Rabies in Europe is mainly a disease of wildlife, being maintained by the red fox. Canine rabies is limited in distribution and remains sporadic, although it is important in Turkey.

Four meetings on Rabies Control in Europe have been organised in Strasbourg (1985), in Annecy (1988), in Nancy (1991) and in Piestany in Slovac Republic (October 1993). These meetings were conducted to inform veterinary services about the situation of rabies control in the European countries and to allow exchange of information.

Thirty-five heads of the veterinary services of the different countries were sent questionnaires. The different data presented in this paper are a summary of the data collected from the 22 countries that answered the questionnaire, i.e. Austria, Belgium, Croatia, Denmark, Estonia, Finland, France, Netherlands, Hungary, Italy, Latvia, Lithuania, Norway, Portugal, Czech Republic, Romania, United Kingdom, Slovak Republic, Slovenia, Sweden, Switzerland and Turkey.

The first step of rabies surveillance involves diagnosis, reporting of cases and exchange of epidemiological information. In the second step, the aim of veterinary services is to reduce the spread of the disease, the risk of domestic animal contacts and finally the risk of human contacts because most often, humans are contaminated through domestic animal contacts.

Diagnosis of rabies

Most of the 22 countries that answered have fewer than 10 diagnostic laboratories, the exceptions being Romania and Lithuania that have 49 and 42 diagnostic centres respectively. This means that most often a centralised structure exists for rabies diagnosis, which allows the regular training of technicians necessary for a reliable experimental diagnosis. In France and in Lithuania, specimens from animals that have caused human contacts are treated in special laboratories. In France, for instance, cases with human contact are diagnosed in laboratories under the Ministry of Health, while epidemiological diagnosis falls under the Ministry of Agriculture.

The fluorescent antibody test (FAT) is used in all the countries, on all the specimens. Immunoenzymatic tests for diagnosis are regularly used in France and Portugal. Nineteen countries use the mouse inoculation test while 6 use the cell culture test on a regular basis.

1 Co-author: M.F. Aubert Laboratoire d'Etudes sur la Rage et la Pathologie des Animaux Sauvages, Malzeville, France.
Histology is performed in 9 countries: 2 of them use Seller's staining technique, 1 uses Mann's technique.

Sixteen out of 21 countries regularly type the strains isolated. This operation is most often made abroad using monoclonal antibodies rather than molecular biology.

Not all the techniques are used for every specimen. Table 1 summarises the average use of the different techniques according to the purpose of the diagnosis.

Table 1. The use of the different diagnostic techniques in 22 European countries according to the purpose of the diagnosis. Figures are percentage of countries.

<table>
<thead>
<tr>
<th></th>
<th>FAT</th>
<th>Histology</th>
<th>Mouse inoculation test</th>
<th>Cell culture test</th>
<th>Immuno-enzymatic test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human contact</td>
<td>100</td>
<td>44</td>
<td>80</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>Domestic animal contact</td>
<td>100</td>
<td>44</td>
<td>67</td>
<td>46</td>
<td>8</td>
</tr>
<tr>
<td>Epidemiological Surveillance</td>
<td>100</td>
<td>16</td>
<td>46</td>
<td>36</td>
<td>7</td>
</tr>
<tr>
<td>Oral vaccination Survey</td>
<td>71</td>
<td>9</td>
<td>33</td>
<td>40</td>
<td>9</td>
</tr>
</tbody>
</table>

Exchange of epidemiological data

Most of the countries regularly transmit epidemiological data to international organisations: WHO (21 countries), OIE (19 countries) and FAO (11 countries).

Seventeen countries regularly exchange information on rabies epidemiology with neighbouring countries. The exchange is most often an official one using bulletins. Six of these countries also exchange data on an informal basis, using letters and telecommunication means. This information exchange has improved since 1991.

Control measures against human rabies

All the countries that answered the questionnaire practise post-exposure treatment for humans. Dogs, cats and cattle are the principal source of human contacts. Foxes are generally the fourth or the fifth ranking source of human contact.

Treatments are either given only in specialised centers (12/20 countries) or both in specialised centres and by doctors out of these centres (5/20). In the three remaining
countries, treatment is given only by doctors out of these centres. Twenty to 100 treatment centres exist per country.

The average estimated cost of a treatment is 380 US dollars. Only five countries produce the rabies vaccine they use: France, Netherlands, Romania, Russia and Switzerland. The number of treatments is related to the type of rabies that exists in the country: an average of 2 000 treatments was performed in 1992 in the European countries that have fox rabies while in Turkey (a canine rabies country) 90 000 treatments were undertaken. Both in 1991 and 1992, 75 percent of human treatments used vaccine alone, antirabies serum plus vaccination was administered in 20 percent of treatments while the remaining 5 percent corresponded to the use of antirabies serum alone.

Most often the countries use a single vaccination schedule, 6 of them use 2 schedules and Latvia uses 3. Generally the immunisation schedules correspond to WHO recommendations:

- The 2, 1, 1 scheme with 2 doses on DO, 1 on D7 and 1 on D21 is used in 4 countries.
- 14 countries use 5 injections at days 0, 3, 7, 14, 30 or 6 with the last one at D90.
- Daily injections are administered in Lithuania for 25 days and in Latvia for 7 or 28 days.

Fifteen countries use the intramuscular route of injection, 3 others the subcutaneous one. When daily injections are administered, the subcutaneous or the intraperitoneal route are used. None of the countries indicated that the intradermal administration route is used.

Vaccines used for humans are controlled using the NIH test (8/14) or the European pharmacopoeia test (7/14). Five countries use both tests for controls. The Habel test is used in only one country. These controls are performed in official laboratories of the country (13/17) and in the producer's own laboratories (8/12). All batches of vaccine are controlled.

When antirabies, serum is needed, 14 out of 22 countries use globulins of human origin. The rest use globulins of animal origin. No countries use both human and animal globulins. The serum is administered intramuscularly either by general route only or using a partial local administration also.

The only postvaccinal problems that are reported are local reactions alone (7.4 percent) or with a general reaction (2.2 percent). Fever is observed in 1. 1 percent of cases.

**Control measures against domestic animal rabies**

Most often vaccination of domestic animals is at least advised. Vaccination of dogs is compulsory in 13 countries, at least in the rabies contaminated part of the country.

Vaccination is always performed by veterinarians helped by technicians in two countries. The owner of an animal can never vaccinate a domestic animal against rabies. Antirabies vaccination of domestic animals is under state control in 80 percent of the countries.
The first vaccination of domestic carnivores occurs between 2 to 6 months of age (92 percent of countries, while half of all countries vaccinate at 3 months) and boosters are given yearly (85 percent). Vaccination of domestic herbivores are undertaken between 1 and 6 months of age (6 months in 50 percent of countries), and boostered yearly (90 percent).

Once vaccinated, animals must be identified to validate antirabies vaccination in 16 countries (Table 2).

Table 2. The means used to identify animals and determine their vaccinal status in European countries.

<table>
<thead>
<tr>
<th>Tattoo or electronic chip</th>
<th>Tag with number</th>
<th>Description</th>
<th>Verification by owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>4/16</td>
<td>11/16</td>
<td>15/16</td>
</tr>
<tr>
<td>Cat</td>
<td>3/16</td>
<td>4/16</td>
<td>14/16</td>
</tr>
<tr>
<td>Cattle</td>
<td>1/16</td>
<td>10/16</td>
<td>4/16</td>
</tr>
<tr>
<td>Horse</td>
<td>2/16</td>
<td>2/16</td>
<td>6/16</td>
</tr>
</tbody>
</table>

When a previously vaccinated domestic animal is exposed, it may be killed (in all species or livestock only). Most often, it is observed for 2 to 6 months sometimes with a booster injection of vaccine. If an unvaccinated domestic animal is exposed, 3 countries allow post-contact antirabies vaccination.

Active measures against fox rabies

1. Fox population control

Different ways to control fox populations may be used in the European countries according to the type of rabies. This information is summarised in Table 3.

The raccoon dog is considered as a possible vector of rabies in Finland, Latvia, Lithuania and Sweden where they are shot, trapped and gassed.

Table 3. The numbers of European countries which practice the different methods of fox population or rabies control.

<table>
<thead>
<tr>
<th></th>
<th>Shooting</th>
<th>Gassing</th>
<th>Poisoning</th>
<th>Trapping</th>
<th>Oral vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fox rabies</td>
<td>18/20</td>
<td>3/16</td>
<td>1/12</td>
<td>9/16</td>
<td>17/18</td>
</tr>
<tr>
<td>Dog rabies</td>
<td>8/11</td>
<td>1/9</td>
<td>1/9</td>
<td>5/9</td>
<td>8/9</td>
</tr>
<tr>
<td>Bat rabies</td>
<td>0/7</td>
<td>0/7</td>
<td>0/7</td>
<td>0/7</td>
<td>0/4</td>
</tr>
</tbody>
</table>
2. Oral vaccination of foxes

Most European countries that experience fox rabies either use or plan to use oral vaccination of foxes. They will carry out these campaigns until eradication of the disease has been achieved or at least maintain tests in experimental areas. Austria, Belgium, Denmark, Estonia, Finland, France, Netherlands, Hungary, Italy, Latvia, Lithuania, Czech Republic, Slovak Republic, Slovenia and Switzerland submitted data on this topic.

When such campaigns are undertaken, most often central governments finance the campaigns, sometimes together with regional structures. The European Union participates financially in the vaccination campaigns in 6 out of 15 countries.

The total area treated in Europe in 1991 was 250 000 square kilometres and in 1992 it was 400 000 (a 60 percent increase). Baiting was done on foot (9 countries) and sometimes also by vehicle (2 countries). Five countries used aerial distribution, only one used helicopter baiting. State agents distributed baits in eight countries and volunteers in nine. In four countries baiting was performed both by state agents and volunteers. The average baiting density was 16 baits/km². Campaigns were usually carried out in spring and in autumn, Finland and Netherlands distributed baits only in autumn while Latvia distributed only in spring, all other countries conducted two campaigns a year.

Reports of contacts of domestic animals with vaccine baits are infrequent. The control of efficacy of oral vaccination campaigns is performed both by studying the rabies cases and also by studying specially sampled foxes. These foxes are shot during day (11 countries) and also during the night (8 of the 11 countries), the average sampling pressure is 0.05 animal/km². Most often a single laboratory deals with the control of oral vaccination campaigns. The tetracycline used as a marker in baits is sampled either in teeth (5 countries) or in bones (9 countries, mainly the mandible); three countries test both teeth and mandible. Serological testing of foxes is carried out in 11 countries, most often using a cell culture test, sometimes by ELISA or mouse inoculation test. Eight countries look for the possibility of vaccinal rabies with monoclonal antibodies.

Average bait uptake is 60 percent for the first campaign and reaches 72 percent at the fifth. Over the same period the average seroconversion rates are 55 percent and 66 percent respectively. The average cost of oral vaccination per square kilometre may be divided as follows:

- US$ 15.5 for the vaccine itself
- US$ 9 for the bait
- US$ 3.6 for the organisation of vaccination campaigns

Since the decrease of rabies, the number of foxes killed for analysis is decreasing in spite of the fact that foxes may be killed all year round in the majority of countries. Hunters' testimony and scientific studies have shown that fox densities have increased since the decrease of rabies.
Active measures against dogs in cases of dog rabies

If canine rabies occurs, half of the countries would begin culling operations by shooting and/or trapping dogs. Vaccination would become compulsory in all the countries, oral vaccination of dogs would be performed only in Turkey which already has canine rabies. In all the countries, all the dogs would be kept on leash. A tax would be imposed in 60 percent of the countries.

Table 4. The number of countries and the doses of vaccine of the different strains used during 1991 and 1992.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SAD Bern</td>
<td>0</td>
<td>0</td>
<td>Czech Republic</td>
<td>885000</td>
<td></td>
</tr>
<tr>
<td>SAD B 19</td>
<td>6</td>
<td>1990000</td>
<td>7</td>
<td>1950000</td>
<td></td>
</tr>
<tr>
<td>SAG1</td>
<td>2</td>
<td>1020000</td>
<td>2</td>
<td>1360000</td>
<td></td>
</tr>
<tr>
<td>VRG</td>
<td>2</td>
<td>1070000</td>
<td>2</td>
<td>1570000</td>
<td></td>
</tr>
<tr>
<td>Experimental.</td>
<td></td>
<td></td>
<td>Latvia</td>
<td>14210</td>
<td>0</td>
</tr>
<tr>
<td>vaccine from</td>
<td></td>
<td></td>
<td>Slovak Republic</td>
<td>11000</td>
<td>100000</td>
</tr>
<tr>
<td>Bielorussia</td>
<td></td>
<td></td>
<td>Slovak Republic</td>
<td>11000</td>
<td>100000</td>
</tr>
</tbody>
</table>

Research into rabies control

Fifteen countries have research centres that work on rabies. These centres study the following topics:
- diagnosis (15 countries)
- vaccine control (13 countries)
- epidemiology of rabies (12 countries)
- bat rabies (10 countries)
- oral vaccination and parenteral immunisation (8 countries)
- monoclonal antibodies (7 countries)
- molecular biology (6 countries)
- quarantine efficacy (4 countries)

Among the possible research fields in rabies, heads of veterinary services were asked to indicate the ones that they considered as important for future research. The first ranked was epidemiology of rabies followed by oral vaccination, diagnosis and surveillance, vaccine control and vaccine improvement.