.2 Personnel needs and responsibilities

The situation in Guayaquil, Ecuador (approximately 2.5 million inhabitants and 1 dog/9.2 inhabitants) may be taken as an example. The rabies control project in Guayaquil had the personnel and organization as shown in figure 2.

Figure 2: Organigramme of the Guayaquil city rabies control project:

- Rabies project director
- Rabies diagnostic laboratory
- Rabies vaccine laboratory
- Clerical and records staff (3) 1
- Support personnel and drivers (4) 1
- Health educator 4
- Rabies investigation officer 1
- Ecologic survey volunteers (18 college students) 3
- Animal vaccinators (100 organized in 50 cadres) 2
- Treasurer 3
- Procurement Officer 3
- Local Police 3
- Community Development Officials 3
- Community Educators 3
- Physicians/Health Care Workers 3
- Veterinarians/Animal Health Workers 3
- Project Evaluation Personnel 3

1 - Full time employees for rabies control
2 - Temporary employees for rabies control
3 - Persons relating to rabies control but not paid by rabies control programmes
4 - In Guayaquil, the project veterinarian and educator rated in coordination of the programme.

( ) - The numbers in brackets indicate the number of staff of the above categories.
3.2 Supporting Factors for the Provision of Appropriate Manpower

Programme management at the community level needs political, administrative and technical support from regional, national and ultimately international levels. Human, financial and technical resources must be procured and organized in order to support urban rabies control actions. The working group recommends that reference be made to the report of the 7th Expert Committee on Rabies (WHO Technical Report Series No 709, 1983).

In considering the question put before it, the group came to the conclusion that management of programme implementation - apart from financial management, and certainly at the global level - consists of two major, related components: Communication and Coordination.

Global and interregional rabies control activities should be supported by guidelines for communication procedures.

WHO's role in further exploiting the available channels of communication between itself and other UN Organizations (FAO, UNICEF, UNESCO, etc.) should not be overlooked. This level of coordination, and the coordination achieved as a result of efforts to expand communications between WHO and international agencies and non-governmental organizations is a basic need for the temporary redeployment of the resources needed for global urban rabies control.

Efforts by WHO to increase the provision of veterinary public health services at the regional level (AMRO/PAHO could serve as a model) is an essential pre-requisite to the existence of viable regional urban rabies control programming. The sharing of experience (and possibly other resources) between countries is an important regional activity.

Regional and national efforts to develop and disseminate appropriate training manuals on topics such as mass vaccination campaign management, the processes through which community participation is firmly established, community leader training, and intersectoral cooperation, coordination and collaboration at all levels (from community through provincial and national to regional), play a crucial role in the support of effective action against rabies conducted at the community level. The group specifically identified a number of specific skills that will need special emphasis in regional training. These are: resources acquisition; budgeting; preparation, analysis and interpretation of reports; accounting; epidemiological investigation of human and canine rabies; sociological studies; coordination with other health and development programmes; health systems research; and community participation and participatory research.

Manpower factors were considered in the form of bundles of skills needed to support urban rabies control at community level. Besides the technical procedures described in Section 2, manpower must be developed with particular skills in communications and in educational approaches regarding the community as a whole and preparing services for intersectoral collaboration in rabies control. For this purpose, WHO should keep a register of experts in health systems research related to zoonotic diseases such as rabies.
4. FEASIBILITY FROM THE ECONOMIC POINT OF VIEW

4.1 Comparison of costs of postexposure treatment and urban rabies elimination

The economic analysis of two strategies and their combination, namely rabies elimination by dog vaccination and optimum human postexposure treatment shows that under conditions prevailing in some countries the elimination of canine rabies is less expensive than increasing efforts to provide effective postexposure treatment. Nonetheless, many governments will be dependent upon international sources to finance these programmes.

Analysis of the present situation in canine rabies infected countries shows that in most cases the levels of activity for controlling the disease in man and in dogs are far too low to prevent human death due to rabies or to eliminate the disease in the dog population. In this context, comparisons were made between the costs of the two major orientations of a rabies control programme, that is, the prevention of the disease in man by intensifying and modernising postexposure treatment (strategy A) and canine rabies elimination by controlling the disease in the animal reservoir (strategy B) were compared. For obvious ethical reasons, the association of the two strategies (strategy A plus B) was also analyzed.

Based on the available data and assumptions for calculation of the costs, results show that when the strategies are applied independently of each other, the annual cost of strategy B amounts to 25-56% of that of strategy A, depending on types and levels of administration of rabies immunoglobulin. When the two strategies are applied together, it is shown that actual annual spending related to the implementation of strategy A plus B becomes less than that of strategy A alone as from the 5th year following programme initiation. On the basis of cost per life saved, a canine rabies elimination programme compares favourably with the cost of prevention programmes for other human diseases.

In countries where resources allocated to rabies control are inadequate in both the health and veterinary sectors so that the problem of rabies persists without improvements, the comparison in costs and effectiveness of the two programme strategies for rabies elimination strongly suggests that consideration should be given to a national programme of dog rabies elimination. On the other hand, for obvious ethical reasons, if attention is also paid to improvement of modalities for postexposure treatment, then the national authorities should consider a planning horizon close to 15 years. (see Economics of human and canine rabies elimination: Guidelines for programme orientation by K. Bögel and F.-X. Meslin, WHO Bulletin in press)

4.2 Projected costs of urban rabies elimination at global level

About 800 million people and 80 million dogs live in canine rabies-free countries of Europe, North America and the Western Pacific region. Assuming that about 50% of the dogs are vaccinated annually, at least US$400 million are spent for rabies prevention in these countries. Vaccination is largely paid by the dog owner and is frequently necessary because of sylvatic rabies which is difficult to control; such individual vaccination amounts to US$10-20.

In developing countries about 15% of the dogs (i.e. 40.5 million out of 270 million animals) are vaccinated annually, primarily to prevent transmission between canines and from canines to humans. The average costs of vaccination in these programmes (i.e. vaccine and vaccine delivery costs) have been estimated at US$1.3 per animal; therefore about US$52 million is at present spent in dog vaccination in developing countries, but in view of the low level of vaccination coverage, this is without actually improving the overall epidemiological situation.
As shown in the proceeding chapter, the economic costs for prevention of the disease in man by a strategy of intensifying and modernising post-infection treatment alone would be at least twice as high as controlling and eliminating the disease in the canine reservoir.

Urban elimination of canine rabies would require augmented programmes of canine rabies control in infected areas over a period of five years, after which a maintenance programme can be instituted at greatly reduced cost. Thus, apart from radically reducing human suffering and deaths from the disease, an appreciable positive cost/benefit ratio could be anticipated within a relatively short period of time.

4.3 Funding

There are three strategies to solve the financial problems:

(a) If local and national services include the cost of rabies prevention following dog bites as part of the economic burden of the disease, the benefit of rabies control (savings and avoidance of death) becomes an obvious justification for an elimination programme. Unfortunately, vaccine to conduct large-scale programmes is often not available in such situations and additional funding may have to be obtained. A regional or global rotating fund for veterinary vaccine procurement may be necessary.

(b) Support at the civic and national levels may have to be mobilized to overcome the hesitation of the agricultural sector to bear the costs of a programme, the benefit of which is predominantly on the side of the health sector. Where necessary and possible, the funds may be used directly by the health sector to arrange for systematic dog vaccination. Intersectoral cooperation and national coordination are necessary.

(c) Multilateral resources should be obtained jointly by the government(s), NGO’s and international organizations to assist governments to finance programmes which are sound and endorsed by international advisory and expert groups. (A global or regional consultation may be required).

Governmental budgets in animal and human health sectors are generally unable to absorb the costs of especially planned services for urban rabies elimination. The fact that the input in urban rabies control may wholly be offset by reduced costs in postexposure treatment, calls for a solution by mutual recognition of re-arrangement of expenses in rabies prevention and control between the ministries concerned and the municipalities/communities. In a large number of developing countries it is, however, indispensable to provide some foreign currency aid. This could be included in horizontal or general development projects such as urban sanitation, animal health, laboratory development and animal protection activities.

Regional/global programme components, therefore, remain the key to success. Above all, this assistance should foresee assistance in careful economic analyses of resources and benefits for all components of a programme in the various sectors and social administrations.
4.4 Minimum service to be covered at global and regional levels

It is understood and common experience that global or regional approaches to urban rabies elimination should not only be geared towards vaccine delivery but also include the following areas of activities:

1. Technology transfer for vaccine production at national/local level. This would equal but not exceed the costs calculated for vaccine provision.

2. Technical cooperation in planning of national/local projects.

3. Training of trainers in community participation in dog vaccination and dog population management including rabies surveillance, reference service and research coordination.
5. DECISION-MAKING MATRIX AND LIST OF IMPORTANT PROGRAMME COMPONENTS FOR FEASIBILITY ANALYSIS

5.1 Scope and Purpose

It was originally thought useful to develop a decision-making matrix at the national level. This would allow communities and governments to decide on the most feasible strategy of dog rabies elimination. This was to entail:

- adequacy of coordination, regulations, and status of government preparedness and commitment, etc.;
- availability of vaccine and personnel for vaccination;
- the status of community preparedness and accessibility of the dogs to vaccination and other activities of responsible dog ownership, and in disease surveillance.

Based on such data it would be possible to decide on the preferred vaccine delivery method, e.g. by campaign or through continuing services, or both, and the defense of the rabies-free areas which may require intensive surveillance, vaccine delivery and enforcement of dog movement restrictions.

However, a decision-making matrix was considered impracticable for regional levels and global analysis; many factors and pre-requisites change within a country, and even more between countries. Any judgement at the international level must be based on a compilation of present conditions in the majority of countries being considered. To mention only the major components and resources as an example, committees must be set up, coordinators designated, comprehensive plans established, vaccine imported (or the technology for vaccine production transferred), the potentials for intersectoral cooperation determined (reference report of WHO Consultation on Health Systems Research (HSR) and Intersectoral Collaboration in VPH, document WHO/CDS/VPH/90.88), and manpower allocated (particularly for mass vaccination, surveillance and public education). Of great importance is the adoption of new scientific findings on dog ecology; this requires from many governments an almost dramatic change of understanding in policies and approaches concerning the control of the dog population.

In view of these concerns for international assessment of pre-requisites and the feasibility of canine rabies elimination in urban areas, the Consultation proposed to proceed with the following steps:

- Preparation of a list of important programme components.
- Assessment of the availability/functioning of these components at the present time (or their potential for mobilization in the near future without significant external assistance) for groups of countries or whole regions (excluding exceptional situations) to arrive at a general judgement.

5.2 Provisional assessment of the status of major programme components

Out of numerous programme components, a list of the most important prerequisites of a rabies elimination programme was developed during the consultation to allow a provisional assessment of the present situation in groups of countries and regions, assuming initially a national level of organization. If weighting within a region was not uniform, a range was used. The listings are only approximations and should be confirmed or changed by the collection of further data.
Table 6
Provisional Assessment of the Status of Important Components for Urban Rabies Elimination

<table>
<thead>
<tr>
<th>PROGRAMME COMPONENTS</th>
<th>Americas</th>
<th>Eastern Africa</th>
<th>SEARO</th>
<th>WPRO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government commitment</td>
<td>3**</td>
<td>2/3</td>
<td>0/2</td>
<td>1/2</td>
</tr>
<tr>
<td>Intersectoral cooperation</td>
<td>2</td>
<td>1/3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Managerial stability, leadership</td>
<td>3</td>
<td>1/2</td>
<td>1</td>
<td>1/2</td>
</tr>
<tr>
<td>Epidemiology/Surveillance</td>
<td>2</td>
<td>2/3</td>
<td>1/2</td>
<td>2</td>
</tr>
<tr>
<td>Rabies programme formulated</td>
<td>3</td>
<td>2/3</td>
<td>0</td>
<td>1/3</td>
</tr>
<tr>
<td>Animal health infrastruct.</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1/2</td>
</tr>
<tr>
<td>Free dog vaccine</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1/2</td>
</tr>
<tr>
<td>Vaccine source</td>
<td>local</td>
<td>local</td>
<td>local</td>
<td>loc/imp</td>
</tr>
<tr>
<td><strong>Accessibility to owner or dog</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Physical</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cultural/religious</td>
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<td>2</td>
<td>2</td>
</tr>
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<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Community involvement</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1/2</td>
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<tr>
<td>Proportion of restrainable dogs</td>
<td>3</td>
<td>2/3</td>
<td>?</td>
<td>1/2</td>
</tr>
</tbody>
</table>

**KEY TO SYMBOLS:**

**rating scale:**

3 = optimal
2 = acceptable
1 = suboptimal
0 = absent/inadequate
? = unknown
NA = not applicable

**Loc** = locally produced vaccine
**Imp** = imported vaccine

*Regions:*

Central America includes Mexico; Africa without South Africa, Zimbabwe; East. Med.: Turkey, Syria, Iran, Egypt; WPRO: rabies-free countries excluded; SOS: South of Sahara.
Of the components, only physical accessibility of owners is consistently acceptable or optimal in all regions evaluated. Except for Latin America and the Caribbean, government commitment is felt to be suboptimal or inadequate in parts of most of the regions. Managerial leadership is probably the greatest weakness on a global scale, with South America as the only exception. Lack of availability of free vaccine and questions about the accessibility of the canine population are also major obstacles to effective national vaccination campaigns in parts of most regions of the world except the Americas. Another important obstacle to successful vaccination campaigns was the lack of intersectoral cooperation in Asia and Africa, including the Eastern Mediterranean. On the other hand, manpower instability is a constraint in much of Latin America, parts of Asia and Africa south of the Sahara.

The above proposal for national and international assessment of the feasibility of urban rabies elimination does not preclude the vigorous implementation of ongoing rabies control programmes in some 40 countries throughout the world.
6. RECOMMENDATIONS AND CONCLUSIONS

6.1 Recommendations

In view of the need to establish more appropriate management technologies to make global control and elimination of urban rabies feasible, the participants recommend the following actions to be taken regarding:

6.1.1 Vaccine

(a) Assess long-term needs for rabies vaccine requirements in urbanized areas, by WHO region.

(b) Select mechanisms for vaccine procurement (import/production) and establish long-term strategies for vaccine supply.

(c) If production has to be carried out locally, better attention should be paid to the more appropriate type of vaccine for each country/region. Facilities should be established for production, including assessment for building, laboratory equipment and training of laboratory personnel.

(d) Establish facilities for proper storage, application and quality control.

(e) Strengthen the ongoing activities for the transfer of technology for production of rabies vaccines carried out by WHO and the Rockefeller Foundation.

(f) Research is strongly recommended for the development of vaccines and baits for oral immunization of dogs. This research should concentrate on the development of a suitable bait and a virus product which would immunize dogs at a concentration low enough to make the mass vaccination programme economically feasible.

6.1.2 Mass vaccination procedures

(a) Assess community-based human resources.

(b) Select, for a given country, adapted and economical means of transportation of vaccination teams.

(c) Develop community mobilization/education campaigns through community leaders.

(d) Promote research on oral vaccination of dogs.

6.1.3 Dog population management

(a) Community study must be done before initiation of local rabies programmes.

(b) Train personnel for studies on dog populations in urban areas.

(c) Train staff/personnel in dog census techniques.
6.1.4 Laboratory diagnosis and epidemiological surveillance systems

(a) Organize regional/national training programmes for adequate laboratory practices.

(b) Acknowledging the fundamental role of the WHO collaborating centres in providing reagents and transferring technologies for rabies diagnosis, it is recommended to strengthen their activities according to the expected increase in the demand for assistance from member states.

(c) Establish national and regional surveillance systems. For this latter purpose the AMRO semestrial and EURO quarterly rabies report should be utilized as guides. At global level, WHO is requested to make all efforts to expand the geographical coverage of its World Survey of Rabies.

6.1.5 Manpower development and training

(a) Guidelines for community education in rabies should be prepared for nonformal as well as formal (school) levels, and for mass vaccination at community level.

(b) WHO should expand training programmes for Member states in rabies epidemiology, health systems research, including sociological studies and rabies programme evaluation.

(c) WHO should develop cadres of equipment and instrument maintenance to assist diagnostic laboratories, vaccine production facilities and information systems in maintenance and repair of such items acquired from or through assistance by WHO.

(d) WHO, in collaboration with the regions, should expand and regularly update its register of regional consultants available interregionally to support all aspects of urban rabies control.

6.1.6 Strengthening of regional activities for urban rabies elimination

In order to support urban rabies control programmes, as well as other zoonotic and foodborne disease control, each WHO Regional Office should establish a VPH unit. The AMRO VPH unit should be studied as a model. This will also facilitate interregional coordination in Veterinary Public Health programmes.

WHO should expand assistance and guidance to Member states in developing urban rabies control programmes at the action (community) level.

6.1.7 Assessment of the situation of individual countries

(a) So as to more fully assess the situation of urban dog rabies elimination at national, regional and global levels, a questionnaire should be prepared on the availability and potentials for an elimination programme in individual countries in the near future. It is expected that the survey, which should be supplemented with reference to guidelines, etc., be by itself conducive to the promotion of national urban rabies control programmes.
Priority should be given to countries where the important components for urban rabies elimination (as outlined in Section 5) are in place; in these countries every effort should be made to facilitate the completion of the programmes.

Countries where the important components of urban rabies elimination are absent or insufficient should initiate health systems research projects to identify the causes explaining their situation and to identify solutions for the strengthening or establishment of these components within a programme.

6.1.8 Cost effectiveness analysis and programme funding

Research should lead to the identification of a standardized procedure for the cost-effectiveness analysis of urban rabies elimination at local and national levels. Research should focus on determining what levels of surveillance are appropriate before, during, and after the initiation of urban rabies control programmes.

WHO, in collaboration with other international organizations, should discuss with interested institutions (e.g. World Society for the Protection of Animals, Association of Pet Food Industries, scientific associations, industries concerned with animal nutrition and health), the potential of a World Rabies Fund based on a "one cent for animal health in developing countries" to be given by industries for each rabies vaccine dose and for each canned and pelleted pet food package sold in developed countries.

Support of the urban rabies control programme should receive appropriate recognition as a contribution primarily to human, but also to animal health in developing countries. Procedures should be developed to make this contribution socially attractive.

6.2 Conclusions

The participants in the consultation acknowledged the valuable results obtained by the AMRO/PAHO programme for urban rabies elimination in Latin America by the year 1990. The group also acknowledged the results of the WHO coordinated research, especially within the framework of the WHO/AGFUND/Radda Barnen project for the control of human and canine rabies in developing countries, particularly in a number of pilot areas in Asia and Africa, on health systems, dog population and ecology and public information and education for the control of canine rabies. It was underlined that the Regional Office for the Americas is the only regional office with a strong VPH unit with field staff based in a number of Member States. It was also pointed out that similar programmes could be directed from WHO/HQs or coordinated by the Regional Offices; in this latter case, provided that there was the involvement of VPH units established in the Regional Offices with staff specialising in this field.

Experience with recent dog rabies control projects shows that elimination of urban rabies is possible under all prevailing epidemiological and social conditions, so long as certain specific political, managerial and technical pre-requisites are met.
2. Costs of national programmes should not be a major constraint to urban rabies elimination since total costs are generally offset by savings in human postexposure treatment costs. In countries without adequate manufacture of vaccine and immunoglobulin for human postexposure treatment, elimination programmes may cost relatively more. However, in such situations, regional or global technical cooperation and resource sharing may help reduce costs. Nevertheless, in dog rabies control, it should not be overlooked that vaccine represents only about 25% of the total costs of vaccination per dog. About US$1 is needed for the vaccine delivery.

3. Technology packages as addressed in Section 2 are available. This includes cheap and simple procedures for diagnosis, surveillance and veterinary vaccine production.

4. Technologies are most likely adaptable to all possible socioeconomic conditions. This is especially important as regards community participation and disease surveillance. In any case, procedures must be applied that are acceptable to the community and therefore do not contain undesirable features such as the killing of dogs or vaccination by fee.

5. Ample manpower is available for urban rabies control through the policy of sharing resources by health and veterinary services and the community.

6. Most modern equipment and vaccines are not available to all countries and communities. A regional or global programme should first of all concentrate on the procurement of such materials.

7. Management procedures, including technical guides, formulation and organization of programmes and supporting guidance for health systems research, have been developed. However, it requires great effort to transfer knowledge and experience in this field to national services, civic groups and communities in Member States. The participants therefore strongly recommend strengthening of training and education through a regional or global approach.
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