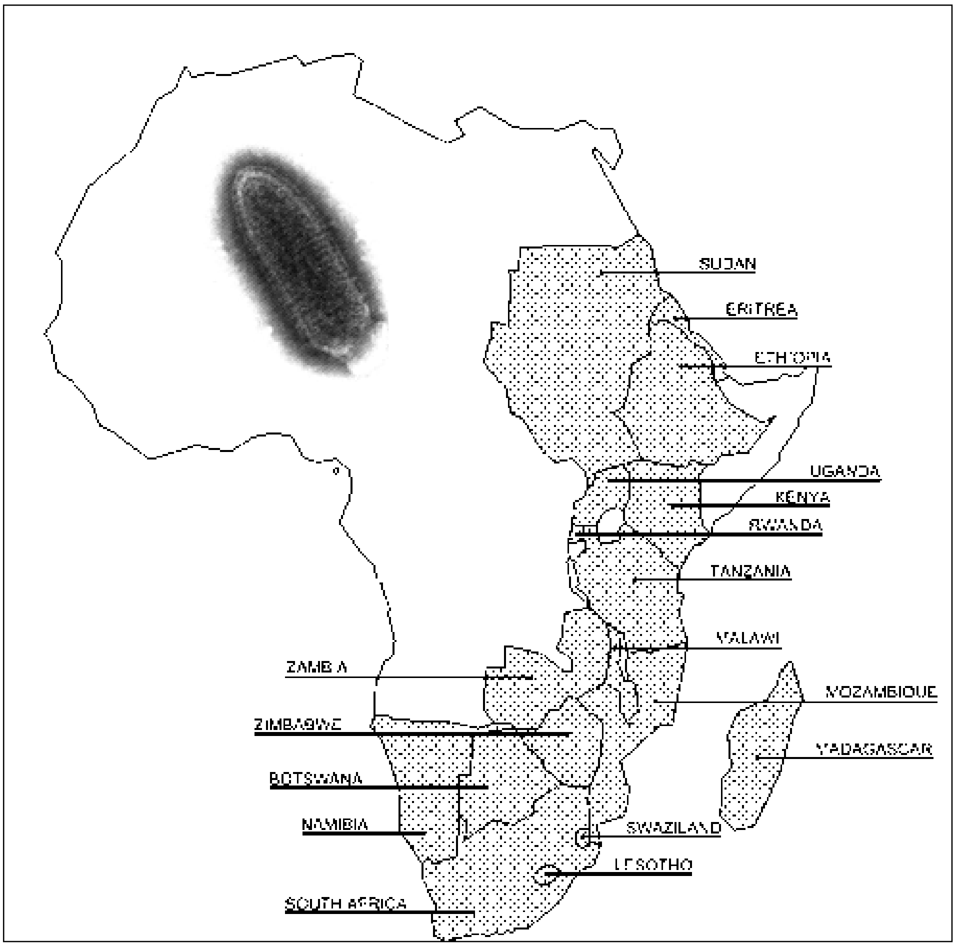
W. H. O.

PROCEEDINGS OF THE SOUTHERN AND EASTERN AFRICAN RABIES GROUP / WORLD HEALTH ORGANIZATION MEETING



ENTEBBE, UGANDA – 29-31 MARCH 1999

ÉDITIONS FONDATION MARCEL MÉRIEUX
17, rue Bourgelat, 69002 Lyon - France

CONTENTS

FOREWORD

The Southern and Eastern African Rabies Group (SEARG) was founded in 1992 at a gathering of rabies scientists, diagnosticians and policy makers in Lusaka, Zambia. The following year, in South Africa, two meetings were held under the auspices of SEARG, in Pietermaritzburg and Onderstepoort. At the meeting in Pietermaritzburg a decision was taken to hold the third meeting of the Group in Mozambique, but due to logistical difficulties the venue was changed to Zimbabwe and the meeting took place in Harare in March 1995. In March 1997 we met again, this time in Nairobi, Kenya, when Philip Kitala and Brian Perry acted as Chairman and Secretary respectively. At that meeting there was healthy competition to provide the next meeting venue and a small committee decided that we should meet in Uganda. The meeting took place in Entebbe, Uganda, 29-31 March 1999.

As in all of our previous meetings, this meeting would not have been possible without the financial assistance of the World Health Organization. In fact, the WHO has consistently supported the aims and objectives of the Group, as well as giving financial assistance and indeed at the Nairobi meeting WHO became permanently linked to the Group such that we are now SEARG/WHO. This arrangement is of mutual benefit. The Group is instrumental in providing WHO with information which may not otherwise be gathered and at the same time allows the Group to continue its independence of thought and activity. One advantage of this independence is that we are able to provide a platform for commercial companies not only to promote their wares but also to give presentations to the open meeting on the latest advances in vaccine technology.

Outstanding though the financial assistance of WHO undoubtedly is, we need more if we are to achieve our aims and objectives. At each meeting we provide a diagnostic training day; we try to bring international experts to the meeting to avail us of their expertise; we cover the travelling and subsistence expenses of all participants from countries other than the host nation and we provide them with a small per diem. Of course, this would not be possible without the support of many, and we gratefully thank Chiron Behring GmbH & Co., Medvet Laboratories (Uganda) Ltd., Fort Dodge (Uganda) Ltd., Intervet, Coopers (Uganda) Ltd. and Virbac (France) and a host of others, all of whom have helped with donations large and small. We also thank Fondation Marcel Merieux for publishing our Proceedings. In addition and in particular, we thank the Government of Uganda for providing excellent venues, facilities and transport for relaxing visits to local places of interest.

When we first met in Lusaka we had representatives from ten countries. We have grown and our catchment area now covers eighteen countries, an area 10% larger than the USA and with 25 million more people! We have made progress in other directions : we begin to understand better the needs of African countries in the control of rabies, we have promoted greater co-operation between medical and veterinary disciplines and we have been instrumental in encouraging research projects in, for example, dog ecology. In the latter context, we are delighted to accept an African Chiron Vaccine Rabies Award made by Chiron Vaccines. This award, to be presented at future biennial meetings, is to the value of $3,000 for the best scientific contribution in the field of research work in rabies control in Africa and is to used by the winner for his/her research work.

Our meetings are a ‘moveable feast’ and once again there was competition for the venue of our next meeting. We shall continue with George Bishop as Secretary and Arthur King as Chairman and our next meeting will be in Malawi in March 2001.

Chris Rutebarika, Richard Winyi-Kaboyo, Jacques Barrat and Arthur King (editors).

Programme

THEME : THE CHALLENGES OF RABIES DIAGNOSIS, SURVEILLANCE AND CONTROL IN THE 21ST CENTURY

<u>Monday 29th March 1999</u>

08.00 Registration

Session 1 : Official Opening

Chairman : *Dr. C.S. Rutebarika,* Rapporteur : A.A. King

08.30	Welcome :	*C.S. Rutebarika*
08.40	Overview of SEARG activities and theme of the meeting :	*R.W. Kaboyo,* Meeting Secretary
08.50	Welcome	*HAB Njie*, WHO Uganda
09.00	Welcome	*F.X. Meslin*, WHO Geneva
09.10	Official opening	*Hon. Minister of State Animal Industry*

Session 2 : Rabies Occurrence and Control in the SEARG Region

Chairman : *A.A. King* *Rapporteur : R.X. Dlamini*

09.30	Kenya	*A.K. Karugah (in abstentia)*
09.50	Sudan	*Y. Hassan Ali*
10.10	Tanzania	*J.G. Mundogo*
10.15	Tea/Coffee break	
11.00	Rwanda	*J. Sebatware*
11.20	Malawi	*S. Ndaomba*
11.40	Zambia	*A. Mutemwa*
12.00	Mozambique	*M.E. Pinto*
12.20	Lesotho	*K. Moshoeshoe*
13.00	Lunch break	

Chairman : *J. Barrat* Rapporteur : *S Cleaveland*

14.00	Swaziland	*R.X. Dlamini*
14.20	Namibia	*O.J.B. Hubschle*
14.40	Botswana	*M.K. Monyame*
15.00	South Africa	*G. Bishop*
15.20	Uganda	*C.S. Rutebarika*
15.40	Zimbabwe	*S. Javangwe*
16.00	Tea/Coffee break	
16.20	Discussion	

Note: Representatives from Burundi was unable to attend.

17.15 Cocktail Party at Entebbe Resort Beach

Tuesday, 30th March 1999

Session 3 : Rabies diagnosis : Challenges and opportunities

Chairman : *F.-X. Meslin* Rapporteur : *J. Bingham*

08.30 Have we met the challenges of rabies diagnosis, surveillance and control in the 20th century? *A.A. King*

09.00 Detecting rabies in rural Africa; a case for a new approach. *S. Cleaveland*

09.20 The inclusion of a distemper vaccine in rabies vaccination campaigns *A.P. Kloeck*

09.40 Discussion.

10.00 Tea/Coffee break.

Chairman : *P. Kloeck* Rapporteur : *S. Javangwe*

10.20 Practical realisation of rabies diagnosis in Central and Eastern Europe. *J. Barrat*

10.40 Rabies in a two week old calf. *E.S. Bizimenyera*

11.00 A review of clinical rabies admitted in Mulago Hospital, 1990-1998 Uganda. *E. Mworozi*

11.20 Rabies in Uganda in a retro and prospective view. *L. Siefert*

11.40 Detection and identification of rabies and rabies related viruses using rapid cycle PCR. *J. Bowen-Davies*

12.00 Rabies in wildlife : implication for conservation and wildlife. *G. Kalema*

12.20 Discussion.

13.00 Lunch break.

14.00 Tour of the source of the Nile.

Wednesday 31st March 1999

Session 4 : Human and animal rabies surveillance and control.

Chairman : *P.M. Ociba* Rapporteur : *P. Kloeck*

08.30 Urban rabies control initiative in Kampala. *J. Kinengyere*

08.50 Rabies virus excretion. *J. Barrat*

09.10 Human to human bites associated with clinical rabies. *R.W. Kaboyo*

09.30 Protection offered by cell-culture vaccines. *W. Haupt*

09.50 Tea/coffee break.

Chairman : *S. Cleaveland* Rapporteur : *R.W. Kaboyo*

10.20 Dog bites, rabies and patterns of treatment. *J. Acon*

10.40 Oral vaccines : research up-date. *A.F. Berthon*

11.00 Rabies survey in Swaziland. *R.X. Dlamini*

11.20 Control strategy that would minimise the DALY score of rabies for E.A. *M. Fevre*

11.40 Discussion.

12.30 Official closure *Hon. Minister of State for Health.*

13.00 Lunch.

Session 5 : SEARG / WHO business meeting.

Chairman : *A.A. King* Rapporteur : *G.C. Bishop*

14.00 Perspectives on the future of SEARG / WHO. *R.W Kaboyo and P. Kitala*

14.10 The viewpoint of the director of animal resources. *P.M. Ociba*

14.20 The viewpoint of the medical profession. *R.W. Kaboyo*

14.30 The viewpoint of WHO *F.X. Meslin*

14.40 A revised training manual by J. Barrat, A.I. Wandeler and A.A. King (Eds). *J. Barrat*

14.50 Discussion

15.15 Any other business – Next meeting

16.00 Return to hotels

19.00 Dinner at Imperial botanical beach hotel

Thursday 1st April 1999

Training Session.

08.30 – 12.30 Sample collection, preservation and analysis. *J. Bingham, G. Bishop and J. Barrat*

OVERVIEW OF SOUTHERN AND EASTERN AFRICAN RABIES GROUP (SEARG) ACTIVITIES 1997 - 1999

R. Winyi Kaboyo [1]

Mr. Chairman, Ladies and Gentlemen.

Let me first of all welcome all of you to the 5th SEARG conference. I am particularly pleased that Botswana and Namibia are now represented having missed the last SEARG conference in Nairobi, Kenya in 1997. Further I am happy to report that all the 17 countries of the SEARG have remained committed members throughout the 1997-1999 period. It has been our intention that more countries in this region be invited to join as new SEARG members. Burundi had shown interest but contacts were not made early enough for it to send a delegate to this meeting. We would therefore like to request the in-coming secretariat to follow up these developments which are aimed at expanding the SEARG membership.

I am also very pleased to inform you that during this period the World Health Organization (WHO) Headquarters through the efforts of Dr. F.X Meslin sponsored a consultancy on rabies in 12 SEARG member countries. The consultancy was undertaken by Dr. A. King with the main objectives of assessing the diagnosis, surveillance and control of rabies in the region.

This scientific "audit" on the rabies situation is very timely. The findings should form a baseline on which member countries will plan and implement rabies control strategies as we move towards the 21st century. I am also grateful to the member countries who allowed and indeed facilitated Dr. King during this consultancy.

The theme of this meeting is "The Challenges of Rabies Diagnosis, Surveillance and Control in the 21st century". A lot still needs to be done in the SEARG member countries in order to meet this challenge. There is need for accelerated technology transfer, improved communication within and between member countries, better training and more funding for rabies programmes. There should be improvement in the quality of data, analysis and timely reporting so as to build a more accurate and reliable data base on rabies in our region.

This will enable us to influence policy and attract more interest in rabies. We need to realise that the strongest motivation for rabies control generates from the magnitude of the rabies burden not in animals, but in the human population.

For this reason therefore, both medical and veterinary staff face an equal challenge to work together and harmonise diagnosis, surveillance and control strategies in the coming century.

I regret to inform you that in the course of organising this conference I received the sad news of the passing away of Dr. B. Nzioka in Kenya last September. The late Dr. Nzioka was a keen participant in the last SEARG conference at which he presented a paper on "The Surveillance and Management of bite wounds in Machakos district, Kenya" . May I request you to stand for a minute's silence in recognition of his work and association with the SEARG.

This meeting will no doubt recognize the absence of some of the founder members in the names of Dr. B.D. Perry, Dr. A. Wandeler, Dr. M. Fekadu, Dr. J. Mc Dermott and others who have been key participants in past SEARG conferences. Many of these colleagues could not make it to this conference for various reasons. It is our sincere hope that they will keep in touch with SEARG and will be able to participate in future meetings.

Let me thank all of you who have come and also those companies and individuals who have made this meeting possible through their generous contributions and other forms of sponsorship.

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[1] Veterinary Public Health – PO box 8 – Entebbe – UGANDA

WELLCOME SPEECH

Kapitaine Khantaway[1]

Honorable Minister, Distinguished Delegates, Ladies and Gentlemen,

It is my honour and privilege to welcome you all at this 5th Southern and Eastern African Rabies Group (SEARG) Conference in Uganda.

First of all, I would like to extend to you the apologies from Dr Hatib Njie, the WHO Country Representative who is out of the country. He has requested me to inform you that WHO, which supported this Group from its inception, is very delighted and honoured to be a partner to this forum as a step forward in epidemiology and control of rabies in this region. It is playing a big role in integrating zoonotic diseases surveillance as well as strengthening epidemic preparedness and responses at national and regional level.

Reliable data on rabies are scarce in many areas of the globe, making it difficult to assess its full impact on human and animal health.

Rabies remains a permanent threat to human population in many parts of the World. The number of deaths caused each year by rabies is estimated to be at least 40000 world-wide and as high as 70000 if higher case estimates are used for densely populated countries in Africa and Asia, where rabies is endemic. Four million people in over 80 countries require post-exposure treatment where the disease is present in its most dangerous reservoir, the dog.

Most of these deaths occur in parts of Africa, Asia and South America. However rabies represents an economic burden for both developed and developing countries because of the costs of human post exposure treatment, diagnosis and surveillance, immunization of domestic animals and control of wild animal populations.

In developed countries, rabies is today found mainly in wild animal hosts from which the disease spills over to domestic animals and humans. By contrast, in most of countries in Africa, Asia and Latin America dogs continue to be the main hosts and are responsible for most of the rabies deaths that occur world-wide.

In his recent report visit to South Africa, Zimbabwe, Mozambique, Malawi, Zambia, Tanzania and Uganda, Dr Arthur King mentioned: " Lack of financial resources and Country infrastructure are the major factors which prevent Mozambique, Malawi, Zambia, Tanzania and Uganda from controlling rabies. The majority of the people are poor, with annual per capita incomes of US$ 300 or less. In all of the countries canine rabies is a serious problem and both human and animal rabies is under-reported. In Uganda and recently in Tanzania liaison between the veterinary and medical professions is improving, but in the other countries it is poor or non-existent. Supplies of post-exposure vaccine are always inadequate; ERIG or HRIG are never available; in no country is human rabies confirmed by laboratory tests. In all countries there are serious problems with surveillance, sample collection and shipping and diagnosis. Very few animal samples reach the laboratory; laboratories are poorly equipped and although all countries possess at least one fluorescence microscope, only in Malawi is the FAT satisfactorily performed".

The rabies situation in Africa should be improved despite the fact that it may not be considered first priority. If information on rabies is provided in conjunction with health education in general, then we may be able to reduce the frequency of exposure, improve proper therapeutic behaviour after exposure and put in place a proper reporting system. This will in turn facilitate the planning of rabies control programmes and given political will and true commitment of countries across the region, there is no reason why this goal should not be reached and the deteriorating health situation in Africa reversed.

With this few remarks, I wish a successful and fruitful deliberation.

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[1] WHO - Plot4 - Nile avenue - East African Development Bank Building - PO box 24578 - Kampala - UGANDA

OPENING SPEECH

HON MINISTER OF STATE FOR AGRICULTURE
IN CHARGE OF ANIMAL HUSBANDRY

WHO Representative Geneva, WHO Representative Uganda, Country Delegates, Distinguished Guests, Ladies and Gentlemen,

I am pleased to have the honour of being invited to officiate at this function of the opening ceremony of the 5th SEARG/WHO conference here in Entebbe, Uganda.

I would like to welcome you all to Uganda. You feel free and enjoy yourselves. Your choice of this country for this conference was well made. As you will hear later from the country papers, we have a rabies problem in this region.

The theme of the conference "Rabies diagnosis, surveillance and control in the next millennium" is most fitting. I will briefly look at the historical perspective, present situation and future challenges of rabies in this country.

HISTORICAL PERSPECTIVE.

Rabies was first diagnosed in this country in 1935 in our laboratory here in Entebbe. The department of veterinary services that had been created in 1909 to control major epidemic diseases vigorously vaccinated the dogs and brought the disease under control. Up to the early 1970's, rabies was only restricted to the border districts of North West and South Western parts of the country. Other districts were regarded as rabies free.

During the period of civil strife of the 1970's and 1980's, there was a breakdown of delivery of veterinary services and there was a resurgence of most of the major epidemics of livestock including rabies. This was accentuated by the increasing number and mobility of both human and dog populations that are usually associated with civil strife and breakdown of the economy.

The economic situation at the time could not regularly avail the vaccines and logistics to enable carrying out meaningful rabies vaccination campaigns.

The staff morale was low and our diagnostic capacity literally went to nil.

PRESENT SITUATION.

Rabies has been reported in all the districts of Uganda and the government is mandated to control the disease through the department of livestock health and entomology.

The domestic dog accounts for the majority of the cases (95%). The control strategy aims at vaccinating most of the pets and destruction of stray and unvaccinated dogs. This has not been very successful because of the nature of our economy and the competition for the meagre resources by other disease epidemics of greater economic importance and with a potential to spread faster. However, Government still recognizes the importance of rabies and especially so the public health aspect of the disease.

The role of wildlife in the transmission and reservoir status of the disease is equally important. Very little study has been done in this country and it needs to be tackled.

FUTURE CHALLENGES.

Adequate control of rabies in the future lies in vaccination of all dogs and cats in the country and control of their populations. The challenge here is how to prevent infection from the reservoir hosts. This is the area where oral vaccination should be considered so that the wildlife in the forests game parks are vaccinated.

The development of a thermostable rabies vaccine would also go a long way in the control of this disease.

The enforcement of laws and regulations pertaining to animal welfare in this country need to be strengthened.

The privatisation of the delivery of veterinary services in the region needs to be speeded up so as to fully participate in rabies control programmes.

I am sure these are the areas your deliberations are going to tackle. I can only but mention them since you are the experts.

I would like to request this august gathering to do some cost-benefit analysis of rabies control programmes in future which will highlight the economic importance of rabies and guide both the national governments as well as the donor communities.

Permit me to sincerely thank all of you that contributed to the success of this conference. I know very well that this group has no specific funding agency but depends on the goodwill of all the people that would like to see rabies controlled or eradicated completely. Your association and co-operation with SEARG/WHO is highly commendable.

Finally, I would like to commend the SEARG/WHO organising committee for their tireless efforts in bringing about this conference. I also wish to thank delegates for devoting much of their time to the preparation of the scientific papers and for attending the conference.

I wish you all fruitful deliberations.

I therefore have the pleasure to declare this conference officially open.

Thank You Very Much.

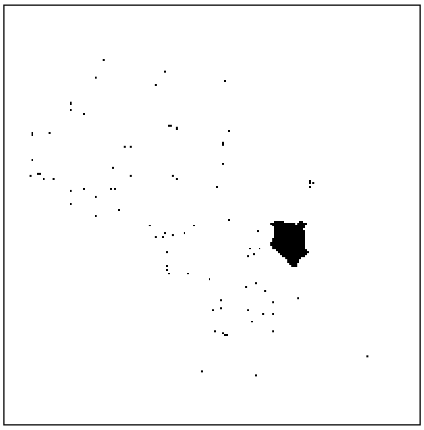
FOR GOD AND MY COUNTRY

Session 2 :

Rabies occurrence and control

in the region,

country reports



RABIES IN KENYA

A. K. Karugah [1] *in absentia*

1 INTRODUCTION.

Rabies situation in the country has not changed much since the last report submitted during the Nairobi meeting of March 1997. We know that the disease is endemic in all the districts though it is not possible to quantify the disease because of lack of hard data. But we know that fewer samples are reaching the laboratory these days and the majority of those that do are diagnosed positive as the data presented later will show.

2 HUMAN RABIES.

Since diagnosis of human rabies is no longer done at the Veterinary Research Laboratory, Kabete, it is difficult to quote figures of cases diagnosed. However, Kenya Medical Research Institute (KEMRI) is currently trying to establish a facility to diagnose human rabies; this will provide useful data in the future.

3 ANIMAL RABIES : CURRENT INCIDENCE, RECENT TRENDS.

Most positive cases occurred in dogs and cattle (Table 1).

Table 1 : Positive cases according to species, 1995 - 1998

	1995	1996	1997	1998
Dogs	77	53	35	42
Cattle	20	45	19	16
Cats	6	2	7	7
Sheep	0	0	0	2
Goats	4	5	1	1
Horses	7	7	1	1
Pigs	0	0	0	1
Wildlife	3	0	2	0
Human	0	0	N/A	N/A
Total	**117**	**112**	**65**	**70**

N/A - Not available

The origin of specimens that have been analysed is detailed in Table 2.

[1] Veterinary Research Laboratory - P. O. Kabete - KENYA

Table 2 : Source of samples for laboratory diagnosis.

Source	1996		1997		1998	
	Pos	Neg	Pos	Neg	Pos	Neg
District Veterinary Office	31	20	12	9	17	0
Veterinary Investigation Laboratory	30	7	18	19	18	5
Kenya Society for Protection and Care of Animals	25	15	8	5	9	3
Farmers	14	10	10	9	15	4
University of Nairobi	2	1	4	1	5	0
Private vets	7	1	6	4	5	3
Researchers	3	1	6	0	1	2
Police	0	2	1	0	0	1

NB : Farmers do not deliver samples to a laboratory but the samples are registered in the laboratory forms in farmers' names.

Thus, during 1998, out of 88 samples submitted, 70 were positive; this is significant in that it implies samples are mostly submitted to the laboratory only when clinical diagnosis has virtually confirmed the disease.

4 ANIMAL RABIES CONTROL : CURRENT STRATEGIES AND FUNDS ALLOCATED.

As reported during the 1997 meeting, our control measures include : dog vaccination, destruction by baiting of stray dogs and restriction of dog movement. We are of course aware of view expressed frequently that poison baiting dogs is not a useful way of controlling rabies because the vacuum created is easily filled by other dogs, but for the time being we feel this is something we have to continue doing because of the large number of stray dogs in the country.

Public funding of rabies control since 1993 ranges between 60000 and 255000 Kenya pounds (see Table 3)

Table 3 : Public funding of rabies control since 1993

Financial year	Total allocation (kenya pounds)
1993/94	107500
1994/95	60000
1995/96	210000
1996/97	255000
1997/98	131964

1 Kenya pound = 1 US$

Kenya society for protection and care of animals (KSPCA) conducts rabies vaccination campaigns, especially in urban and peri-urban areas. Additionally, KSPCA regularly submits samples for the laboratory diagnosis.

5 ANIMAL AND HUMAN RABIES VACCINATION.

Getting accurate records of human vaccine purchase and usage has always been difficult. Part of the reason in that rabies is ranked rather low in the priority list of diseases of medical importance in the country. Further, medical doctors always feel rabies control is more of a veterinary task than their problem.

We know for sure that many human victims of dog bite are vaccinated; but quite frequently, the source of the vaccine is a chemist shop whose records are difficult to get. This the has let to general lack of hard data, thus the low ranking of rabies in the medical profession.

A leading drugs company in tho country that supplies most of human vaccines sells about 5000 doses of vaccine to the Government and about 2500 doses to the private market (chemists, etc…) each year. Considering that there are other drug companies that sell human vaccines too, it is quite possible that the need for human vaccines is well over ten thousand doses per year.

A four year summary of vaccine purchases by the Department of Veterinary Services is given in Table 4.

Table 4 : Vaccine purchases by the Department of Veterinary Services.

Year	Doses of	
	animal vaccine	human vaccine
1994	150000	10000
1995	106375	1023
1996	120000	Nil
1997	94325	3090

The human doses given above are normally purchased for Departmental staff who are at a high risk of contracting rabies during their day to day work.

Table 5 : The actual vaccinations in dogs since 1994.

Year	Doses
1994	52136
1995	53211
1996	70553
1997	58965

ACKNOWLEDGEMENT.

To the Director of Veterinary Services for allowing free use of data and records available in the department.

6 REFERENCE.

Records and data of the Department of Veterinary Services.

RABIES IN SUDAN

Yahia Hassan Ali[1]

1 INTRODUCTION.

Sudan is the largest country in Africa with an area of one million square miles. The country is surrounded by 9 countries and the Red Sea. The human population in 1997 was 27290000.

Sudan is divided administratively into 26 states, which have different climates, densities of livestock and grassing protocols. Animal resources constitute a major part in the economy of the country, the estimated animal population in 1998 was 116419000, while in 1992 the animal census in Khartoum state showed that the dog and cat population is 71866.

In Sudan there is a Federal Ministry of Animal Resources, responsible for planning for animal health and production and two years ago four state ministries of animal resources were established in states with high animal population.

Figure 1 : Map of the Sudan and states.

[1] Rabies Unit-Virology Dep. - Central Veterinary Research Laboratories - P.O. Box 8067 El-Amarat - Khartoum - SUDAN

2 HUMAN RABIES.

Rabies is endemic in Sudan in humans and animals, most of the human exposures are reported in Khartoum state because people come to Khartoum to receive the vaccine from different states of Sudan.

Figure 2 : Location of central and regional veterinary laboratories in the Sudan.

Reporting is well organised, there is weekly, monthly, quarterly and annual reports for all in and out patients in all hospitals and health centres of Sudan which are sent to Federal Ministry of Health regularly. Table 1 shows human rabies post exposure treatments and deaths of the disease between 1992 and 1998.

Table 1 : Human rabies post-exposure treatment and deaths from rabies in Sudan, 1992 – 1998.

	Khartoum		Central states		Northern states		Eastern states		Western states		Total	
Year	**PET**	**Deaths**	**PET**	**Deaths**	**PET**	**Deaths**	**PET**	**Deaths**	**PET**	**Deaths**	**PET**	**Deaths**
1992	10500	2	678	-	91	-	25	-	2358	1	13652	3
1993	7853	2	232	10	1	1	476	21	150	2	8712	36
1994	8122	3	238	15	26	4	215	12	56	3	8657	37
1995	12745	3	264	7	12	-	47	1	650	5	13718	16
1996	6694	7	142	8	56	-	160	14	42	5	7094	34
1997	10685	2	-	1	-	-	2	3	77	4	10764	10
1998	6180	-	117	15	41	4	208	8	20	2	6566	29
TOTAL	**62779**	**19**	**1671**	**56**	**227**	**9**	**1133**	**59**	**3353**	**22**	**69163**	**165**

2.1 Types of vaccine used.

The locally produced goat brain vaccine costs about 5 US$ per course. Imported vaccines may be also used : duck embryo vaccine (about 120 US$ per course) and vero cell culture vaccine (65 US$ per dose) The exposed people have to pay for the vaccination, NGOs or commercial companies do not participate to the cost.

Diagnosis of human rabies is based only on history and clinical signs without laboratory confirmation.

2.2 Recent trends.

Trials to replace goat brain vaccine with home produced cell culture vaccine have been undertaken.

3 ANIMAL RABIES.

Rabies in animals is reported annually in Sudan since the first report in 1904. The disease incidence depends on the control measures adopted by the veterinary authorities.

Epidemiologically, the two species most frequently infected with rabies are the dog and the goat, both of which are usually kept outdoors most of the day.

There is a monthly reporting. Annual reports are sent from each province to the director general of animal resources in the state, then to the prime under secretary of animal resources in federal ministry of animal resources. Reporting to the federal ministry may be delayed but the data is available at any time in each state.

The reporting of cases is poor because people in rural areas (i.e. 50% of the country) usually do not bother to report animal rabies cases. During 1994-1998, 817 were reported suspected of rabies. Table 2 details these cases.

3.1 Diagnosis.

Animal rabies diagnosis is a routine work in Central Veterinary Laboratory (CVL) Rabies unit and some samples are diagnosed in National Health Laboratory.

Brain samples are send to CVL in ice or formalin and the diagnosis is done by fluorescent antibody test and histopathology, the number of samples tested and the results are summarised in Table 3.

Table 2 : Reported rabies suspected cases in Sudan in 1994 -1998.

	1994	1995	1996	1997	1998	Total
Dog	88	75	38	44	65	**310**
Cat	25	-	5	5	7	**42**
Monkey	-	1	3	1	1	**6**
Goat	59	54	30	25	29	**197**
Sheep	14	2	10	3	1	**30**
Equine	31	37	27	7	53	**155**
Bovine	7	4	5	11	7	**34**
Camel	-	-	2	1	40	**43**
Total	**224**	**173**	**120**	**97**	**203**	**817**

4 RABIES CONTROL STRATEGY.

In all provinces of Sudan there is annual funding for rabies control programme. Other funds are allocated by the animal resources administration in each state and by the federal ministry of animal resources.

Table 3 : Results of rabies laboratory diagnosis in Sudan in 1994 – 1998.

Species	1994		1995		1996		1997		1998	
	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG
Dog	7	6	7	2	3	5	4	3	5	10
Cat	-	1	1	2	3	3	1	2	4	6
Monkey	-	-	1	-	-	2	-	1	1	-
Goat	8	2	9	3	6	6	5	4	6	9
Sheep	-	-	-	-	1	-	-	1	-	-
Equine	-	1	2	2	3	-	-	2	1	3
Bovine	3	-	3	2	3	2	6	-	2	2
Camel	-	-	-	-	1	-	-	-	2	-
Total	**18**	**10**	**23**	**11**	**20**	**18**	**16**	**13**	**21**	**30**

The control strategy is based on vaccination of susceptible animals and destruction of stray and non vaccinated animals. Vaccination campaigns are usually followed by dog destruction programmes, e.g. during 1997-1998 the number of dogs destroyed was 19753 in Khartoum state only (Table 4).

Table 4 :Rabies control measures in Sudan in 1994 - 1998.

Year	Animals vaccinated	Animals destroyed
1994	413	-
1995	1030	110
1996	2722	98
1997	765	10253
1998	2302	9500

The dog population reduction strategy is applied according to the fund available. It was noticed that this policy is more effective than vaccination strategy because people do not care to vaccinate their dogs and the law of rabies control in Sudan states that any dog found outside is considered stray and must be destroyed, even if it is vaccinated.

In 1993 the federal ministry of animal resources established the national committee of rabies control, which consists of director general of animal health and epizootic disease control, director of veterinary extension dep., director of Khartoum veterinary hospital, member from CVL, national health laboratory, preventive medicine dep. (federal ministry of health), dep. of epidemics (Khartoum state ministry of health), member from police forces. The committee is working regularly and following up the situation of the disease and has participated in preparing a complete plan for rabies control in Khartoum -State.

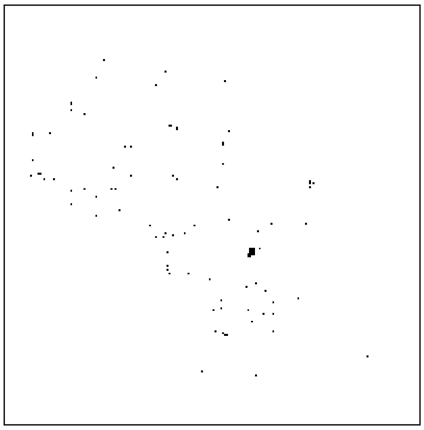
Funding allocated to rabies diagnosis and research is less than other diseases e.g. rinderpest, CBPP. The proposed plans for rabies diagnosis and research in Sudan is improvement of diagnostics and production of tissue culture vaccine.

No role in rabies control, diagnosis and research is played by NG0s or commercial companies. The animal rabies vaccine used in Sudan is tissue culture vaccine which costs US$ 0.5 per dose.

Table 5 : Estimation of animal population in Sudan in 1998.

State	Cattle	Sheep	Goats	Camel
North Kordofan	489943	2135380	1971907	381928
South Kordofan	2184713	861060	1588346	151107
West Kordofan	2868091	4561906	1752658	561790
North Darfor	666961	3483357	2418120	368805
South Darfor	3476516	3548022	2519445	69446
West Darfor	3340724	3421430	2957610	266359
Elgedarif	855832	1482619	888378	153669
Kassala	348157	798334	1035163	400563
Red Sea	63888	296065	601412	208375
Blue Nile	3423790	4065799	2944465	133179
Sennar	1305078	1095998	1007778	72736
Eigezira	1973312	2010732	1431090	77165
White Nile	2882499	2054118	1958689	22082
Northern	275964	798334	963962	30734
River Nile	79010	839434	1009881	71302
Khartoum	178141	382532	529767	4753
North Upper Nile	859939	561826	385997	0
Unity	1034864	1409962	1545542	0
Gongoli	1284517	1233985	1062549	0
N.Bahr Elgazal	1383830	1129749	1436001	0
W.Bahr Elgazal	1092356	1026429	985870	0
Albohairat	1149849	1083617	1287293	0
Warab	1339758	1140477	1204952	0
Bahr Elgabal	767958	1113448	1015824	0
E.Eqatuatoria	777847	901654	997969	0
W.Eqatuatoria	590464	1028731	997974	0
Total	**34584000**	**42363000**	**36498000**	**2974000**

RABIES IN RWANDA



J. Sebatware[1]

1 INTRODUCTION.

Rabies in Rwanda is a well known and most feared public threat to the society though its actual incidence, prevalence and its control measures currently are not well documented. This has been accentuated by the repercussions of war, which decimated veterinary clinics and national veterinary laboratory services, particularly disease epidemiology, treatment and control services. The relationship that exists between man and animals increases the importance of taking the rabies control programme seriously and effectively.

The only rabies control programme currently used is dog vaccination and this has been exercised country wide under supervision of Directorate of Livestock and Veterinary Services of the Ministry of Agriculture, Livestock and Forestry, in collaboration with National Veterinary Laboratory. Suspected rabies cases have been reported in different parts of the country. Thirty four dog bites were reported to the Ministry of Health and victims were given post-exposure treatment accordingly. Nevertheless, none of the suspected rabies cases were confirmed in the laboratory due to the fact that the national veterinary laboratory lacks necessary rabies diagnostic equipment.

There is an urgent need to have the National Veterinary Laboratory (LVNR) re-equipped so that rabies diagnostic services in the country resume and are attended to effectively.

2 HUMAN RABIES AND ITS CONTROL.

According to the public health epidemiology unit in the Ministry of Health (MINISANTE), in the year 1998, thirty four dog bite cases were reported and victims were given post-exposure treatment (PET) accordingly. No human clinical cases were reported. Dog bites reported in each prefecture are shown in Table 1 below.

Table 1 : Reported dog bite cases.

Prefecture	Persons bitten
Butare	25
Byumba	2
Cyangugu	1
Gikongoro	0
Gisenyi	0
Gitarama	0
Kibungo	2
Kibuye	0

[1] National Veterinary Laboratory - Box 804 - Kigali - RWANDA.

Dogs that had bitten persons were detained for fifteen days to see if they developed more rabies symptoms. Dogs which died during detention period were strongly suspected to have died of rabies. Bite victims were reported to the nearest veterinarian and immediately taken to the nearby public health centre, clinic or hospital for post-exposure treatment. Unfortunately, reported dog bites might not reflect the actual number because most of them go unreported. That is why the ministry of health in collaboration with ministry of agriculture, livestock and forestry has decided to embark on a public sensitisation programme on the importance of rabies. This will make the public feel responsible in whole exercise of rabies control.

3 ANIMAL RABIES AND ITS CONTROL.

Rabies control, as for many other epidemics in the country, falls under Directorate of Livestock and Animal Health in the Ministry of Agriculture, Livestock and Forestry (MINAGRI). Due to consequences of genocide of 1994, this directorate and ministry at large suffered and still suffers serious setbacks which led to failure in fulfilling its primary obligations. These include lack of ability both financially, materially and manpower needed to cater for required veterinary services throughout the country. This results, among other things, in inability of the National Veterinary Laboratory to diagnose suspected rabies cases as well as inability to carry out rabies research aiming at providing scientific data to address the challenge posed by rabies to the society. It also led to an inability to conduct the strict and well organised vaccination campaign and destruction of stray dogs exercise in the country. Like other countries we base our rabies control on dog vaccination programmes and human post-exposure treatment.

In 1998, vaccination campaigns were conduced against rabies using inactivated vaccine (Rabdomum®) in Kigali prefecture and this covered about 65% of domestic carnivores in the prefecture. Out of 899 domestic carnivores vaccinated, 769 were dogs and 119 were cats. Vaccination continued in other prefectures under supervision of Directorate of Regional Agricultural Services (DRSA) for the rest of the year 1997 up to 1998.

In the year 1998, about 6000 doses animal rabies vaccine (Rabisin®) were procured and these were sent to respective regional veterinary officers through respective DRSA, aiming at getting all dogs in the country vaccinated against Rabies. Unfortunately there was not enough follow-up due to lack of means for proper monitoring and close supervision. This led to unsatisfactory conduction of vaccination campaign in some parts of the country and therefore made evaluation of the whole exercise difficult. Another problem included poor dog owner response to vaccination campaign, presence of large number of stray dogs and poor public rabies awareness. It is in this regard that we still see that rabies is one of the most serious public threats to Rwandese. That is why the Ministry of Agriculture, Livestock and Forestry has a plan of implementing a strict vaccination campaign against rabies, as well as destruction of stray and unvaccinated dogs in the year 1999. This will go parallel with re-equipping the National Veterinary Laboratory so that it plays its role in the rabies diagnosis and control programme. In its future plan MINAGRI in collaboration with other ministries such as the Ministry of Health and other interested organisations will embark on educating the public so that the importance of rabies is felt in the society. Consequently, co-operation of Rwandese in the whole exercise of rabies control is assured.

4 FUNDING OF RABIES CONTROL, DIAGNOSIS AND REPORTING.

No funds have been set aside specifically for rabies control in the budget of ministry of Agriculture. This resulted in inadequate funds to facilitate the campaigns as required by vaccination regulation. In regard to diagnosis of rabies in Rwanda, the service currently is not operational because of consequences of 1994 genocide. One of the most serious set back is the inability of the National Veterinary Laboratory to diagnose suspected rabies cases. That is why the ministry of Agriculture is giving priority to National Veterinary Laboratory to have it equipped and operational. Other necessary activities like rehabilitation has already been attended to.

5 ANIMAL AND HUMAN VACCINES.

Vaccine currently used for animal in Rwanda is Rabisin®. Number of vaccine doses procured were 6000 and they were distributed to the respective DRSA for animal vaccination exercise exemplified by Kigali, Byumba and Kibuye which received 3000, 2000 and 500 doses of vaccine respectively. Anti-rabies vaccine (ARV) is available in hospitals for post-exposure treatment (PET) of dog bite victims.

6 ROLE OF DONOR ORGANISATIONS, ETC …

Though some non-governmental organisations like Action Nord Sud have assisted in the rabies control programme by donating rabies vaccine, not much of NGO's effort have been allocted to this effect. This could have been due to several factors, among which is lack of proper information about the threat posed by rabies to the society. Consequently the disease did not get the priority it deserves in their disease control programmes.

7 CONSTRAINTS OF RABIES CONTROL.

Constraints suffered in the rabies control exercise include insufficient funding, lack of well equipped veterinary laboratory for rabies diagnosis, and insufficient rabies public awareness, particularly in rural areas.

RABIES IN MALAWI

S.J. Ndamoba[1]

1 INTRODUCTION.

Malawi is a small landlocked country, located in the central eastern part of Africa at 9° latitude, lying in the path of the south Easterly trade winds. The size of the country is approximately 94000 km^2 land surface and 23000 km^2 of water. The human population is currently estimated at 11 million with an average density of 500 persons per km^2. Malawi is one of the poorest countries in the world ranking number 5 from the bottom. Its GDP is very low compared to other African countries. The economy is hinged on Agriculture which contributes about 37 % to the total economy. Tobacco is the main foreign exchange earner.

Administratively the country is divided into three regions : the Northern Region with five districts, the central region with nine districts, and the southern region with ten districts. The southern region is the most densely populated part of the country, followed by the central region. The northern part is still sparsely populated.

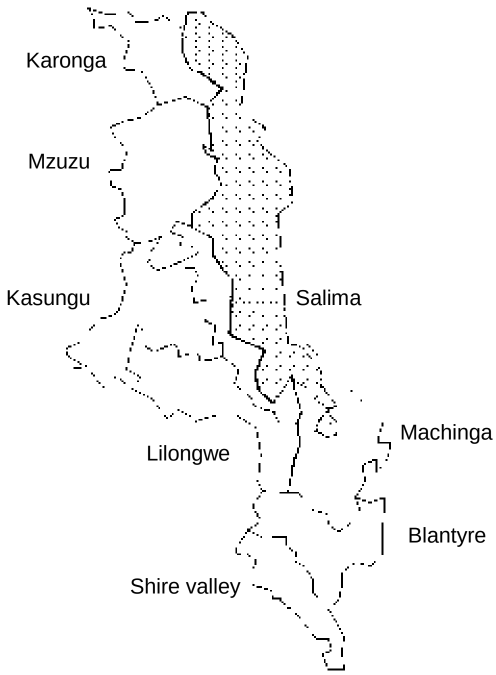
For the purpose of facilitating implementation of Agricultural programmes, the country is divided into eight ecological zones which are called Agricultural Development Divisions (ADD). Each ADD has technical personnel from all departments in the ministry. The ADD boundaries are shown in Figure 1. All Agricultural programmes including the control of animal diseases are operated through this institutional arrangement. Although rabies is a multi-sectoral problem, the department of Animal health takes the lead in implementing control strategies. Canine rabies is the most prevalent in the country and it is estimated that there are just over half a million dogs. According to Dr A King who visited twelve African countries in the region on a WHO project, in no country is the dog population accurately known. In Malawi our figures are obtained from estimates made by field staff during their routine job. The distribution of the dog population depends on the sociocultural beliefs in the particular geographical area.

Table 1 : Population of dogs according to Agricultural Development Divisions.

ADD	Total dogs
Karonga	
Mzuzu	
Kasungu	85326
Salima	32415
Lilongwe	75000
Machinga	
Blantyre	
Shire valley	21685

[1] Department of animal health and industry - PO box 2096 - Lilongwe - MALAWI

Figure 1 : Map of Malawi showing ADD boundaries.



2 HUMAN RABIES.

The incidence of human rabies in Malawi cannot be estimated accurately. There is insufficient liaison between the medical profession and the veterinary side. In the past before the establishment of the College of Medicine in Blantyre, all human rabies suspect specimens were sent to the Central Veterinary Laboratory for processing. The last case was submitted in 1991. The samples are now processed by the college of medicine pathology department. As indicated above, very little exchange of information occurs. In terms of diagnoses, if a patient is suspected to have rabies the clinicians can only make assumptions on the basis of the observed symptoms. The opportunity to conduct an autopsy should the patient die is very remote because traditional cultures would not allow. Only police cases are subjected to autopsy. This observation means that no data is available for human rabies. Dr. King confirms this observation that in most African countries, the lack of financial resources and facilities compound this problem.

3 ANIMAL RABIES CONTROL.

As already indicated, canine rabies is a very serious public health concern, but the commitment at high level is very limited. This is evidenced by the fact that Rabies control as a programme does not have a separate budget line item. It is budgeted together with any other diseases.

3.1 Diagnosis.

In most rabies suspected cases, diagnosis starts from the point of gathering history of the animal.

Confirmatory diagnosis is performed by the Central Veterinary Laboratory or the 2 Regional Laboratories. Use of the Fluorescent Antibody Test is the most reliable means of confirming rabies. This is supported by mouse inoculation tests. Like in many African countries, effective and efficient diagnosis is hampered by lack of adequate resources. Some specimens never reach the laboratory or they are of poor quality. This results in wrong diagnosis and under estimation of the rabies situation.

In Malawi we have strong technicians who conduct the tests in the Central Veterinary Laboratory and one in each regional laboratory to respond to regional cases. Although facilities for Histopathology are available, there are only two pathologists who are in administrative positions and cannot find time to work at the bench.

3.2 Current control strategies.

Before 1983, control of rabies in the country was on an ad hoc basis. Three Regional rabies Control teams existed for sometime controlling rabies, mainly through dog shooting and mass vaccinations.

In 1995 Department of Animal Health and Industry (DAHI) proposed the formation of a joint collaborative taskforce to formulate new strategies for Rabies control in Malawi. The taskforce was composed of representation from Ministry of Health and Population, City Council officials, Department of Parks and Wildlife and the Department of Animal Health and Industry. A project document was produced jointly, and a budget of K2.00 million was proposed and submitted to the relevant ministries for funding. The results were discouraging because there were no responses from the other participating Ministries.

Fortunately in 1997, the project concept was recognised by an Italian NGO (C.E.S.T.A.S.) under the sponsorship of the European Union.

It was decided to implement Rabies control strategy first as a pilot scheme in one ADD - Lilongwe ADD. The pilot scheme has now been completed successfully and finished in February 1999. During the pilot phase, assistance was provided to other ADDs not in the project. On the basis of the results of the pilot, a new project phase will now extend the strategies to 6 other ADDs

The control strategies which were very successful in the pilot phase will now be used in the new phase. These included :

- Complete dog survey by use of questionnaires to consolidate data on dog statistics in the country.
- To collect and analyse all available laboratory and hospital data in order to create a sound background for planning.
- To create specific rabies control offices in each ADD or each district. This is going to fit well with the new bill on decentralisation which has just been passed in Parliament.
- To conduct an awareness and mass media information campaign through the distribution of questionnaires and use of field staff to interview the community. The field staff are to be trained to supply the communities with relevant information concerning the diseases and the vaccination campaigns.

  The use of radios, posters and drama is an effective technique of disseminating information and of attracting support. Information leaflets in local vernacular also enhance the message delivery. In order to ensure that the proposed strategies are sustainable, Government should be convinced to include rabies in a separate budget line item.
- To accomplish two rounds of mass vaccination campaigns per ADD, in order to reach 50% coverage of the dog population and perhaps 100% in two years time.
- To sensitise all dog owners and the public and private sectors on rabies control and to motivate the Veterinary Assistants/Frontline staff and all the personnel directly or indirectly involved in the rabies operation.

4 FUNDING.

As previously indicated, no specific budget line item is identified for rabies control. The funds allocated for all disease control activities are assumed to accommodate rabies. The amount for rabies control depends on the decision of the programme officer.

C.E.S.T.A.S. is the only N.G.0. which has assisted Malawi to strengthen its rabies control strategies. Although the first pilot phase of the project was limited to one ADD, the project also considered requests from six other ADDs and assisted with 30000 doses of vaccine and 30000 syringes. The vaccines were sold and funds realised were created into a revolving fund.

Another donor funded project, the SADC Animal Disease Control project under funding from EU, has established a cost recovery scheme of veterinary drugs and vaccines in 6 ADDs. Veterinary Assistants have been given a drug box which includes relevant vaccines like rabies vaccines. This programme has greatly improved availability of vet drugs and vaccines to the farmers. Since the drugs are sold at cost and a revolving account is maintained, it is assumed to be a sustainable strategy.

A different project - Basic Animal Health Services project (GTZ) working in the 2 Northern ADDs, Mzuzu and Karonga, has strengthened rabies control in the area by following similar strategies as in the other 6 ADDs. Vaccines are sold by Veterinary Assistants and the fund realised is placed in a revolving account. Very little research has been performed in Malawi on rabies. The C.E.S.T.A.S. pilot project initiated a dog ecology survey in the area of operation. This survey is intended to cover the whole country in the extended phase of the project. The exact budget for this has not been established.

The use of dog population reduction.

The use of dog population reduction by shooting stray dogs has been the only way used in the past. Currently, the use of increased public awareness and community education are preferred to the above strategy.

5 ANIMAL AND HUMAN RABIES VACCINATION.

One of the control strategies has been to mount massive vaccination campaigns. Rabisin and Rabdomun are the types of vaccines used. There has been an improvement in coverage between 1997 and 1998 (Table 2). In 1998, 98375 vaccinations were carried out, compared with only 8339 vaccinations in 1997. This improvement can be attributed to the support from the donor funded projects C.E.S.T.A.S, SADC, ADCP, BAHSP.

Table 2 : Animal rabies, dog vaccinations.

ADD	1997	1998
Lilongwe		65161
Blantyre	3163	7445
Shire Valley		319
Machinga	3928	1674
Salima	677	9699
Kasunga	210	12580
Karonga	361	1497
Mzuzu	-	-
Total	**8339**	**98375**

Massive vaccination campaigns are used to back other strategies. Vaccinated dogs are given a collar for easy identification in the next round. Rabisin and Rabdomun are the types of vaccines used.

RABIES IN ZAMBIA

A. Mutemwa [1]

1 INTRODUCTION.

In the last two years, the country's civil service has been engaged in a restructuring programme. This affected all the ministries and as a result most workers did not perform maximally as they waited to be interviewed and either be appointed or retrenched.

This naturally affected our department i.e. Department of Veterinary and Tse-tse control. However, by end of 1997 the veterinary department was almost fully restructured. A new department called Research and Specialist Services came into being. This department is headed by a Director.

All this was done under ASIP "Agriculture Sector Investment Programme" which ended in a policy privatising the veterinary services in Zambia.

2 PRIVATISATION.

This is going on with the help of European Community giving loans to those intending to go private. So far three loans have been given i.e. one in Lusaka, one in Coperbelt and one in Central Province. So government stays in arrears where there are private veterinarians. The government vets must not engage in any vet activity, but must play a role of monitoring, supervision and regulation.

However, our role of monitoring, supervision and regulation has not been satisfactory and to that effect an inspectorate is being formed to carry out this function.

3 FUNDING.

This is a major set back and 1997 and 1998 have been wasted years. 1998 saw all the departments being paralysed as the lack of funding ended in being unable to pay for services i.e. telephones, water and electricity. There was no phone communication within our department. The only telephone operating was one at headquarters.

4 TRANSPORT.

This is very poor and over 90% of district veterinarians are immobile.

[1] Department of Animal Production & Health - P.O Box 30041 – Lusaka - ZAMBIA

5 DISEASES OF NATIONAL IMPORTANCE.

The country has identified certain diseases as being of national importance and these are contagious bovine peri-pneumoniae (CBPP), rinderpest, foot and mouth disease (FMD), Corridor and lack rabies among others.

6 RABIES CONTROL.

Government encourages people to routinely vaccinate their pets and this is done at their cost. Government can only get fully involved in providing free rabies campaigns in cases where there is a serious outbreak.

Since government is not involved routinely there are so many rabies campaigns, especially in Lusaka, where private vets have almost divided the district and own specific areas where they do annual rabies campaigns. These rabies campaigns are blessed by the district veterinary officer. In the last two years, no outbreak of rabies has been reported in Lusaka. It is not known if this is attributed to good coverage or to lack of proper surveillance.

The only drawback of allowing private vet to do these campaigns is that they may think of money more than the control. However, with proper monitoring the system can work.

7 VACCINES USED BOTH ANIMAL AND HUMAN.

Balmoral vaccine	C.V.R.I.
Rabisin	Imported R.M.
Human rabies vaccine	Imported

An outbreak was reported in a small town of Kapirimposhi in mid March 1998. A suspected rabid dog had bitten a son of a wealth man and this forced the parents and the D.V.0 to drive about 250 km to Lusaka to bring the dead dog. Post exposure treatment was given immediately at the owner's cost.

8 COST.

	ZK	US$
Rabies vaccine/dog	500	2
Post exposure for full course	300000	120
Vaccine from Asia i.e. India	150000	60

9 CENTRAL VETERINARY RESEARCH INSTITUTE (CVRI).

CVRI is still operating and is mainly doing diagnostic work. Research activities are almost non existent. Vaccine production is going on and the following vaccines are produced:

- Rabies vaccine
- Haemorrhagic septicaemia vaccine
- Anthrax vaccine (live)
- S 19 Brucellosis (live)

There is an increasing concern over the quality of these products as no independent body carries quality tests.

Funding to the institute, especially after restructuring, has been very poor. They do not get funds directly as was the case previously, but instead get allocation through the deputy director at headquarters.

A policy was passed to make CVRI to be part of the Department of Science and Technology. This however met a lot of resistance from the vets and the situation has remained unchanged.

RABIES IN MOZAMBIQUE

M. E. Pinto[1]

1 INTRODUCTION.

In Mozambique rabies is one of the most important zoonotic diseases and has a major impact in the socio-economy of the nation.

The disease occurs in both human and animals throughout the country, with an incidence changing according to time and province.

Dogs are the most affected species and are also responsible for the transmission of the disease to humans.

Reports have been received from urban areas indicating rabies in goats (2 cases in 1989, 3 in 1992), cats (2 in 1992) and monkey (1 in 1989).

2 HUMAN RABIES.

As stated above, human rabies is a very serious zoonotic disease in Mozambique and the number of cases has increased since the past 3 years, especially in the rural areas.

People bitten by dogs report to clinics or hospitals run by the Ministry of Health. Information on the history of the dog, its vaccination status and duration of the disease are collected.

Health officials then inform the veterinary department to approach the owner and find out if the dog had been vaccinated or not and other relevant questions. This information cannot be gathered for stray dogs.

Table 1 summarizes human case during 1993-1997, by province.

Table 1 : Distribution of rabies in the various provinces, 1993-1997.

Province	1993	1994	1995	1996	1997	Total
Maputo	0	0	0	0	0	**0**
Gaza	0	0	0	1	6	**7**
Inhamban	1	0	1	0	5	**7**
Sofala	0	1	3	0	5	**9**
Manica	2	3	6	6	1	**18**
Tete	3	1	0	1	-	**5**
Zambézia	0	0	1	3	2	**6**
Nampula	3	2	4	5	5	**19**
C.Delgado	0	0	2	0	4	**6**
Niassa	0	0	0	1	0	**1**
Totals	**9**	**7**	**17**	**17**	**28**	**78**

[1] National Directorate of Livestock - Animal Health Department - P.O. Box 1406 - Maputo - MOZAMBIQUE

3 METHODS OF DIAGNOSIS AND REPORTING.

Rabies diagnosis in animals is carried out at the National Veterinary Research Institute (INIVE), which is the Central Veterinary Laboratory using any of the three tests, immunological (FAT), biological (mouse inoculation test) or slide test (Seller's staining). Laboratories in the field use Seller's test only.

Most of the reports of human cases are based on clinical signs and history of the person bitten. Many of the human cases occur in Nampula, Manica and Sofala Province.

Ministry of Health sends its weekly bulletin which reports on rabies and other diseases to the veterinary Department.

4 ANIMAL RABIES CONTROL.

Annual vaccination campaigns are carried out throughout the country, provided finance was not a constraint.

The capturing and killing of stray dogs is now done in most of the Provinces.

It is envisaged to launch an extensive educational campaign throughout the country to improve public awareness of the seriousness of Rabies and educate dog owners to keep their dogs in their dwellings and have vaccination for their dogs as advised by the veterinary department. This will reduce the number of stray dogs which are mostly responsible in the transmission of this disease to humans and other animals.

In budget allocation, the amount of money for use to procure vaccines or conduct investigations is not specifically indicated. This is one of the major problems- to control rabies.

The Veterinary Department, which is under the National Directorate of Livestock, is responsible for animal vaccination campaigns, observation of suspected animals, collection and sending suspected samples to the laboratories.

The National Veterinary Research Institute is responsible for vaccine production and laboratory diagnosis.

Funds for animal health activities for the years 1993-1997 is shown in Table 2.

Table 2 : Expenditures for animal health activities between 1993-1997 (US$).

1993	1994	1995	1996	1997	Total
229418	207747	181246	227117	170250	1015778

5 DIAGNOSIS AND RESEARCH.

Only the Central Veterinary Laboratory in Maputo uses FAT, MIT and Seller's Staining.

The other three regional laboratories have facilities to perform Seller's staining for diagnosis of the disease.

Confirmed rabies cases do not reflect the actual picture of the rabies situation in Mozambique. Cases are mostly unreported due to poor veterinary infrastructure. Many patients also stay in the villages trying traditional method of treatment.

The role that wildlife may play in rabies cycle is not known.

Table 3 shows the number of confirmed rabies cases in animals for the period 1993-1997.

Table 3 : Confirmed rabies cases in 1993-1997.

1993	1994	1995	1996	1997	Total
14	21	9	43	14	**101**

6 ROLE OF DONOR ORGANISATIONS, PROJECTS, CAMPAIGNS, INSTITUTIONS AND NGOS.

Students of the Veterinary Faculty conducted by the Provincial Veterinary Services participate vigorously in annual vaccination campaigns.

Some Projects run under DINAP procure both human and animal rabies vaccine; Veterinary supplies and vehicles and bear all costs associated with the vaccination campaign. The projects also cover costs for educating the public via the public media or in schools.

The veterinary department is in discussion with the Ministry of Health to initiate a pilot rabies control project in Maputo city involving all concerned on this matter. The start shall be in Maputo city to be followed in other urban centres.

7 STRAY DOG POPULATION REDUCTION.

In rural areas, where the dog population density is far higher than in the cities, stray dogs are the main public health hazard . Unfortunately, destruction of stray dogs is concentrated in Maputo and Beira cities.

8 ANIMAL AND HUMAN VACCINATION.

Vaccine used for animal vaccination is produced at INIVE and is prepared on embryonated eggs. Other vaccines produced in tissue culture cells are also imported. The quantity of imported vaccine (Table 4) depends mostly on the capacity of INIVE to produce vaccine locally.

Table 4 : Doses of animal rabies vaccine imported in 1993 –1997.

1993	1994	1995	1996	1997	Total
32000	45000	3200	5460	25505	**111165**

Because of the gradual increase in public awareness to the fatal consequence of rabies on human health, the number of people who bring their dogs for vaccination is on the increase.

The quantity of vaccine distributed in the country during 1993 -1997 is summarised in Table 5.

Table 5 : Vaccine used for animals between 1993 and 1997.

1993	1994	1995	1996	1997	Total
54399	8491	25692	26390	54755	**169727**

Private veterinary practitioners in the big urban centres conduct vaccinations for cats, dogs and domesticated monkeys.

The Ministry of Health imports vaccine for use in humans bitten by suspected rabies animals.

Because of the lack financial resources for vaccine acquisition by the Government, patients are forced to go to private clinics or obtain the vaccine by themselves from neighbouring countries.

Table 6 shows the number of patients vaccinated against rabies by the Ministry of Health in Maputo City during 1993 -1997.

Table 6 : Human vaccination in Maputo city between 1993 and 1997.

	1993	1994	1995	1996	1997	Total
Bitten in the country	881	950	938	996	1601	5366
Vaccination Maputo city	178	215	43	107	15	558
% Vaccination	20.2	22.6	4.6	10.7	0.94	10.4

RABIES IN LESOTHO

K. Moshoeshoe[1]

1 GEOGRAPHICAL LOCATION.

Lesotho is situated in the Southern African region. It has an area of 30000 km^2, divided into 10 districts. One third is arable land and the rest of the country is mountainous, with the highest peak of 3600 metres above sea level. This mountainous area is used for livestock production. The climate is subtropical. The Republic of South Africa surrounds the entire country.

2 INTRODUCTION.

Rabies in Lesotho was first introduced through illegal importation of dogs in 1981. After that, the country started having sporadic cases of rabies in animals which were confirmed by our diagnostic laboratory. The high incidence of rabies was becoming a threat to the nation after a loss of 18 human lives in 1984. The government of Lesotho through the Department of Livestock Services had to take drastic steps of controlling the disease by vaccinating carrier animals, which were 100000 dogs and 20000 cats. The response was good with free vaccine for the pets from the year 1985 to 1994 when the owners complained of mortality post immunisation and this needed education.

3 HUMAN RABIES.

Currently the number of human reported to have been bitten by dogs has risen, and all the dogs are always suspected to be rabid until after monitoring by the Veterinarians for two weeks. During this period the patient is referred to a health clinic or hospital where they are given treatment. With cases of a dog known and under monitoring a patient is not immediately given anti rabies human diploid post exposure unless the animal dies during monitoring or if the dog can not be traced. The figures for these cases will be shown in Table 1.

Table 1 : Human Rabies cases by year.

Year	Morbidity	Mortality
1996	1	-
1997	29	-
1998	43	-
1999	14	-
Total	**87**	**0**

There are still no laboratory confirmatory facilities for human cases in Lesotho, the only method is by clinical diagnosis of the patient. The co-ordination between the Ministry of Health and Veterinary services have improved and this has led to better reporting with up to date statistics.

[1] Department of Livestock Services - Private Bag A82 - Maseru 100 – LESOTHO

4 ANIMAL RABIES CONTROL.

The current strategies are mainly control measures, which is done by organising campaigns to immunise cats and dogs. The Animal Health Division conducts these campaigns at district level in the form of mobile clinics. These clinics were adopted because they suit the programs of the Veterinarians in their area, except that they are expensive because the organiser has to maintain a cold chain to protect the vaccine. At present, the programs are conducted during warm seasons, whereas previously rabies campaigns were conducted during cold winter months when a cold chain was not needed as temperatures drop to 0° C. The response of the pet owners is beginning to improve during vaccination campaigns, probably because of awareness campaigns being held by the Ministries of Health and Agriculture for the public about the disease.

We are again presently looking for funding to host a National Seminar for Technical and Professional personnel between the two Ministries, where we can set standards and formulate a policy together towards combating Rabies in man and animals.

The present situation concerning diagnosis is through our diagnostic laboratory by using a fluorescent microscope to do Florescent Antibody Test (F.A.T), although recently we have been entirely dependent on Ondestepoort Research Institute for all our samples after vandalism that occurred to our laboratory during the resent unrest in Lesotho. We are again looking for funding from donor organisation to come to our rescue for provision of a Fluorescent Microscope and if possible a Histopathological diagnostic machine comprising of

- Processor machine
- Microtome
- Tissue blending machine.

We had suspect rabies cases in dogs which had bitten people but most of them were observed and did not die. There were however in July 1998, 2 dogs that died ten days after they had had contact with 8 people of ages 9 to 16 years. Their carcasses were exhumed and samples sent to Ondestepoort Research Institute in South Africa for tests and the results were positive. The exposed people were immediately given anti rabies human diploid post exposure and they are still alive. Table 2 indicates the animal vaccination figures of dogs and cats and positive to rabies.

Table 2 : Rabies vaccination figures for dogs and cats, 1996-1998.

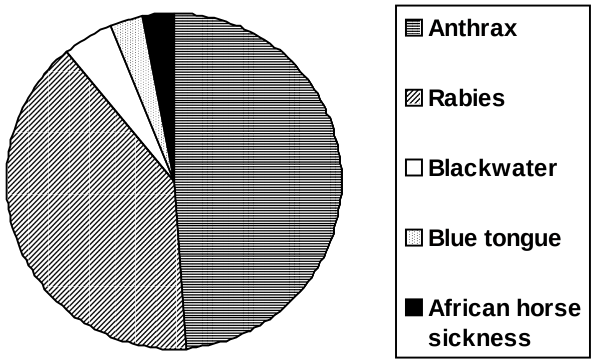
Year	Dogs and cats vaccinated	Positive	
		Dogs	Cats
1996	66113	-	-
1997	71304	-	-
1998	67560	2	-

No research on rabies is carried out, except that we are beginning to monitor its incidence in districts where we feel vaccination coverage is low. In Lesotho we do not use population reduction except that we have embarked on strict methods of importation of dogs and cats and as a result our pet population has decreased. The type of vaccine that is used to control rabies in animals is the inactivated cell culture vaccine Rabdomun recommended by WHO.

5 FUNDING.

The Ministry of Agriculture allocates funds for control of animal diseases amounting. R200,000.00 (US $ 28000). On the five major diseases of concern in Lesotho, rabies comes second as shown in Figure 1.

Figure 1 : Allocation of funds per disease.



ACKNOWLEDGEMENT

Lesotho welcomes the 1999 invitation to the Southern and Eastern African Rabies Group (SEARG) in collaboration with W.H.O..

RABIES IN SWAZILAND

R. X. Dlamini[1]

SUMMARY.

It appears that in Swaziland we are not doing sufficient work to stop the spread of rabies within the vector species (dogs). The fact that vaccination coverage only picks up after there has been an increase in outbreaks and the fact that we cannot sustain high vaccination coverage irrespective of the positive cases might mean that we need to do a lot of work in public awareness. There may also be need for more rigorous law enforcement to "persuade" those members of the public who are reluctant to vaccinate their dogs against the disease. The positive aspect seen is that in the years following a good vaccination coverage there is a decline in the number of positive cases.

It is expected that once people become aware of the seriousness of the disease there will be improvement in reporting suspected rabies cases in domestic animals. The report of dog bite cases in humans will also be expected to improve, thus making it possible for the Veterinary Department and the Ministry of Health to make the necessary impact. All we need is better information on the cases.

1 INTRODUCTION.

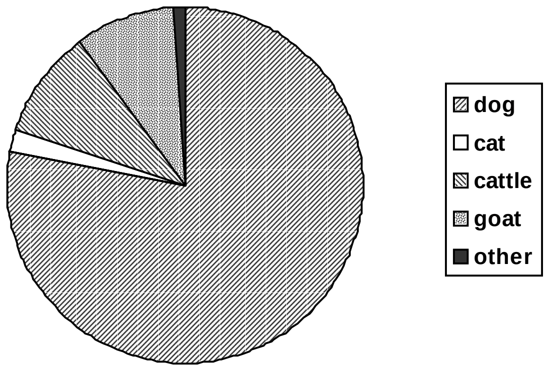
In Swaziland there is a statutory requirement for annual vaccination of all dogs. The stock diseases act of 1965 also stipulates that in case of an outbreak infected areas should be declared rabies guard areas. Vaccination campaigns are then conducted following which dogs that are not vaccinated and/or tied up are destroyed. These control strategies are generally effective and they bring down cases quickly. However once major outbreaks are controlled the department of veterinary services tend to relax and cases increase. If the control pressure were to be maintained throughout the country, at least for five years, rabies occurrence could be reduced to insignificant levels.

2 ANIMAL RABIES.

Domestic dogs remain the principal vectors for rabies (Table 1). They accounted for 78% of all laboratory confirmed cases (Figure 1). The veterinary department conducts annual rabies vaccination campaigns at dip tanks and other community centres. The coverage is usually above 70% (Table 2) but despite such good coverage canine rabies still occurs. The majority of cases occur in dogs between 2-18 months of age. Most of these dogs were either not born or had not reached 3 months of age by September of the previous year when annual vaccinations were done. For this reason it may be necessary to vaccinate at least twice a year especially in problem areas, targeting such puppies.

[1] Ministry of Agriculture - P.O. Box 162 – Mbambane - SWAZILAND

Figure 1 : Species distribution of rabies cases.



Rabies vaccination is fully subsidised by the government. Adequate vaccines are normally purchased to cover annual rabies campaigns and outbreak vaccinations. In the year 1998/99 government changed its vaccine purchasing procedures which resulted in a 6 months delay of the annual vaccination campaign. The outcome was a major set back in rabies control resulting in very low vaccination coverage in the same year (Table 2).

Table 1 : Laboratory confirmed animal rabies cases (1994 – 1998).

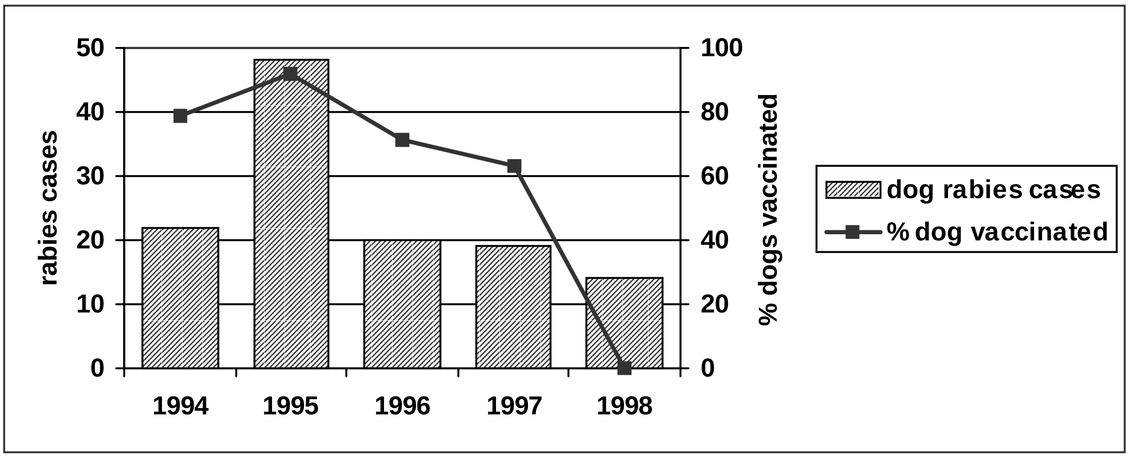
Species	1994	1995	1996	1997	1998	Total
Dog	22	48	20	19	14	**123**
Cat	1	0	0	2	0	**3**
Cattle	1	9	5	0	1	**16**
Goat	1	8	3	2	0	**14**
Other	1	0	0	0	0	**1**
Total	**26**	**65**	**28**	**23**	**15**	**157**

Table 2 : Dog rabies vaccination coverage (1994 – 1998).

Year	Dog population	Number vaccinated	Vaccination coverage (%)
1994	72686	57204	78.7
1995	78885	72345	91.7
1996	85302	60381	70.8
1997	85305 (1996 figure)	53914	63.2
1998	85305 (1996 figure)	2757	3.2

Rabies outbreak reports are usually reported in the news of both the electronic and print media. Major rabies awareness campaigns are conducted by the veterinary department in the outbreak areas. The main target for such campaigns is usually schools, dip tanks and community meetings. Following the publicity, a higher number of dogs are presented, improving overall vaccination coverage. There is relationship between the number of cases and the percentage of dogs vaccinated as seen in Figure 2. As the number of cases increases the vaccination coverage improves.

Figure 2 : Dog vaccination and rabies cases in Swaziland in 1994-1998.

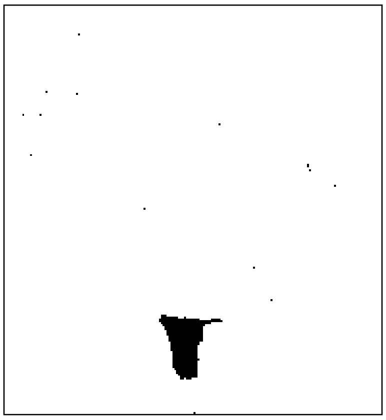


3 HUMAN RABIES.

According to scanty medical records, during the past two years only three people died from clinically diagnosed rabies. None of the cases were confirmed by laboratory tests. The number could be much higher as hospital records do not accurately reflect the rabies situation. There is generally good co-operation between the veterinary department and the Ministry of Health. Suspicious bites of humans by animals are promptly reported to the veterinary department for investigation, especially in urban areas. Government provides free rabies post exposure vaccination through the country's major hospitals. In the past two years more than 100 patients received post exposure rabies vaccination (actual figures not available).

The department has made efforts in making the public aware of the disease. This has been done through radio broadcasts (though not sufficient), displays/pamphlets/video displays and discussions at the annual trade fair, educational campaigns and video displays at community centres, e.g., schools and chiefdoms. The department has also made efforts to make the public health personnel aware of the disease and it’s control in humans.

It must be said that the publicity campaigns are not programmed and there are no special funds to support them. These campaigns are done on an ad hoc basis depending on available expertise and resources in each regional veterinary office. The Swaziland Veterinary Association has also played a significant role in publicity awareness especially at technical level in both veterinary and public health.



CONTROL OF RABIES IN NAMIBIA

O. J.B. Huebschle [1]

Adaptation of overheads.

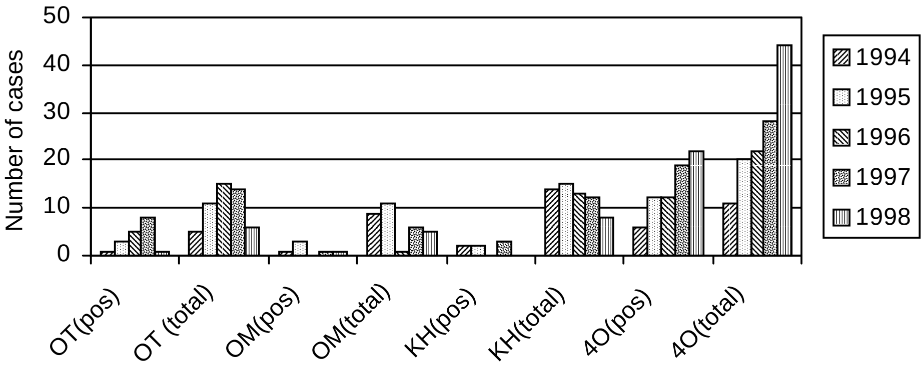
1 CANINE RABIES.

Vaccination of dogs and cats is mandatory.

In communal areas, vaccination of dogs is performed cost free with Rabisin.

In urban area, vaccination is performed either free of charge in vaccination clinics run by Veterinary Services or at a normal consultation fee by private veterinarians.

Figure 1 : Rabies in dogs in 7 regions of Namibia from 1994 to 1998, data obtained from the submitted specimens.



code	name	place
OM	Omaheke	Eastern Namibia
KH	Khomas	central Namibia
OT	Otjozondjupa	northern Namibia
4O	4 regions in North Central	Far north central Namibia

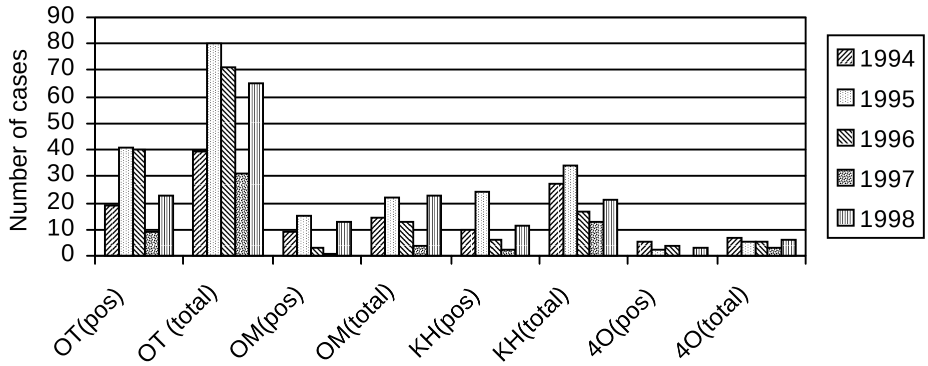
2 BOVINE RABIES.

Vaccination is performed by stock owners with Rabisin. It is also frequently done by breeders and the cost is to owner.

The cost of the vaccine is N$ 2.00 per dose (0.34 US $), i.e. nearly 0.1% of the value of the animal.

[1] Central Veterinary Laboratory – Private bag 13187 – Windhoek – NAMIBIA.

Figure 2 : Rabies in cattle in 7 regions of Namibia from 1994 to 1998, data obtained from the submitted specimens.



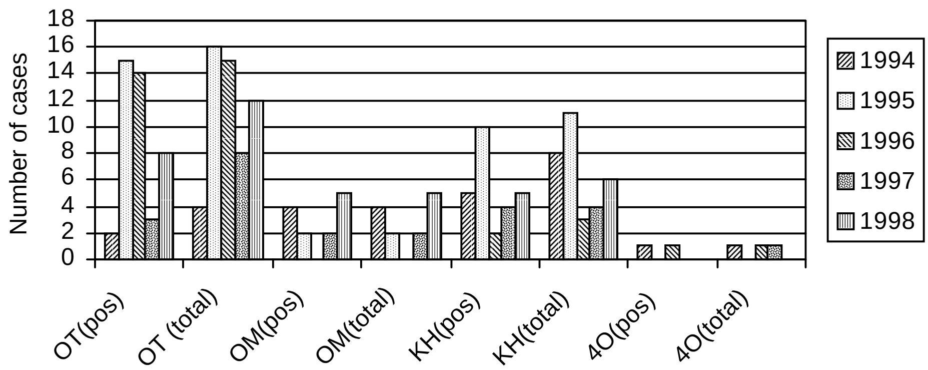
code	name	place
OM	Omaheke	Eastern Namibia
KH	Khomas	central Namibia
OT	Otjozondjupa	northern Namibia
4O	4 regions in North Central	Far north central Namibia

3 JACKAL RABIES.

No control system is envisaged due to costs.

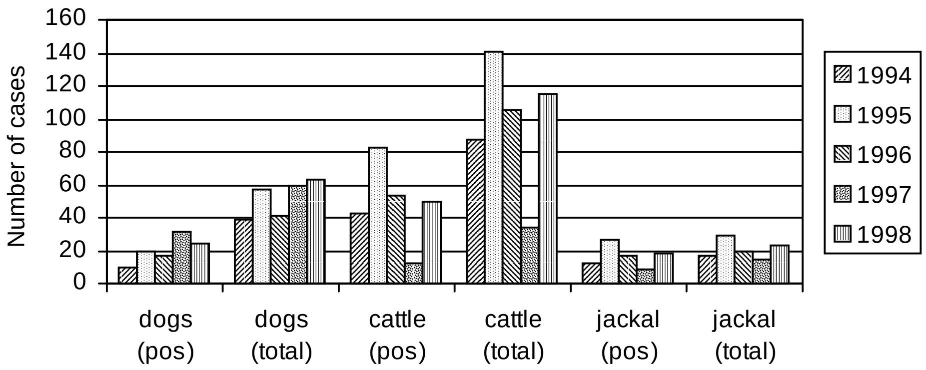
Experiments with oral vaccine (Tuebingen bait) performed 1989/1990 gave very high serological titres.

Figure 3 : Rabies in jackal in 7 regions of Namibia from 1994 to 1998, data obtained from the submitted specimens.



code	name	place
OM	Omaheke	Eastern Namibia
KH	Khomas	central Namibia
OT	Otjozondjupa	northern Namibia
4O	4 regions in North Central	Far north central Namibia

Figure 4 : Rabies in cattle, dogs and jackals in 7 regions of Namibia from 1994 to 1998



code	name	place
OM	Omaheke	Eastern Namibia
KH	Khomas	central Namibia
OT	Otjozondjupa	northern Namibia
4O	4 regions in North Central	Far north central Namibia

Figure 5 : FAT confirmed rabies cases in Namibia from 1994 to 1998.

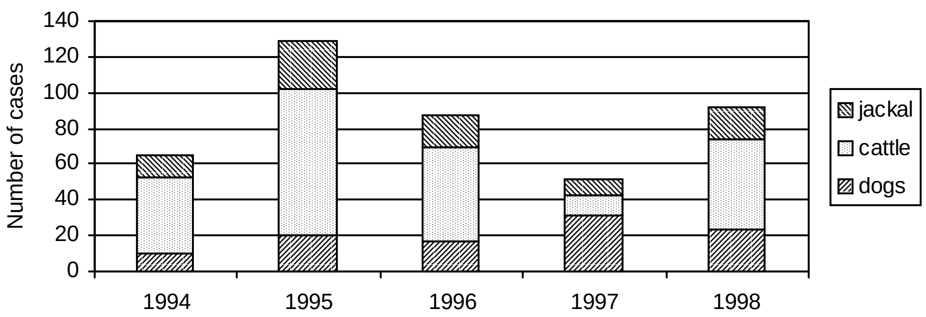
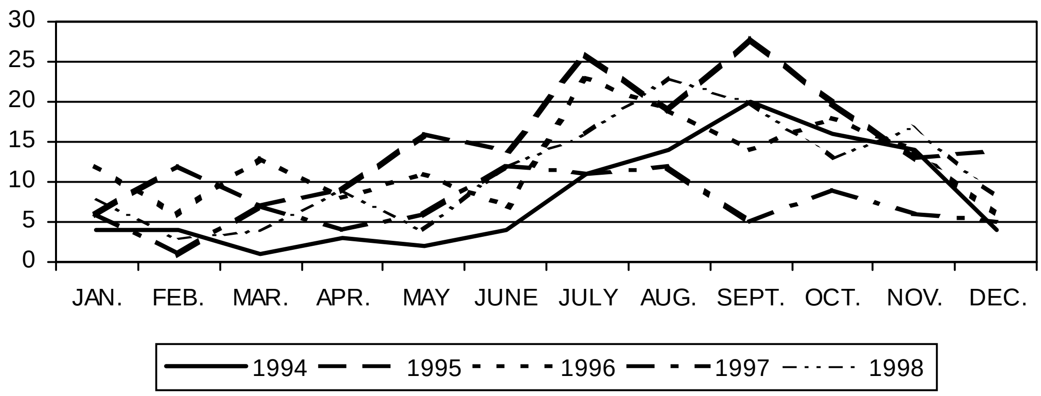


Figure 6 : Monthly distribution of rabies cases (FAT pos.) from 1994 to 1998.



4 HUMAN RABIES EXPOSURE.

Human diploid cell vaccine is available and vaccination is free.

Rabies immunoglobulins are available.

RABIES IN BOTSWANA

K.V. Masupu[1], K.B. Monyame[2] and J.M.K Hyera[2]

1 INTRODUCTION.

Rabies is a highly fatal infectious disease of man and animals which is characterised clinically by nervous signs of change in behaviour, convulsion, paralysis, coma and death (Mushi, 1995, Radostits *et al.*, 1994). It is caused by a neurotropic virus that belongs to the family Rhabdoviridae (Andrewes *et al.*, 1978) and is transmitted principally through the bite of an infected animal when the virus is excreted in saliva (Mushi, 1995, Radostits *et al.*, 1994).

Rabies occurs in most parts of the world except the island countries which are able to prevent entry of the disease by rigid quarantine measures or prohibition of entry of pet animals especially dogs and cats (Mushi, 1995, Radostits *et al.*, 1994). Australia and Antarctica have never had the disease and Japan, New Zealand and Scandinavian countries have managed to bring the disease under control (Mushi, 1995, Radostits *et al.*, 1994). Rabies is endemic in Europe, America, Asia and Africa (Mushi, 1995, Radostits *et al.*, 1994)

2 ANIMAL RABIES IN BOTSWANA.

2.1 Historical background.

Rabies in Botswana commonly known as “Molafo” was first recorded by Hobday (1936) as occurring in a child in 1936. It is thought that the infection originated from a rabies outbreak in Angola (Rey, 1988) which then crossed the Caprivi strip to enter Botswana, known at that time as the Protectorate of Bechuanaland. Subsequent to this occurrence, approximately 2000 dogs were destroyed in the surrounding areas.

During 1937 and 1938, laboratory confirmed cases of rabies were recorded in dogs in the North Western area of Ngamiland. Such cases have been since then recorded annually from most parts of Botswana, occurring not only in the dog but also in cattle, goats, sheep, horses, donkeys and cats (Maganu and Staugard, 1985, Mosienyane, 1988, Masupu, 1992, Tremlet, 1993).

[1] Department of Animal Health and Production, Private Bag 0032 – Gaborone - BOTSWANA

[2] National Veterinary Laboratory, Private Bag 0035, Gaborone - BOTSWANA

2.2 Methods of diagnosis and reporting.

Laboratory confirmation of rabies in Botswana is done at the National Veterinary Laboratory (NVL) Sebele situated about 10 km from the centre of Gaborone City. Primary diagnosis is based on examination of suspect brain specimens for the presence of rabies viral antigen by the direct fluorescent antibody test (FAT). In a secondary diagnosis, all FAT negative samples are inoculated in mice and observed daily up to a period of 30 days for evidence of clinical signs of the disease. Brain samples harvested from dead and/or surviving mice are also investigated for rabies viral antigen by the direct FAT. Protocols and procedures for the mouse inoculation test (MIT) and FAT used at NVL are essentially similar to those used elsewhere (King, 1995).

Rabies is a notifiable disease in Botswana. Laboratory confirmative results (FAT) are reported immediately to the respective veterinary office by phone for immediate action and a formal written report with a copy to the Director of Animal Health and Production (Botswana) is prepared and dispatched shortly after the report by phone.

2.3 Infection rates and trends.

Table 1 shows infection rates (prevalence) of rabies virus in animals (domestic and wild) in Botswana between 1991 – 1998. The lowest and highest rates were recorded respectively, in 1993 and 1995. The trend of infection appeared to be mainly that of an undulating nature during the first five years (1991 – 1995), although in the last three years (1996 – 1998) the infection seems to have stabilised.

Table 1 : Prevalence of infection with rabies virus in domestic and wild animals in Botswana 1991 – 1998.

Year of survey	Brain samples tested(n)*	Brain samples positive	Prevalence (%) ± SE**
1991	346	203	58.7 ± 5.2
1992	329	203	61.7 ± 5.3
1993	204	102	50.0 ± 6.9
1994	310	180	58.1 ± 5.5
1995	377	311	82.5 ± 3.8
1996	197	122	61.9 ± 6.8
1997	265	167	63.0 ± 5.8
1998	350	227	64.9 ± 5.0

Source of data: Annual reports from NVL Gaborone
* Tested by FAT and MIT
** Standard error

Evaluating species – wise, the rabies positive samples using relative frequency values (%), infection with rabies virus in domestic animals appears to be more frequently encountered in the bovine (Table 2) whereas in wildlife, jackals seems to be more often infected with the virus than the other species (Table 3).

Table 2 : Frequency of infection with rabies virus in domestic species of animals in Botswana 1991 – 1998.

Species	Number of positive cases*	Frequency of infection (%)
Canine	200	15.6
Feline	9	0.7
Bovine	673	52.5
Caprine	346	27.0
Ovine	9	0.7
Equine	45	3.5
Total	**1282**	

Source of data: Annual reports from NVL, Gaborone
* Rabies positive by FAT and MIT

2.4 Main epidemiological patterns.

According to data on confirmed cases of animal rabies at NVL (1991 – 1998), there appears to be three main epidemiological patterns of animal rabies in Botswana. First is ruminant (mainly bovine and caprine) rabies followed second by wildlife and third by canine rabies (Table 2 and Table 3). During 1991 – 1998, ruminant rabies accounted for about 68% (1028 of 1515 positives), wildlife 15% (233 of 1515 positives) and canine rabies 13% (200 of 1515 positives).

Table 3 : Frequency of rabies virus infection in wild animals in Botswana 1991 – 1998.

Species	Number of positive cases*	Frequency of infection (%)
Jackal	150	64.10
Non jackal Carnivores	26	11.11
Wild cat	16	6.84
Genet cat	18	7.69
Mongoose	16	6.84
Others	7	3.42
Total	**233**	

Source of data: Annual reports from NVL, Gaborone
* Rabies positive by FAT and MIT

2.5 Geographical distribution.

Rabies infection rates seem to vary considerably between geographical locations in Botswana with some districts being more affected than others (Table 4). The central and eastern parts of the country appear to be more severely affected than the other regions.

Table 4 : Rate of infection with rabies virus in domestic and wild animals in Botswana by districts 1998.

District	Number of brain positive samples*	Rate of infection (%)
Francistown	25	10.1
Gaborone	8	3.52
Gantsi	3	1.32
Jwaneng	7	3.10
Kanye	11	5.00
Kasane	1	0.44
Letlhakane	21	9.30
Lobatse	1	0.44
Mahalapye	14	6.20
Maun	8	3.52
Mochudi	2	1.00
Molepolole	8	3.52
Palapye	32	14.10
Selibe Phikwe	9	4.00
Serowe	71	31.30
Tsabong	6	3.00
Total	**227**	

Source of data: Annual report from NVL, Gaborone
* Rabies positive by FAT and MIT

2.6 Current control strategies.

Creation of awareness on rabies as a disease is the foremost strategy in Botswana. To achieve that, meetings "Kgotlas" are addressed in villages by Veterinary staff in all stations. Video films on rabies are shown at "Kgotlas" and schools. Primary and secondary school children in some districts are enlightened on rabies and thereafter assist Veterinary Staff in information publicity. Radio programmes on rabies are broadcast over Radio Botswana and vaccination programmes announced by the Ministry of Agriculture in a specific programme known as "Pitso Ya Balemi Programme". Posters on vaccination campaigns are sent by the Ministry of Agriculture to all districts for distribution to the general public; they are also mounted on the vaccination vehicles which have loudspeakers. Local private newspapers and the government run Botswana Daily News also publish articles and pictures on rabies during control campaigns.

Compulsory vaccination of dogs and cats is the second strategy. To achieve this vaccination campaigns are conducted each year. During each campaign, two effective days of house to house vaccination of dogs and cats are carried out, followed by a tie up order the third day and destruction of all roaming dogs and cats. Table 5 shows the numbers of dogs and cats that were vaccinated or destroyed during the 1998 rabies campaign. A total of 200000 doses of rabies vaccine, (Rabisin) were imported into the country out of which 190,382 doses were used during the 1998 vaccination campaign.

Table 5 : Rabies control figures in Botswana by District 1998.

District	No. of dogs vaccinated	No. of dogs destroyed	No. of cats vaccinated	No. of cats destroyed
Gaborone	22852	5	1396	14
Mochudi	9497	66	1143	1
Molepolole	12437	165	1340	0
Tsabong	7341	0	484	0
Kanye	17960	147	3881	66
Gantsi	5532	72	232	3
Jwaneng	5985	52	1154	22
Selibe Phikwe	7389	133	132	6
Palapye	9265	265	994	0
Mahalapye	16864	529	3033	65
Letlhakane	7192	163	655	6
Serowe	6459	0	857	0
Francistown	26091	648	1847	303
Maun	17200	412	1045	0
Total	**172064**	**2657**	**18193**	**486**

Source of data: Progress reports from DAHP, Gaborone

Vaccination of livestock species (cattle, goats, sheep and horses) is done by some farmers on optional basis especially in the event of a threatening outbreak.

3 HUMAN RABIES.

Neither deaths nor clinical cases associated with rabies virus infection have been recorded in Botswana in man between 1992 – 1997. There were however several reports of human exposures to the virus from various districts of the country during the same period (Table 6). As in animals rabies, the rates of exposure in humans also varied considerably between districts (Table 7). Serowe district which in 1998 had the highest infection rate of animal rabies (Table 4) also showed the highest rate of human exposure (Table 7).

Table 6 : Incidence of human exposure to rabies virus infection in Botswana, 1992 – 1997.

District	Estimated population*	Number of Exposures	Incidence (%) ±SE**
Maun	60445	298	0.49 ± 0.06
North east	46077	42	0.09 ± 0.03
Serowe	138720	1036	0.75 ± 0.05
Bobirwa	56036	236	0.42 ± 0.05
Kweneng East	150706	171	0.11 ± 0.02
Sourthern	156689	831	0.53 ± 0.04
Gantsi	26194	31	0.12 ± 0.04
Mahalapye	99847	380	0.38 ± 0.04
Kgatleng	61301	73	0.12 ± 0.03
Kasane	15757	22	0.14 ± 0.06
Kgalagadi	33070	242	0.73 ± 0.09
Tutume	106030	361	0.34 ± 0.04
Boteti	37766	153	0.41 ± 0.06

District	Estimated population*	Number of Exposures	Incidence (%) ±SE**
Gumare	39394	182	0.46 ± 0.07
Gaborone	161147	263	0.16 ± 0.02
Francistown	77938	390	0.50 ± 0.05
South East	49296	23	0.05 ± 0.02
Lobatse	28276	203	0.72 ± 0.09
Selibe Phikwe	43090	67	0.16 ± 0.04
Kweneng West	30668	130	0.42 ± 0.07
Goodhope	19739 a	25	0.13 ± 0.05
Hukuntsi	12401 b	0	0.00 ± 0.00

Source of data: Ministry of Health, Gaborone
*Average population of 6 years;
a = Average of two years (1996,1997);
b = Population of 1997
** National Veterinary Laboratory, Private Bag 0035, Gaborone

Table 7 : Rate of human exposure to rabies virus infection in Botswana, 1992 – 1997.

District	Number of humans exposures	Rate of exposure (%)
Maun	298	5.78
North East	42	0.81
Serowe	1,036	20.08
Bobirwa	236	4.57
Kweneng East	171	3.31
Sourthern	831	16.11
Gantsi	31	0.60
Mahalapye	380	7.37
Kgatleng	73	1.41
Kasane	22	0.43
Kgalagadi	242	4.69
Tutume	361	6.99
Boteti	153	2.97
Gumare	182	3.53
Gaborone	263	5.10
Francistown	390	7.56
South East	23	0.45
Lobatse	203	3.93
Selibe Phikwe	67	1.30
Kweneng West	130	2.52
Goodhope	25	0.49
Hukuntsi	0	0.00
Total	**5159**	

Source of data: Ministry of Health, Gaborone

ACKNOLEDGEMENTS

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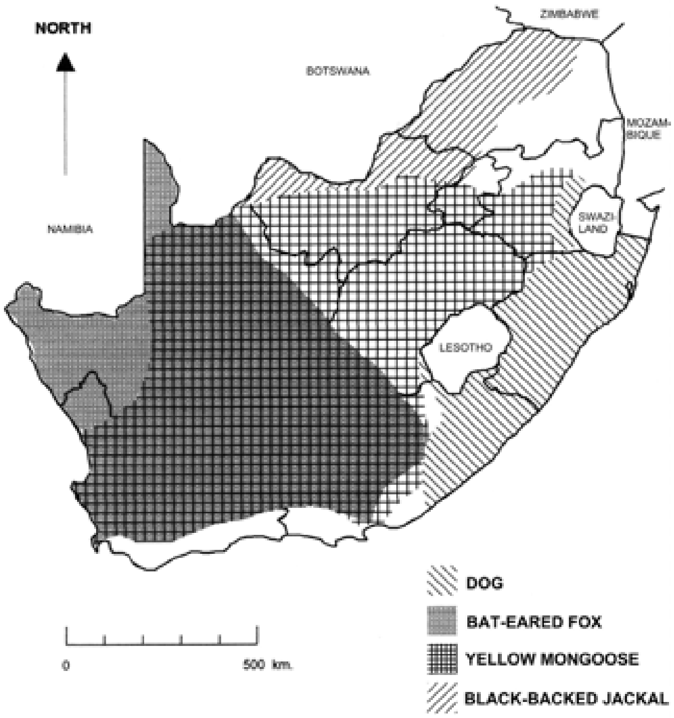
RABIES IN SOUTH AFRICA

George Bishop[1]

1 INTRODUCTION.

This report, covering the two year period 1997 to 1998, is an update of previous reports published in the Proceedings of SEARG meetings which took place in Zambia, South Africa, Zimbabwe and Kenya. The overall rabies situation in South Africa has changed very little and the disease remains endemic throughout the country. Four major vectors have been identified, namely the domestic dog, the yellow mongoose, the black-backed jackal and the bat-eared fox. Two strains of the rabies virus have been identified on the basis of monoclonal antibody typing and gene sequencing, namely the canid and viverrid types. Canine rabies is still largely confined to three provinces on the east coast of South Africa, namely Kwazulu-Natal, Mpumalanga and the Eastern Cape, where nearly all cases of human rabies are reported. The sylvatic form of rabies is largely dictated by the distribution of the three wild animal vectors (Figure 1). Five isolations of Mokola virus were made from cats in Kwazulu-Natal and the Eastern Cape during the period 1996 to 1997.

Figure 1 : Distribution of rabies in the Republic of South Africa - The main vectors.



[1] Allerton Veterinary Laboratory - Pietermaritzburg - Kwazulu-Natal – SOUTH AFRICA

2 HUMAN RABIES.

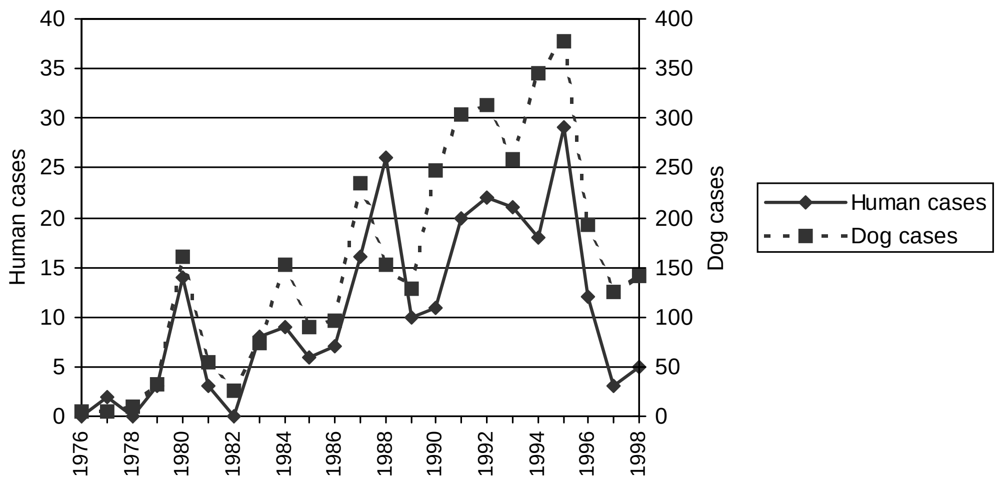
Table 1 : Number of confirmed human deaths due to rabies in Kwazulu-Natal and the remainder of South Africa.

Year	Kwazulu Natal	Rest of South Africa	Total
1995	29	0	**29**
1996	12	2	**14**
1997	3	3	**6**
1998	5	1	**6**

data obtained from the National Institute for Virology, Sandringham, Gauteng, South Africa

There has been a noticeable decrease in the reported number of human deaths due to rabies since 1995 when 29 people are known to have succumbed to the disease (Table 1). This is probably mainly related to the corresponding decrease in canine rabies in the areas where this form of the disease is endemic. The close relationship between the number of dog cases and human cases is well documented in the literature and this is also seen in Figure 2. Lowered vigilance, which results in decreased surveillance, is not thought to be a major contributing factor in this improved situation since the veterinary and medical authorities operate independently of each other. The efforts of various groups of South African scientists to improve pre- and post-exposure rabies treatment protocols have also played a role in reducing the number of human deaths due to rabies.

Figure 2 : Rabies in Kwazulu Natal in 1976-1998.

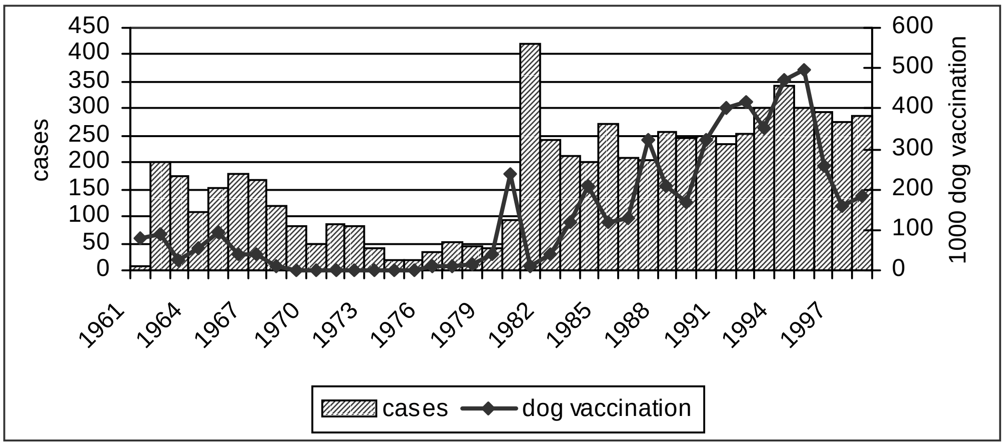


3 CONTROL OF RABIES.

The vaccination of dogs is of paramount importance in those areas where the canine form of the disease occurs. Very large and highly successful rabies campaigns were carried out in three eastern areas of Mpumalanga. High vaccination coverage (>90%) was achieved in these campaigns, which effectively eradicated the disease from that region of the Province. In one of these areas, there has not been a single case diagnosed for 18 months and this in a region where up to six outbreaks were found per month prior to the campaign. Elsewhere in South Africa, the vaccination of dogs has proved adequate, since there have been no new major outbreaks of canine rabies outside the identified endemic areas. The black-backed jackal is the major vector involved in spreading rabies to cattle in the northern regions of South Africa where farmers respond by vaccinating their herds.

The first documented case of canine rabies in Kwazulu-Natal was in 1961. The number of animal cases together with annual vaccination figures are depicted graphically in Figure 3.

Figure 3 : Rabies cases in domestic animals and dog vaccinations in Kwazulu Natal 1961-1998.



The Rabies Advisory Group (RAG) comprising scientists from the Directorates of Animal Health and National Health have been advising those responsible for disease regulations on new measures that could be adopted to improve rabies control and reduce the number of deaths due to rabies in South Africa. A booklet, «Guidelines for the Medical Management of Rabies in South Africa», was published in 1997 by the South African Department of Health. Post- and pre-exposure vaccination protocols are based on those issued by the World Health Organization (WHO, 1992, WHO, 1997). The Essen regime (including the use of human anti-rabies immunoglobulin, or HRIG) is standard post-exposure procedure in South Africa. All vaccinations are given by deep intramuscular injection, as the intradermal route is deemed too difficult to implement on a wide scale. Since the WHO recently included in its recommendations the use of HRIG with the 2-1-1 protocol (WHO, 1997), Kwazulu-Natal (KZN) Province intends introducing this approach as an alternative to the 5-dose Essen protocol. This change in policy is based on the results of an unpublished survey, conducted at hospitals and clinics in KZN, which showed that patients, who were supposed to present for 5 vaccinations, averaged only 2.3 visits each. A more comprehensive update of a previously available rabies booklet is in the process of being compiled by the RAG.

A recent recommendation by the RAG that the entire South Africa be regarded as a rabies endemic country for the purpose of control was adopted by the veterinary authorities. It will soon be compulsory for all dogs and cats in South Africa to be vaccinated at the age of three months and boosted within a year. Further vaccinations must then take place every three years. In certain provinces, such as Kwazulu-Natal and Mpumalanga, the provincial veterinary directors have insisted on annual vaccinations because of the ongoing canine rabies threat and the high turn-over in the dog population.

Pilot field trials using placebo oral baits have been initiated in KZN. More than 90% of the dogs offered these baits have accepted them, most of them within 3 seconds. Baits containing SAG2 vaccine will be used in more extensive trials which will start within a few weeks.

4 ANIMAL RABIES.

The rabies cases diagnosed during 1997 and 1998 are listed in Table 2. These figures are based on dates of submission to the three laboratories which carried out this work. There was a marked increase in the number of black-backed jackal cases in 1998 compared to the previous year. The distribution of canine, other domestic animals, yellow mongoose, black-backed jackal, bat-eared fox and other wild animal rabies cases are shown in Figure 4

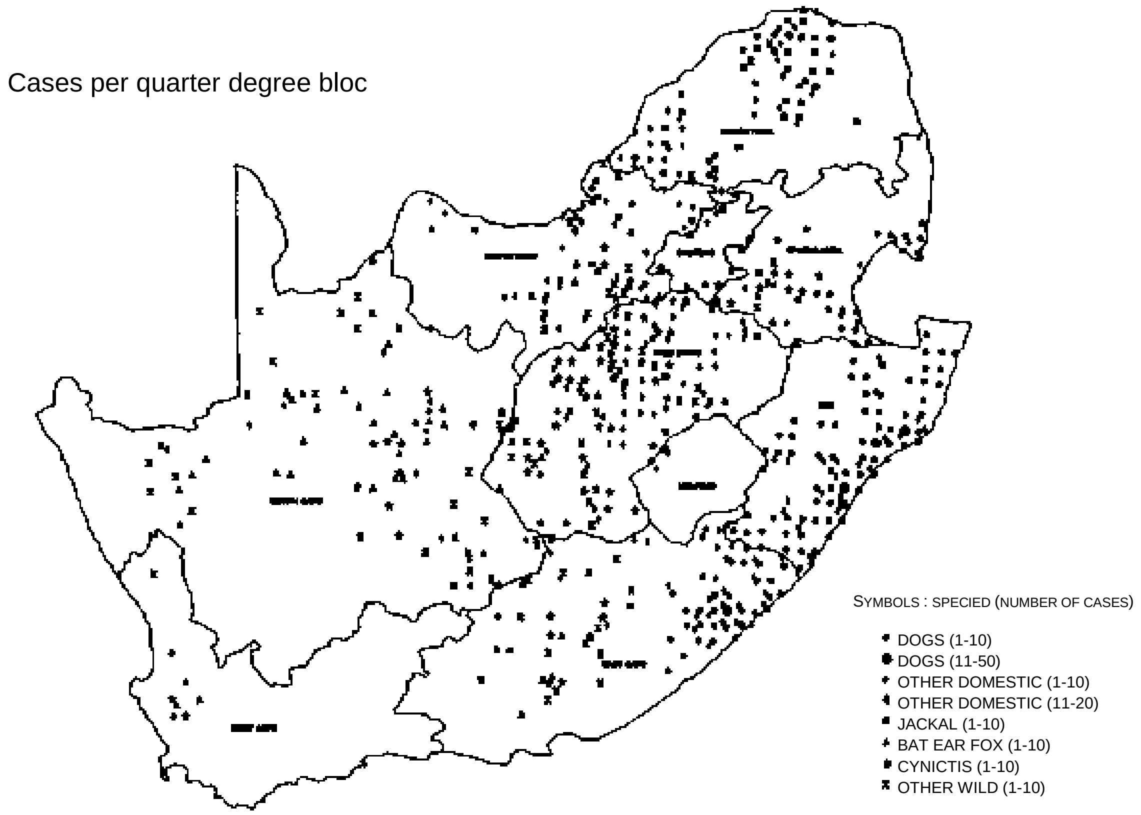
Table 2 : South African animal rabies cases in 1997 and 1998.

	1997	1998
Dogs	231	210
Cattle	106	101
Cats	19	22
Donkey	1	
Goats	12	8
Horses	1	3
Pigs		1
Sheep	6	2
Aardwolf	4	7
African wild cat	1	6
Bat-eared fox	27	18
Black-backed jackal	21	49
Cape fox	3	1
Caracal		1
Civet	1	
Duiker		1
Eland	1	1
Ground squirrel		4
Hyrax	1	
Large grey mongoose	1	
Small spotted genet	2	6
Small spotted cat		1
Spotted necked otter		1
Suricate	13	16
Slender mongoose	10	11
Small grey mongoose	3	6
Striped polecat	2	
Water mongoose	1	
Wild dog	5	
Yellow mongoose	54	69
TOTAL	**526**	**545**

5 DIAGNOSTICS.

Three veterinary laboratories have carried out all animal rabies diagnostics over the past two years. The OIE Rabies Reference Laboratory at Onderstepoort has increased its diagnostic capabilities considerably and tissue culture isolations of virus are now used routinely instead of the mouse inoculation test. Furthermore, all positive cases are typed using monoclonal antibodies. Allerton Provincial Veterinary laboratory still provides a rapid diagnostic service, but the Rabies Unit at Umtata Veterinary Laboratory ceased functioning towards the end of 1998. Suspect human rabies cases are all forwarded to the centrally-placed National Institute for Virology in Gauteng Province.

Figure 4 : animal rabies cases in South Africa in 1997 and 1998 (1071 cases).



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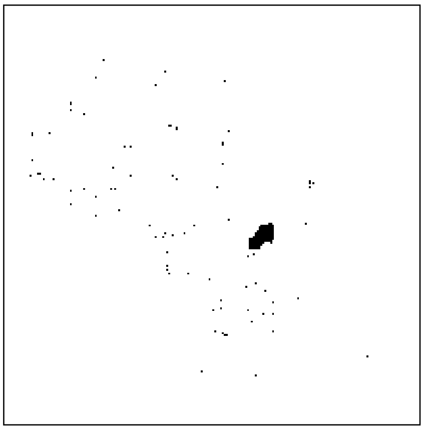


RABIES IN UGANDA

C. S. Rutebarika[1]

1 INTRODUCTION.

The incidence of Rabies in Uganda has remained high in the last two years because of the political and socio-economic circumstances in the country. This has been accentuated by the increasing number and mobility of both human and dog populations. The domestic dog is responsible for over 95% of the rabies cases reported in the country while other domestic stock and wildlife play a minor role.

The department of Livestock Health and Entomology is responsible for the control of rabies in the domestic dog through preventive measures.

The delivery of Animal health services has been greatly affected by the civil service reform and decentralisation. This has adversely affected data collection, disease reporting as well as sample collection, shipping, analysis and rabies control in general.

The dog population is estimated at 1.5 million but no actual census has been carried out. The co-operation and close liaison of the medical and veterinary services has been fundamental in containing rabies to the levels that exist in this country.

2 HUMAN RABIES.

Source: Veterinary Public Health Unit / Ministry of Health

Table 1 : Human Rabies data (1992- 1998).

Year	Number of post exposure treatments	ARV doses used (imported)	Number of rabies cases	ARV estimated cost (US $)
1992	766	3976	50	35000
1993	1518	5720	23	51000
1994	2614	8298	15	74700
1995	3222	13623	14	122000
1996	1698	16000	9	144000
1997	2916	16000	10	144000
1998	3112	16000	10	144000
Total	**15846**	**79617**	**131**	**74700**

Source : Veterinary Public Health/ Ministry of Health

A report for 1997 - 1998 indicates that 20 cases of rabies were recorded while a total of 6,028 dog bite victims received post exposure treatment with anti rabies vaccine (ARV) in the various health units in the country.

[1] Department of Livestock Health and Entomology - Entebbe - UGANDA.

A decreasing trend of rabies incidence is indicated in Table 1. The amount of ARV increased from 3976 doses in 1992 to 16000 doses in 1998 due to public health sensitisation programmes about the importance of rabies by members of Technical Committee for Rabies control (TECOR). The beginning of 1996/97 financial year saw government recognise the public health importance of rabies by offering free post exposure treatment for contaminated people and this accounts for the steady supply of 16000 of ARV doses per annum. We have adopted the 2-1-1 regime.

Rabies has been recently diagnosed in a laboratory in Mulago Hospital. The district medical and veterinary staff co-ordinate data collection, analysis and dissemination in the districts and reports are later sent to the central co-ordinating committee at the national level. In the districts where the multisectoral approach has been established, the local administrators, the communities and the medical and veterinary staff co-ordinate the reporting at the local level and later send reports to the national level. The national committee makes reports to the policy makers and regional and international organisations.

3 ANIMAL RABIES CONTROL.

The department of Livestock Health and Entomology, which belongs to the directorate of Animal Resources, is mandated to control major epizootics including rabies. Rabies has remained a serious epidemic in the last two years though the government attaches a lot of importance to its control and possible eventual eradication.

The following are the current strategies employed in its control :

- Notification in case of disease outbreaks (Tie up order).
- Compulsory mass vaccination of dogs and cats.
- Destruction of stray and unvaccinated dogs.
- Laboratory diagnosis.
- Control of dog movement (internal and external).
- Provision of appropriate legislation.
- Public awareness programmes; a multisectoral approach (MSA) to rabies control and surveillance has been adopted. The districts of Kabarole, Masaka, Kumi, Pallisa, Iganga, Ntungamo, Kasese, Apac, Hoima, Masindi, Mpigi, Kampala, Mukono, Tororo, Kamuli, Rakai, Soroti and Mubende have implemented MSA. The rest of the country will be covered funds permitting. Areas where MSA has been implemented have registered high levels of compliance.

4 FUNDING FOR RABIES CONTROL, DIAGNOSIS AND REPORTING.

The central diagnostic laboratory has received equipment and reagents and public awareness programmes have been funded, though inadequately. Currently the implementation of vaccination campaigns is the mandate of local authorities whose funding priorities may not favour rabies. The number of dogs and cats vaccinated are indicated in Table 2.

Table 2 : Animal Rabies data.

Year	Amount of vaccine procured (doses)	No. of vaccinates (cats and dogs)	Estimated cost of vaccine (US$)
1992	80000	56662	25600
1993	Nil	24875	-
1994	100000	82306	32000
1995	90000	73906	28800
1996	400000	63390	128000
1997	-	130480	-
1998	-	69555	-

Source: Departmental Annual Reports,1992 - 1998

5 ROLE OF DONOR ORGANISATION PROJECTS.

Donor organisation projects.

The previous two years, 1997 and 1998, have received insufficient funding. The Livestock Services Project, an IDA funded project, is the only project that has facilitated rabies control programmes. This project wound up its activities in June 1998. Part of the 500000 doses of rabies vaccine procured in 1996 facilitated vaccination campaigns during 1997 and 1998 in all the districts of the country.

6 USE OF DOG POPULATION REDUCTION.

The strategy of dog population reduction, though temporary in nature, has been used in urban areas mainly until recently when rural areas saw big populations of stray dogs left behind by displaced people during the civil strife in the North and Western parts of the country. Such populations have been reduced by poisoning, shooting and hunting.

In the last two years 2163 dogs, 417 cats, 21 jackals and 50 foxes were destroyed. More recently the Uganda Society for the Protection and Care of Animals (USPCA) has embarked on sterilisation of the dogs and cats (both domestic and stray) in and around Kampala as a method of population reduction.

7 ANIMAL AND HUMAN VACCINATIONS.

7.1 Types of vaccines used for man.

Vaccines currently in use are the inactivated cell culture vaccines prepared on VERO Cells (Verorab). In the past (1992/93) human diploid cell culture (HDCV) and Duck embryo vaccines have been used.

The numbers of contaminated people who received post exposure treatment and amounts imported per year are shown in Table 1 for the period of 1992-98. The vaccines were used in all the districts of the country.

The current government policy of issuing free vaccines has enabled all the districts to treat most of the bite victims.

7.2 Animal vaccines.

The country has been importing inactivated tissue culture vaccines which provide immunity for 1 year or 3 years since 1992. This 3 year immunity vaccine is ideal for our situation where vaccines are irregularly available and vaccination coverage is usually low. The number of doses of vaccines procured and used are shown in Table 2. These vaccines have been used in all the districts of the country.

The cases of rabies reported in the different species of animals for the period 1992-98 are indicated in Table 3.

7.3 Constraints to rabies control.

Rabies control programmes are still constrained by :

- Irregular and insufficient funding.
- Control of stray dog populations which are on the increase.
- Public awareness on rabies is still insufficient.

- Decentralisation policy and civil service reform.

Table 3 : Reported cases of rabies in Uganda, 1992 – 1998.

Species	1992	1993	1994	1995	1996	1997	1998
Dog	243	228	376	252	38	298	61
Cat	-	-	1	4	1	5	3
Cattle	1	2	-	4	1	30	5
Goat/Sheep	2	-	7	5	8	4	-
Fox	-	2		5	8	-	-
Jackal	3	6		4	2	-	-
Monkey	-	-	1	-	3	3	-
Rabbit			-	-	2	2	-
Mongoose	-	-	-	2	-	-	-
TOTAL	**249**	**238**	**385**	**276**	**63**	**342**	**69**

Source : Departmental Annual Reports, 1992 - 1998

The liberalisation of vaccine procurement to the private sector may ease the chronic shortage of vaccines and insufficient funding by government.

Acknowledgements

Dr. Winyi Kaboyo, Veterinary Public Health, Ministry of Health.

Dr. M.V. Aluma, Veterinary Diagnostics and Epidemiological Unit.

RABIES IN ZIMBABWE

S. D. Javangwe[1]

1 ANIMAL RABIES.

Dogs and jackals are the principal vectors of rabies. Cattle and goats are the main non-vector domestic species as shown in Table 1.

Table 1 : Rabies in Zimbabwe, total of laboratory - confirmed cases in 1997-1998.

Species	1997	1998
Human	0	6
Domestic animals		
Dog	162	159
Cat	11	8
Cow	99	123
Sheep	5	3
Goat	22	19
Horse		4
Donkey	1	7
Pig	1	
Wild animals		
Jackal	78	101
Mongoose		3
Civet	4	7
Aardwolf		1
Hyena		
Honeybadger	1	1
Serval	2	3
Cheetah		1
Duiker	1	
Wildcat	2	
Wild dog		1
Elephant	1	
Total	**390**	**441**

2 HUMAN RABIES.

Table 2 summarises the human rabies cases recorded in 1997 and 1998.

In 1997 no human rabies case was reported to the Central Veterinary Laboratory (CVL) for confirmation and details of unconfirmed clinical cases, if any, were not available from the Ministry of Health officials.

[1] Central Veterinary Laboratory – P.O. Box CY 551 – Causeway – Harare - ZIMBABWE

In 1998, a total of 6 Human cases were confirmed at the CVL. Two other cases were diagnosed on clinical grounds only.

Table 2 : Details of confirmed human rabies cases in 1998.

Origin	Date of death	Sex	Vector	Type of contact	Incubation (months)	FAT diagnosis on
Chinhoyi	12/98	Male	Dog	Bite	1	Skin biopsy
Sadza	11/98	?	Dog	Bite	2	Brain
Kandeya	10/98	Female	Dog	Bite	?	Brain
Marange	09/98	?	Dog	Bite	?	Brain (+ immunohistochemistry)
Shurugwi	02/98	Male	Dog	Bite	4	Brain
Mutoko	02/98	Female	Dog	Bite	3	Skin biopsy

Four of the cases confirmed at the CVL in 1998 were diagnosed by FAT on brain material while the other two were diagnosed by FAT on skin biopsies.

The CVL is the only institution that carries out rabies diagnosis for both humans and animals in the country. The methods of diagnosis are listed below in order of importance:

- FAT on brain material
- Mice inoculation tests
- Immunohistochemistry (recent development)
- Histology (H and E)
- FAT on skin biopsy

Reporting of human contacts.

All dog bites must be reported to the veterinary staff who will check the vaccination status of the dog. If the vaccination status of the dog is not known or if the dog is not vaccinated, the dog is detained for at least 10 days for signs of the disease to appear. In the meantime the person who has been bitten is referred to hospital for treatment. The department will inform the hospital on the rabies status of the dog for follow up.

3 ANIMAL RABIES CONTROL.

3.1 Regulations.

The animal Health (Rabies) Regulation, 1966, requires that the owner of a dog must have the dog vaccinated within one month of attaining the age of three months, followed by a second vaccination at 12-15 months of age and thereafter every three years. If anyone acquires a dog of uncertain vaccination status, the dog must be vaccinated within seven days of acquisition and again after 6 months and within every three years thereafter.

Rabies is a notifiable disease and as such it must be reported to the department of Veterinary services.

An animal Health (Rabies area) order may be issued by the director of Veterinary services in the event of an outbreak, declaring such an area a rabies area. This allows the department to carry out measures necessary to contain the outbreak, such as tie-up orders and the shooting of dogs.

The Animal Health (import) Regulation, 1989, requires that a veterinary import permit is obtained before a dog is brought into the country. Requirements for import are as follows:

- The dog must originate from an area free from movement restrictions imposed for the control of rabies.
- The animal has a valid rabies certificate indicating that vaccination was carried out not less than 30 days ago, and not more than 1 year before movement in case of primary vaccination.

- The animal has been re-vaccinated for rabies not less than 30 days but not more than 3 years before movement in the case of dogs. In the case of cats the period after vaccination is not less than 30 days but not more than a year.
- If the dog is under 3 months of age its dam has to have been vaccinated at least 30 days before but no longer than 1 year before birth.

City by-laws require that a dog must be vaccinated against rabies before a dog licence is issued.

3.2 Vaccination strategies.

Government veterinary offices as well as private veterinary surgeries carry out vaccination every day during working hours. In addition Government veterinary offices set aside Friday afternoons for rabies vaccinations. Annual vaccination campaigns are carried out at dip tanks in the communal areas and similar mass vaccination campaigns are at times carried out at designated shopping centres in urban areas.

At every vaccination, each dog receives an ear tattoo bearing the year's unit number. A fee of Z$3 is charged if a vaccination certificate is required.

In the event of an outbreak, an area may be gazetted a Rabies area and a vaccination campaign is mounted.

4 FUNDING.

There is a general fund for all animal disease control, which includes rabies. Thus to quantify in monetary terms the amount allocated to rabies control is difficult. Diagnosis of rabies is given a very high priority, with diagnosis being a seven-day service to the public.

5 DOG POPULATION REDUCTION.

If an area is designated a rabies area in terms of the animal health act (Rabies Area) a tie up order may be gazetted and a tie-up order issued. Stray dogs are then rounded up and destroyed.

In addition there are city by-laws aimed at controlling the dog population.

6 ANIMAL VACCINATIONS.

In 1997, 419500 doses of vaccine were purchased and in 1998 the number purchased was 400000 doses. The type of vaccine used is an inactivated cell culture vaccine. In 1997 a total of 450000 dogs were vaccinated and in 1998 a total of 401674 dogs were vaccinated.

7 HUMAN VACCINATIONS.

Most of vaccines used for humans are purchased by government (Table 3).

Table 3 : Vaccines purchased since 1996.

	Government	Private sector
1996	27000	3478
1997	20640	2469
1998	66000	1531

The vaccine is an inactivated vaccine grown on vero cells.

RABIES IN MADAGASCAR 1994 - 1998

H. G. Zeller[1], M. Rakoto-Andrianarivelo[1],
L. A. Rakotonjanabelo[2], J. F. Roux[1]
in absentia

1 INTRODUCTION.

Rabies is endemic in Madagascar, with the dog reported as the sole reservoir of the virus (Coulanges , 1982). Since the first cases reported in dogs and humans more than one hundred years ago, rabies is an acute public health threat, with a continued rise in the number of cases throughout the 1980s (Morvan, 1992).

Madagascar has a surface area of 587000 km^2 and is the fourth largest island in the world with a population of 14.5 millions inhabitants of whom 44.1% are under 15 years old and 22% are living in urban areas. (source Ministry of the Population, 1995). A 2.8% population growth may result in a doubling within 25 years.

The Direction of transmissible disease prevention form the Ministry of Health created in 1994 an epidemiological unit, the Epidemiological Surveillance Service, in charge of collecting data on transmissible diseases and sending results of epidemiological investigations and surveillance via a journal published four times a year, the Bulletin d'Information en Epidémiologie en Sante publique. A result of this new network is an important increase of reported human rabies (Rakotomalala W *et al.*, 1998)

Only few data on the epidemiology of rabies are available. The Pasteur Institute is in charge of the National Laboratory for Rabies diagnosis, and provides human vaccine for the different rabies centres. It is collecting data on human treatments and provides all information to the Ministries of Health and of Agriculture for actions. Estimates of the dog population size are not available.

2 LABORATORY RABIES DIAGNOSIS.

Table 1 : Distribution of specimens tested for rabies by species for the period 1994-1998.

Species	Tested No.	Positive No	Positive (%)
Humans	6	4	(66.7)
Animals			
Dogs	347	240	(69,2)
Cats	33	9	(27.3)
Lemur	26	1	(3.8)
Ruminants	13	9	(69.2)
Rats	6	4	(66.7)
other	2	1	(50.0)
Total	**427**	**264**	**(61.5)**

[1] Centre National de Référence pour la Rage, Institut Pasteur - BP 1274 - Antananarivo 101 - MADAGASCAR

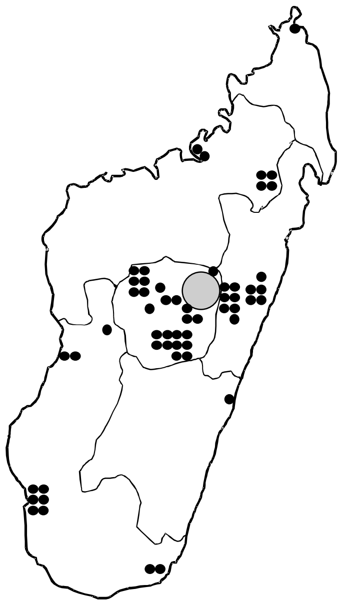
[2] Service de Surveillance Epidémiologique, Direction de la Lutte contre les Maladies Transmissibles - BP 460 - Antananarivo 101- MADAGASCAR

Rabies diagnosis includes :

- direct immunofluorescence assay (IFA) on brain smear
- confirmation test by intra-cerebral inoculation into suckling mice and test by IFA from day 4 post-inoculation without any clinical symptoms, with an extended observation up to day 20.

During the 1994-1998 period, only 427 specimens were tested. The number of specimens is low and was decreasing: 78 in 1994, 67 in 1995, 65 in 1996. An effort was made in 1997 to encourage veterinarians to ask for rabies diagnosis in suspicious animals (free of charge): 92 specimens were received in 1997 and 126 in 1998. Eighty four per cent of the specimens (361) originated from the capital Antananarivo, (35) 8% from the Antananarivo province and only 33 (8%) from the five other regions. Among these, 61,5% specimens were positive, showing the presence of rabies in all provinces (Figure 1).

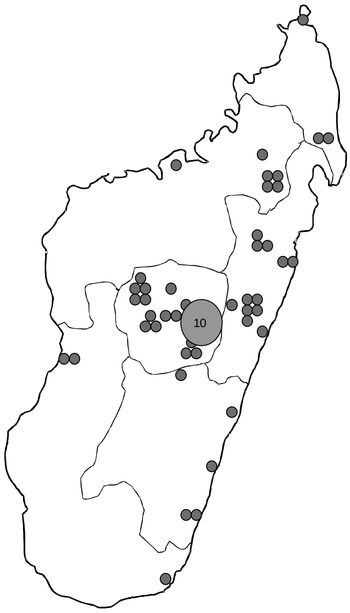
Figure 1 : Spatial distribution of confirmed cases of Rabies in animals (1994-1998).



3 HUMAN RABIES.

For the period 1899-1998, 166 cases of human rabies were reported in Madagascar and among these, 49 cases (29.5%) were reported for the last three years (1996-1998). Figure 2 shows the distribution of reported cases in 1994-1998 (3 cases in 1994 and in 1995, 13 cases in 1996 and 1997, and 23 cases in 1998). Five cases were confirmed by the laboratory. Twenty five cases (51.0 %) were reported in the Antananarivo province and 11 cases (22.4%) in the Toamasina province. Forty five per cent of the Malagasy population is living in these two provinces. In the Fianarantsoa province, in 1994-1998, 5 human cases of rabies were reported and only one rabid animal was diagnosed.

Figure 2 : Distribution of reported Human cases of Rabies (1994-1998).



4 TREATMENTS.

Two kinds of vaccine are used for treatments:

- a suckling mouse brain (SMB) vaccine (from Pasteur Institute Alger) with a classical schedule : eight injections on days 0 to 7 by sub-cutaneous route and boosters by intra-dermal route on days 11, 15, 30 and 90, free of charge,
- a cell culture vaccine (VeroRab™) with scheme 2-1-1 by IM route on day 0 (2 doses) , day 7 and day 21, free for children under 2 years-old, and possibly on charge for other patients

Only the SMB vaccine is distributed to the secondary rabies centres.

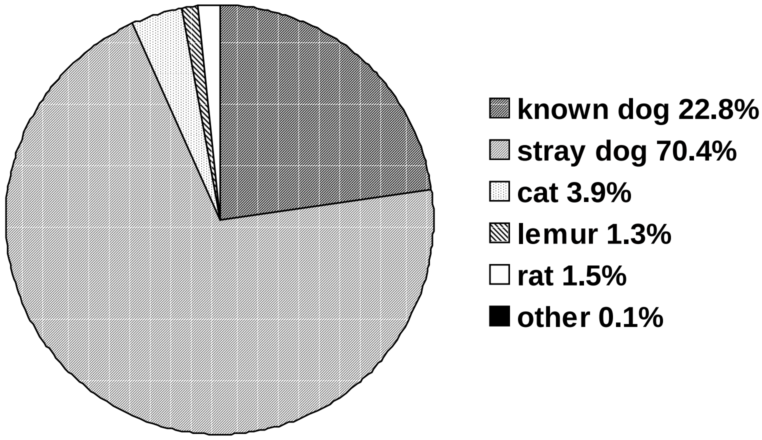
An important public health reform occurred in 1997 with the establishment of 110 sanitary districts throughout the country. In order to improve access to rabies treatments for the population, the creation of a rabies centre in each district was effective in 1998. The theoretical number of centres was increasing from 54 to 110. In fact, 59 centres were active in 1998.

In 1998, a total of 5165 consultations for rabies exposure were recorded, or an increase of 6.0% from 1997. The main cause of exposure was the dog (93% of the consultations, followed by the cat (4%) (Figure 3). Of 5165 patients, with a male/female sex ratio of 1.4/1.0 and 38% of children under 15, 82% received treatment. Patients bitten by stray dogs represented 70% of the treatments. 83% of the treatments were conducted within 5 days post exposure. In 7% of the cases, the delay exceeded a week.

If bites by wild lemurs are not reported, domestic lemurs used as pets represented the third source of exposure. In 1993, the first case of rabies in a lemur was reported. The animal, a *Lemur catta*, belonged to a tourist resort and was in contact with many dogs. This Lemur species is particularly curious and sometimes aggressive. People must be aware of the risk of rabies exposure when bitten by these animals.

In Antananarivo city, a 17% increase of consultations (4150) and 20.0% increase of treatments (2380) were recorded in 1998 vs 1997. One third of the owned dogs were reported to be vaccinated (225/666). In 2.7% of the cases, equine rabies immune serum was also given. Local reactions following the vaccine injections vaccine were reported in 0.7% of the treated patients.

Figure 3 : Distribution of treated patients in 1998 according to the source of exposure.



In the other parts of the country, the number of notified treatments in humans from other centres is apparently decreasing. In fact, information about treatments were received from only 19 centres in 1998 vs 35 in 1997.

A failure of treatment was reported in 1998 in a 61 years-old woman bitten on her left foot by a dog which 3 days later died of rabies confirmed in the laboratory. She consulted on day 1 with a stitched wound on her right foot and was treated with the SMB vaccine. On day 32 post exposure, an ascending paralysis of her legs appeared and she had respiratory problems. She died on day 40. Both the canine and the human strains of rabies virus were identical by partial genetic analysis of the sequences (H. Bourhy, Pasteur Institute Paris, personal communication). Two other persons reported bitten the same day by this dog were treated from day 4 post-exposure.

5 RABIES CONTROL.

5.1 Animal immunisation.

Using a common human dog ratio of 10:1 as reported in Africa, an estimate of 1.4 million dogs are present in Madagascar. For animal immunisation, several types of animal vaccines are used: a local Flury vaccine (Lyorab™) and very few imported vaccines. Annually 3000 to 4000 doses of rabies vaccine are produced in Madagascar (JJ Rajaonarison, personal communication). The number of immunised animals each year is unknown.

Among 12 dogs reported as immunised in 1998 and tested for rabies, 7 were positive: 2 were immunised in less than 1 year and 1 in less than 2 years. For the others, exact data were not recorded. Failure of immunisation by Flury type vaccine was previously recorded but further investigations are needed (Ribot, 1982).

5.2 Rabies control.

If the real economic impact of rabies can be evaluated (vaccine cost, working-time loss…) in human public health, data are inadequate to evaluate the real impact in agriculture. An effort initiated by the Ministry of Health and the Pasteur Institute was made to reinforce the role of public and private veterinarians in rabies for a better application of existing rabies regulations.

The Ministry of Breeding Stock is theoretically in charge of the epidemiological surveillance of rabies. The deterioration in the infrastructures for disease control is evident for many other animal diseases as bovine tuberculosis, classical swine fever, African swine fever…This situation coincided with a period of restructure of the veterinarian services resulting in the division of responsibilities. Rabies does have the same economical impact despite the loss of rabid animals in comparison with the other plagues.

Despite numerous interventions, and the important increase of human cases these last years the Ministry of breeding-stock via the Direction of the Veterinarian Services are not planning to coordinate action to contain the actual explosion of rabies in large cities and in the countryside.

6 CONCLUSION.

The data presented on the epidemiology of rabies in Madagascar have shown the emergency of an national action on rabies. An integrated rabies control program at the national level must be carried out in relationship with a continuous information of the population and health workers about the risks of exposure. Likewise, the presented data showed some areas where specific actions must be conducted as a priority: the Antananarivo urban area, and two regions on the West and the East of the capital.

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DISCUSSION

1 DISCUSSION OF PAPERS.

1) Rwanda.

Are there some links between medics and veterinarians?
Collaboration is just beginning now, but there was no contact before.

What is done if someone is bitten?
First, a report is made to the vet and then the vet makes advice to go to hospital. Most often, people go straight to the hospital.

What is the availability of post exposure treatment?
PET is available at least in the different regions. In fact, there is not enough vaccine in rural areas.

Is there a cost sharing for post exposure treatment?
No, WHO has a hand on it.

2) Malawi.

Are the collars resistant enough to last one year?
Among the 7000 collars, 70 % were lost in 7 months and 90% in 9 months. But in fact the collars are effective because people come to vaccination more because of the collar than because of the vaccination itself.

During the visit made in Malawi, 57 rabid dogs have been reported in Mzuzu without any report of dog bite or human case.
The collection of data will be done for the next meeting.

3) Zambia.

There are even problems of reporting vaccination activity when it is performed by private vets.

Is BAS the Balmoral vaccine checked?
it is not sure and if a control is done, it is not in an independent laboratory.
The titration of the vaccine could be done in WHO collaborative centre in Nancy.

However annual production of vaccine is not sufficient.

4) Mozambique.

How are rabies cases diagnosed?
In man, diagnosis is only a clinical diagnosis. In animals, clinical and experimental diagnosis may be done.

What kind of vaccine is used?
Embryonated egg vaccines.

5) Swaziland.

How is the dog population estimated?
A census is done in August by paravets who count animals in every household.

Why does rabies persist in spite of a vaccination coverage higher than 80 - 90%?
There are 31% of young dogs (less than 1 year).

6) Namibia.

Is a diagnosis of BSE performed on cattle with nervous symptoms?

Yes, no case has been identified so far. The meat flour is heated at 134ºC. There is probably no scrapie.

What are the clinical signs observed in jackals?

They go close to man and die.

Populations of kudu have increased, is there then a risk of return of rabies in kudu?

7) Uganda

Why is there a variation in dogs between 1995-1996 and 1997-1998?

Two possibilities may explain this : a good vaccination coverage in dog population or action of another disease like distemper for example.

2 GENERAL DISCUSSION.

S. Jawangwe presents the Quarterly Bulletin.

O. Hubschle : the presentation of this bulletin is similar to the one of the Rabies Bulletin Europe.

O. Hubschle : the areas of jackal rabies and of cattle rabies are the same in Botswana, like in Namibia.

JB Davies : in Botswana, mongoose rabies may exist like in Namibia and South Africa. Two differences have been observed in mongoose isolates by sequencing by P. Lowings.

O. Hubschle : for the next meeting, it could be interesting to compare the hit rate "lab positive / clinically positive" according to the species.

O. Hubschle : how many vaccine doses are sold in SEARG countries?

A. Kloeck : Intervet sells between 1.5 and 1.7 million doses.

A.F. Berthon : Virbac does not sell parenteral vaccine, but there are projects for oral vaccination trials.

Then a general discussion underlines the differences between the number of doses that have been imported, declared used, really used and out of date.

Session 3 :

Rabies diagnosis

Challenge and opportunities

HAVE WE MET THE CHALLENGES OF RABIES DIAGNOSIS, SURVEILLANCE AND CONTROL IN THE 20TH CENTURY?

Arthur King[1]

The theme of our meeting here today is "The Challenges of Rabies Diagnosis, Surveillance and Control in the 21st Century". It is customary, when one sets out upon a new phase of work, to review the successes and failures of the current and past phases, in order to plan accordingly for the future. We are about to enter a new phase, as it happens, to enter a new century, and thus it is appropriate to ask the question 'Have we met the challenges of diagnosis, surveillance and control during the 20th Century?'

Let us go back in time, right back to the late 19th century, 114 years in fact to 1885 when Pasteur used dried rabies-infected brain and spinal cords as a vaccine. What was Pasteur's challenge? It was to save human lives from the scourge of rabies, which was endemic in dogs and wolves in Europe and in dogs in other parts of the world. Interestingly, the treatment which he initiated - vaccinating the patient after infection, or post exposure treatment as we call it today, remains unique in the field of virology. Inactivation of the virus with phenol and more recently with ß-propiolactone increased safety, but the multi-dose schedules considered necessary to obtain adequate responses to these vaccines enhanced the possibilities of allergic neuroparalytic accidents. Vaccines from neural tissue origin (NTO) are, regrettably, still in use in some countries of our region.

Within a few years, Pasteur Centres were set up in various countries of the world, including some within our region, which remain today. What was their challenge? Precisely the same as Pasteur's, to save human lives from rabies.

Early in the 20th century we learned how to recognise the disease, albeit retrospectively, other than by the history of a bite and subsequent clinical signs - by looking for Negri bodies, either by simple staining methods or by more sophisticated staining of paraffin wax sections. Negri bodies are pathognomonic of rabies in man and animals, although their absence does not exclude the disease. Again, regrettably, examination for Negri bodies is still the only laboratory method of diagnosis used in some countries of our region. But the advent of fluorescent antibody techniques soon after mid-century allowed us to be almost 100% sure of our laboratory diagnoses by a relatively cheap and very rapid method. It is a sad reflection of the lack of progress in our region that some countries, even if they possess FA microscopes, do not maintain them properly, cannot afford conjugate, or simply do not receive samples suitable for testing.

As with many other diseases and disease agents, we have learned a lot about the rabies viruses, their size, shape, molecular structure, the important proteins, how they vary to give different serotypes and genotypes and how antigenic variation can be used as a tool towards the understanding of rabies epidemiology. But perhaps the most important advance in rabies was the movement away from NTO vaccines and the production of vaccines initially in eggs and later by cell-culture techniques. These latter vaccines allowed not only safe post-exposure treatment but also pre-exposure prophylaxis - in other words, the disease could be eradicated in dogs, the most prolific cause of human rabies, and human rabies could be prevented with more certainty if vaccine was administered with anti-serum within a short period of the biting incident.

Vaccine technology grew at such a pace that, as we come to the end of the century, by parenteral vaccination and, where they cannot be reached with a syringe and needle, we can vaccinate dogs orally. We can eradicate the disease in dogs and we can eradicate the disease in wildlife over vast

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geographical areas by oral vaccination. We can be 100% certain that, given proper and timely treatment, no-one need die of rabies.

And yet, we know from our previous SEARG/WHO meetings, that many people in our region do die of rabies. At our meeting in Nairobi in 1997 we heard from Dr. Makonnen Fekadu, a world-wide respected scientist who has published papers on rabies for a quarter of a century, that it is likely that 10,000 people die of rabies in Ethiopia each year. Ten thousand, in one country, in one year! In a country which still has a Pasteur Centre, no doubt Pasteur would have had something to say about that. But other countries in our region have more human and animal rabies cases than are currently reported - in every small-scale dog ecology study and/or dog vaccination programme carried out by our Group members since our first meeting, the weight of infection has been far in excess of that anticipated. Dr. Cleaveland will be presenting some alarming results from Tanzania later in this meeting.

We need to look in greater depth at what is happening in the countries of our region. I have now visited 12 of the 18 countries, on a fact-finding mission funded by WHO. Note please that I say fact-finding and that is what it is, not to criticise, not to promise help which cannot be delivered, but to establish the facts so that we may know what needs to be done. I use a check-list which seeks to establish the country size, human population size and density, per capita income, communications systems, current rabies position, veterinary services structure and liaison with medical services, rabies surveillance, sample collection and shipping, rabies diagnosis, rabies control and, where it occurs, donor organisation input. In return for the information I demonstrate straw-sampling methods, check fluorescence microscopes and diagnostic techniques, give seminars and leave aliquots of conjugate and a copy of each of two videos on rabies, purchased from project funds.

Our Group covers about 10.87 million km^2, about 10% larger than the USA; the human population is some 288.3 million, about 25 million larger than that of the USA. In our region, population density ranges from about 2/km^2 in Namibia (although of course the population is not uniformly distributed) to about 95/km^2 in Malawi, one of the highest population densities in Africa. In our more southerly countries, (South Africa, Namibia, Botswana and Zimbabwe), per capita income is US $2923, US $2059, US $3640 and US $786 respectively. These are relatively wealthy countries and, it has to be said, communications systems and veterinary structures are good. Wildlife rabies is present, but except for eastern areas of South Africa, dog rabies is under control and human rabies cases are not frequently reported.

However, in the remainder of our region, per capita income is much lower, ranging from US $36 in Sudan (although this may change when oil comes on stream later this year) through US $77 in Mozambique, US $96 in Ethiopia, US $139 in Tanzania, US $142 in Malawi to US $382 in Zambia. We think of India, with its estimated 25,000 human rabies case a year, as a poor country, but even here the per capita income is US $365. Thus, unsurprisingly, the low per capita income is a major factor in the lack of rabies control in our region.

Arising from this poverty is the lack of country infrastructure and communications systems, especially roads. The outcome is that hardly any samples get to the laboratories, which as a rule are poorly equipped and, even where there is a good microscope, FA Tests are often poorly performed. Almost all medical and veterinary personnel testify that ‘rabies is a serious problem’ but the non-existent surveillance coupled with lack of samples and poor laboratory techniques mean that the current rabies position simply is not known. This is reflected by the responses to the question posed to each country’s WHO Representative ‘How much of your budget is used in rabies?’ The answer is invariably ‘none’, since veterinary and medical health officials, in the absence of figures for rabies, put rabies as a low priority for their limited funds.

In only a few countries is there any liaison at senior level between the veterinary and medical professions. This is surprising since rabies is a zoonosis - a disease of animals, mostly dogs, but the major financial costs are borne by the medical profession (post exposure treatment and hospitalisation) and the public (loss of earnings and life).

In some countries there is a loose liaison at the local level, where a bitten person reports the dog to a veterinarian, who may recommend that the patient goes to a clinic to obtain treatment. But often even this does not occur and/or the patient may prefer to go to ‘traditional healers’ or, if knowledgeable, may sell a cow and go abroad for treatment. In other countries, the lack of liaison has at least been recognised as a problem and in Uganda, for example, a veterinarian attends Ministry of Health committee meetings.

Vast sums of money may be used by Health Ministries to purchase post-exposure treatment (vaccine only), but distribution is poor and the vaccine is seldom available where it is most needed. In one or two countries large vaccine stocks pass their expiry date sitting in Central Stores, whilst victims die of untreated rabies in the field.

In most countries, some attempt is made to control rabies in dog populations (usually in response to reports of human deaths from rabies), but the numbers of dogs vaccinated or destroyed is most often very low and in no way reaches a significant proportion of the (largely unknown) dog population.

So, have we met the challenges of rabies diagnosis, surveillance and control in our region in the 20th century? Apart from in the four relatively wealthy countries mentioned above, the answer is a resounding ‘No’. Diagnosis is poorly performed, surveillance totally inadequate and control virtually non-existent. We know that all we have to do is to vaccinate dogs, but we do not know how many dogs there are, neither do we know how many people die of rabies in our region.

What has SEARG/WHO done to help? For 1995, the year of our third meeting, in Zimbabwe, the WHO World Survey of Rabies published a figure of 206 human and 1373 laboratory confirmed canine cases for the whole of Africa. We know now that in our region alone human deaths can be counted in thousands; in our Nairobi Proceedings, in 1996 we reported 813 laboratory confirmed canine cases from eight countries. Significantly, we had no figures for canine cases from Eritrea, Ethiopia, Zambia, Mozambique or Sudan, all countries which are known to have chronic dog-rabies.

What more can SEARG/WHO do? It is clear that we are beginning to understand what is happening in our region. We are all (I hope) dedicated rabiologists - we either work at National Rabies Diagnostic Laboratories, or are responsible for veterinary or medical programmes, or have a role in the treatment of patients or are international workers in rabies research. We all know what needs to be done to prevent the appalling and unnecessary loss of life from rabies.

But we must do more than just know it and know how to do it. We must be able to properly diagnose the disease, to get surveillance systems up and running and to carry out dog vaccination and population control programmes. As individuals we must make sure that senior officers are made aware of the problems. We publish Proceedings and we must make sure that copies reach all levels of management within the veterinary and medical Ministries. We must advertise our work to a wider audience. We need financial help from international agencies, but we can only obtain such help in the face of irrefutable statistics showing the need. We have palpably failed to meet the challenges of the 20th century, but we must not continue to do so. But there is even one greater challenge that we face. Over the past quarter of a century, not just in our region bur in almost all the developing countries of the world, the trend has been towards giving more and more post exposure treatments and away from tackling the cause of the problem, rabies in dogs. Today, the number of people worldwide receiving post-exposure treatment, most often in the form of antiquated brain-based vaccines, can be counted at least in hundreds of thousands, if not in millions. This trend will not be reversed until we tackle the problem of rabies in dogs. That is our challenge for the 21st century.

RABIES SURVEILLANCE IN TANZANIA

Cleaveland S.[1], King A[2]., Kaare M.[3], Luwongo S.[3]

ABSTRACT.

This study presents the reported incidence of dog rabies and human bite injuries within the Mara Region, Tanzania using data from 22 villages adopting different rabies surveillance measures. A comparison was made of five groups of villages operating the following strategies: (1) passive surveillance with no additional input; (2) support from the veterinary office in terms of provision of rabies sampling kits and report forms; (3) establishment of a revolving fund; (4) community education; (5) active surveillance. The reported incidence of dog rabies was highest in villages implementing active surveillance measures, in which allowances were paid to livestock officers. The reported incidence of human bite injuries from suspect rabid animals was highest in villages emphasizing community education. No rabies cases or human bite injuries were reported in control villages operating under the current system of passive surveillance. At the District level, case incidence data from District hospitals and veterinary offices were compared for the period 1995-1997, when no human rabies vaccine was available, and for 1998, when human rabies vaccine was available and collaboration between medical and veterinary staff established for reporting of animal bite injuries. In 1998, there was a 29-fold increase in the reported incidence of dog rabies and a 26-fold increase in the reported incidence of human bite injuries from suspect rabid animals in comparison with 1995-7. The total costs and cost-effectiveness of each strategy were compared.

1 INTRODUCTION.

In terms of global human mortality, rabies is considered to be a relatively insignificant disease, with official cases accounting for only about 1% of deaths due to infectious disease (Meslin *et al.*, 1994). However, there is little doubt that human rabies is severely underreported throughout the developing world and that official case figures provide only a poor indication of the true situation. In Tanzania, for example, 158 human deaths were reported from 1989 to 1996 (Ministry of Health, Tanzania), giving an average incidence of 0.07/100000. However, a minimum estimate from preliminary studies in north-western Tanzania from 1992 to 1994 was 1.7/100000 (Cleaveland, unpubl. data).

Relatively low rates of detection of animal rabies pose a similar problem for the interpretation of official case incidence data. Over the past three decades, animal rabies has been reported with an increasing frequency in many parts of Africa. In Kenya, for example, both the total number of rabies cases and the estimated incidence of dog rabies have increased dramatically since the late 1970s (Binepal *et al.*, 1991; Binepal, 1993; Perry,1993a; Karugah, 1995). However, the true increase in rabies is likely to be even greater than indicated because detection rates have probably dropped over the past two decades as resources available to government veterinary services become more limited (Perry, 1993b). Nowhere is the problem of rabies detection more acute than in Tanzania. Here, as in much of sub-Saharan Africa, there is a widespread perception that rabies is growing problem, but in recent years (1990-1997), only 25 animal rabies cases have been reported in the whole of the country. It is evident that while case surveillance data remain so sparse, any attempt to identify or quantify epidemiological trends will remain highly problematic.

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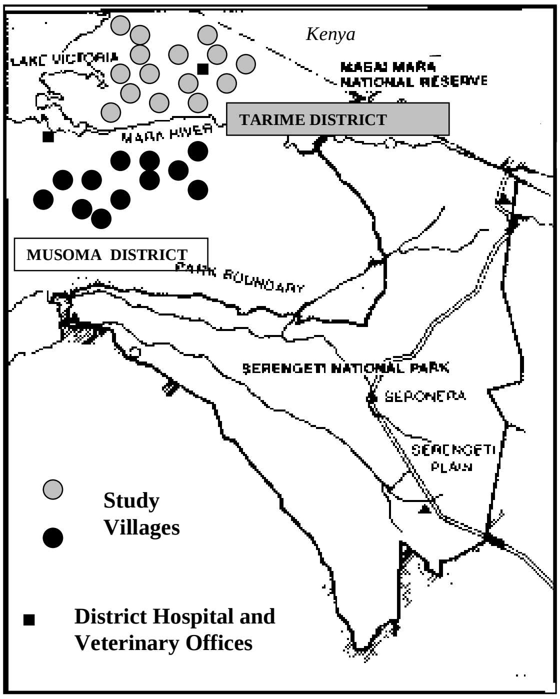
The aim of this study was therefore to investigate methods of rabies surveillance in the Mara Region, in northwestern Tanzania, to identify cost-effective and sustainable strategies for improving surveillance in rural Tanzania and to obtain more accurate data on the true magnitude of the rabies problem.

2 MATERIALS AND METHODS.

2.1 Study area.

Figure 1 : Location of study villages within the Mara Region, northern Tanzania.



The study was conducted within the Mara Region located on the northeastern border of Tanzania on the western shores of Lake Victoria (Figure 1). The Mara Region lies between latitude 1°00' and 2°31' S and longitude 30°10' and 35°15' E and comprises three agro-ecological zones. Study villages were selected from the midland zone, an area of relatively homogeneous agropastoralist land use between the Victoria lake shore region and the Tarime highlands, with an average human population density of 53 inhabitants per km^2 (excluding Serengeti National Park) (FAO/IFAD,1995).

A total of 15 villages were selected from within the midland zone of Tarime District on the basis of a similarity in human population size according to the most recent human census data (Bureau of Statistics, 1991). One of five rabies surveillance strategies was assigned at random to each village. As active surveillance measures were not correctly implemented during the study, incidence data relating to active surveillance were collected from 12 villages within the midland zone of neighbouring Musoma District, where surveillance measures had been implemented as part of another study (Kaare and Cleaveland, 1997).

3 SURVEILLANCE MEASURES.

3.1 Control group.

Surveillance was conducted according to the current system in operation with no additional input provided by the project. Under this system, livestock extension officers were expected to submit monthly reports to the District Veterinary Office.

3.2 Veterinary Office support group.

Surveillance was conducted according to the current system in operation, but additional input was provided in the form of rabies collection kits made available to extension workers and postage paid for sample submission.

3.3 Revolving fund.

Surveillance was conducted by extension workers with an incentive provided by the establishment of a revolving fund. The fund was set up by providing a small quantity of veterinary products, such as anthelminthics and antibiotics, on credit terms for extension workers to sell to livestock owners. Profits on sales were kept by the extension worker as an incentive, however, additional consignments of drugs would be provided only on submission of monthly disease reports and reimbursement of the cost of the original supply.

3.4 Commmunity education.

Efforts were directed towards community participation and public education, without additional financial incentive for community workers. Emphasis was placed on appropriate treatment of dog bite injuries and the need for follow-up of suspect rabies cases. Meetings with community leaders, householders and school children were held in each village. A generator and video was hired to allow screening of an educational video dealing with rabies prevention. The video, 'If Only I Knew', was translated into Kiswahili by project staff at the time of the viewing. Posters with simple drawings and Kiswahili text were prepared and displayed in prominent village locations.

3.5 Active surveillance.

This strategy involved the recruitment of extension workers to actively follow-up all suspect cases of rabies. Forms were prepared for monthly reporting of all suspect cases in the villages, with standardized collection of information from schools, village leaders and medical staff working in local dispensaries. Extension workers were paid an allowance for data collection and sample submission.

3.5.1 Collection of diagnostic samples.

In all villages except the control villages, extension officers were issued with report forms, sample collection kits and basic post-mortem equipment. Wherever possible, brain samples from suspect rabies cases were collected in straws inserted through the occipital foramen. Brain samples were stored in 50% glycerol-saline with 0.01% merthiolate as preservative (Barrat and Blancou, 1988). Samples were stored at 4°C for up to 2 months and submitted to Onderstepoort Veterinary Institute for rabies diagnosis using immunofluorescence (Kaplan and Koprowski, 1973).

All field workers were vaccinated against rabies (Imovax Rabies Vero, Pasteur Merieux) at Tarime or Musoma District Hospitals.

3.5.2 Ecological study of dog populations.

A preliminary household survey was conducted to obtain baseline data on the ecology and demographics of the dog population to identify potential factors likely to influence the local incidence of rabies. Questionnaires were not conducted in the control villages because the presence of a rabies research team could have in reporting of rabies. During the first month of the project (February 1998), households within each village sub-division (kitongoji) were sampled systematically by visiting every second or third household, depending on the size of the village. Questionnaire data included information on the size and structure of the dog population, fertility and mortality of dogs and recent reported cases of rabies within each village. 10 months after the first questionnaire, as many households as possible were re-visited to investigate mortality and causes of mortality in the dog population.

3.5.3 Suspect rabies cases.

At Tarime and Musoma District Hospitals, information was collected on the sex and age and village of people bitten by suspect rabid animals from 1995 to 1998. A protocol was agreed that human rabies vaccine would be administered by the hospital only when the patient had reported the case to the District veterinary office to allow follow-up of the animal case. If the victim presented first to the District veterinary office, the veterinary officer would complete a questionnaire and direct the person to the District hospital for treatment, with written confirmation that a report had been submitted. For all suspect rabies cases reported to the District Veterinary Office, data were collected on species of animal involved, age, sex, clinical signs, history of human exposure and post-exposure treatment.

3.5.4 Data analysis.

Data entry and analysis was carried out using EPI-INFO 5.0 (Dean *et al.*, 1990). An analysis of variance was used to determine whether demographic parameters from household surveys varied significantly between Districts. A Kruskal-Wallis one-way analysis of variance was used to investigate variation in demographic parameters between study groups. Incidence data were calculated on the basis of estimated 1998 human population sizes within each group of villages and in each District, using data from a 1988 government census and growth rate of 2.9% per annum (Bureau of Statistics, 1991).

3.5.5 Cost-effectiveness analysis.

Components of the preliminary cost-effectiveness analysis included capital expenditure (including discounting), proportion costs of fuel/maintenance of vehicle and fridges, administrative costs and field allowances. Although human rabies vaccine was provided free of charge by the World Health Organization (WHO), the cost analysis included purchase and distribution costs of human rabies vaccine.

The component costs of each surveillance strategy were recorded for Tarime District as a whole. The cost-effectiveness of each strategy was calculated in US dollars as cost per rabies case reported; cost per bite injury reported; cost per confirmed case; cost per village.

4 RESULTS.

4.1 Questionnaire surveys.

Results of the first household surveys are given in Table 1. Estimates of dog population size were obtained from the human:dog ratio in each village. There was no significant difference between Districts in the human:dog ratio ($t=1.09$, d.f.=18, $p>0.05$), the number of dogs/household ($t=0.573$, d.f.=18, $p>0.05$) or the number of people per household ($t=0.03$, d.f.=18, $p>0.05$). There was also no significant difference in these parameters between villages grouped according to surveillance strategy (human:dog ratio - $H=1.441$, d.f.=3, $p>0.05$; dogs/household - $H=2.197$, d.f. =3, $p>0.05$; people/household - $H = 1.273$, d.f. =3, $p >0.05$).

4.2 Incidence of dog rabies.

Within Tarime and Musoma Districts, 210/226 (92.9%) cases of suspected rabies reported to the District Veterinary Offices were cases of dog rabies.

4.2.1 Study villages.

The incidence of suspected and confirmed cases of dog rabies in study villages is shown below.

Table 1 : Incidence of dog rabies in study villages in relation to surveillance measures.

Surveillance Strategy	No. suspect dog rabies cases reported (Feb 98 - Nov 98)	Annual incidence /1000 dogs	No. confirmed rabies cases	Annual incidence / 1,000 dogs
Control	0	0.00	0	0.00
Veterinary Office Support	6	2.29	2	0.76
Community Education	7	7.07	2	2.02
Revolving Fund	3	2.70	1	0.90
Active	60	10.89	6	1.09

4.2.2 Cases reported to District Veterinary Offices from other villages.

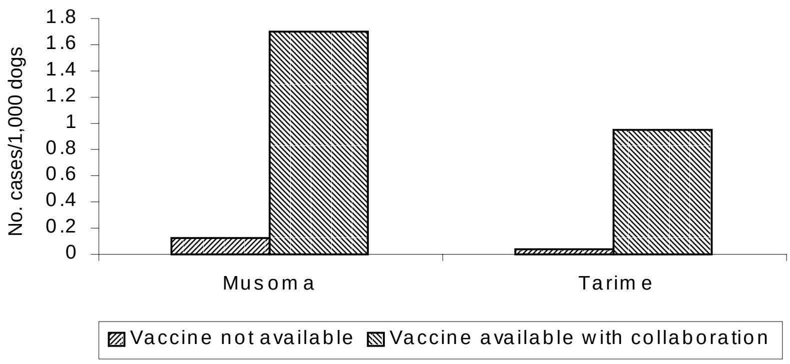
The incidence of cases of dog rabies reported to the District Veterinary Office from all other villages within Musoma and Tarime Districts is shown in Figure 2. With greater availability of human vaccine for post-exposure treatment, and improved liaison between medical and veterinary staff, there was a 13-fold increase in the reported incidence in Musoma District and a 29-fold increase in Tarime District.

4.2.3 Mortality data.

The incidence of dog rabies in Tarime District was also determined from deaths of individual dogs reported by dog owners between February 1998 and November 1998. In 269 households surveyed on both occasions, 69 out of 355 known dogs (19.4%) had died. Of those that died, rabies was reported as the cause of death in 16 cases. Of 36 suspect dog cases in the Mara Region that were reported as rabies positive over the previous two years, 24 (66.7%) were confirmed positive by laboratory diagnosis (Cleaveland, unpubl. data). Assuming that 33.3 % of suspect cases are false positives, we estimate the incidence of dog rabies to be 3.0% per annum.

In Musoma District, detailed longitudinal data were collected on the fate of 597 dogs from interviews conducted each month with dog owners in each of the study villages. Over a 12-month period, rabies was reported as the cause of death in 33 of these dogs. Assuming 66.7% accuracy of detection of true cases, the annual incidence of rabies was estimated to be 3.7%.

Figure 2 : Incidence of dog rabies reported to District veterinary offices in relation to availability of human vaccine and collaboration between medical and veterinary staff.



4.3 Incidence of human bite injuries.

4.3.1 Study villages.

The incidence of human bite injuries from suspect rabid animals is shown for each group of study villages in Figure 3. The incidence of suspected cases of dog rabies is shown in the same figure for comparison.

Figure 4 shows the incidence of human bite injuries in relation to the availability of human vaccine. Human rabies vaccine became available at the hospital in February 1998, and, at the same time, there was enhanced collaboration between veterinary and medical sectors in reporting suspect cases. These changes resulted in a 1.7- fold increase in the reported incidence of human bite injuries in Tarime District Hospital and a 26-fold increase in incidence in Musoma District Hospital.

4.3.1.1 Human rabies cases.

One human rabies case was reported in Tarime District in 1998 and none were reported in Musoma in 1998. The victim in Tarime District was an adult male bitten on the buttocks by a suspect rabid dog on 12/4/98. The man died at Tarime District Hospital on 31/5/98 showing signs of fear, scratching, and blinking of eyes. He had received no post-exposure treatment.

Figure 3 : Incidence of animal bite injuries and incidence of dog rabies in relation to surveillance measures.

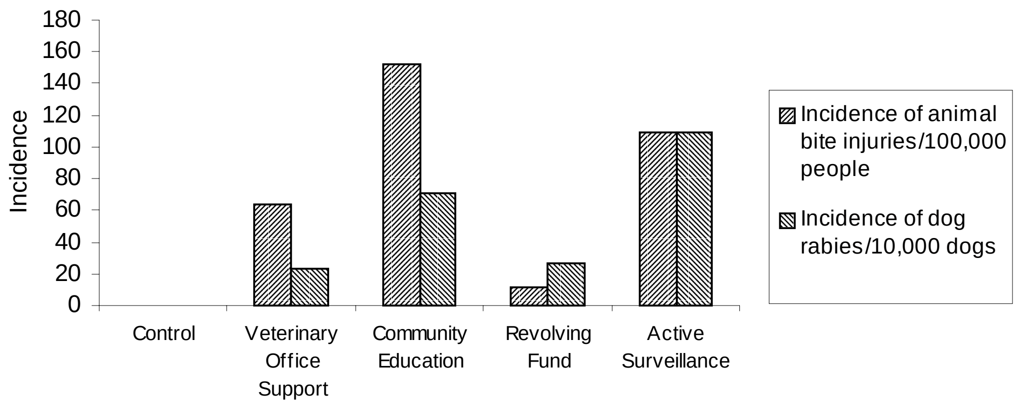
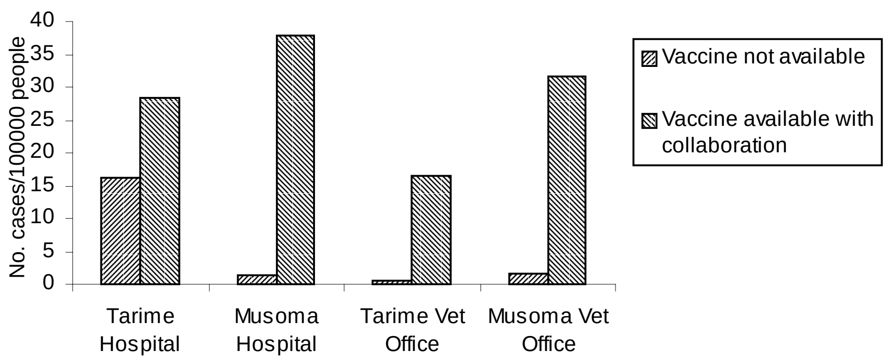


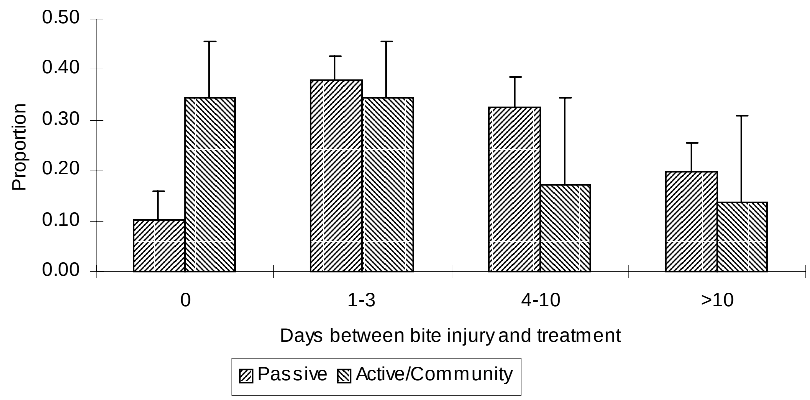
Figure 4 : Reported incidence of human bite injuries from suspect rabid animals.



4.3.1.2 Interval between bite injury and post-exposure treatment.

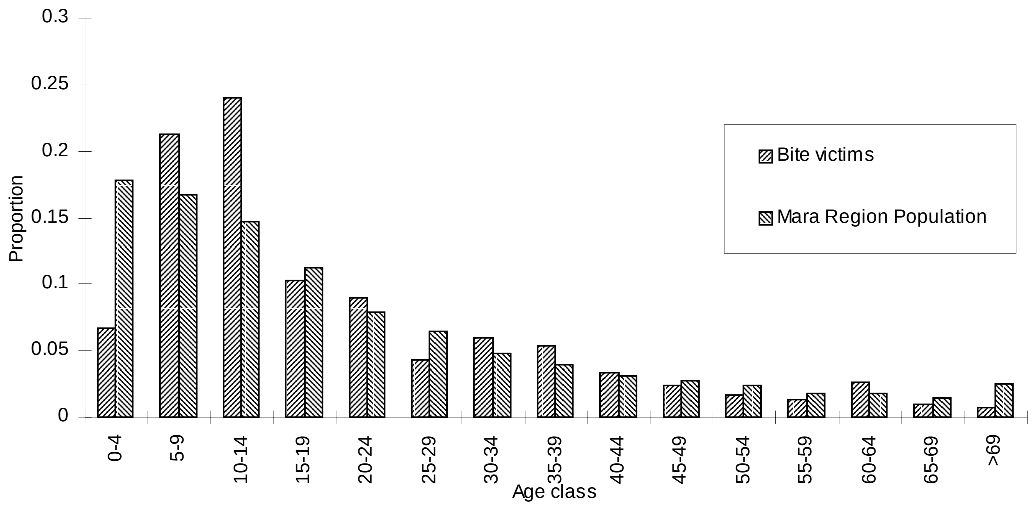
Overall, there was no significant difference in the interval between bite injury and post-exposure treatment in both Districts before the start of the project and after the start of the project. For comparison of the frequency of people reporting at intervals of 0 days, 1-3 days, 4-10 days and > 10 days, $\chi^2 = 0.52$, d.f.=3, p>0.05. However, there was a significant difference when study villages were compared. People living in villages with active surveillance and community education measures reported for treatment at the District Hospitals significantly faster than those living in other villages ($\chi^2 = 14.15$ d.f.=3, p<0.01) (Figure 5).

Figure 5 : Interval between bite injury and treatment in relation to surveillance measures in village.



4.3.1.3 Age distribution of bite victims.

Figure 6 : Age distribution of dog bite victims in Musoma and Tarime Districts.



The age distribution of people bitten by suspect rabid dogs differed significantly from the age distribution of the Mara Region population as a whole (Figure 6). Grouping the data into four age classes (0-4 years, 5-9 years, 10-14 years and > 14 years), $\chi^2 = 43.1$,d.f.=3, p<0.001. Older children suffered disproportionately more bite injuries than expected from the age distribution of the population and younger children (0-4 years) suffered fewer injuries than expected. Bite injuries to the head and neck were significantly more common in children less than 10 years of age than in older patients ($\chi^2 = 9.0$,d.f.=3, p<0.01).

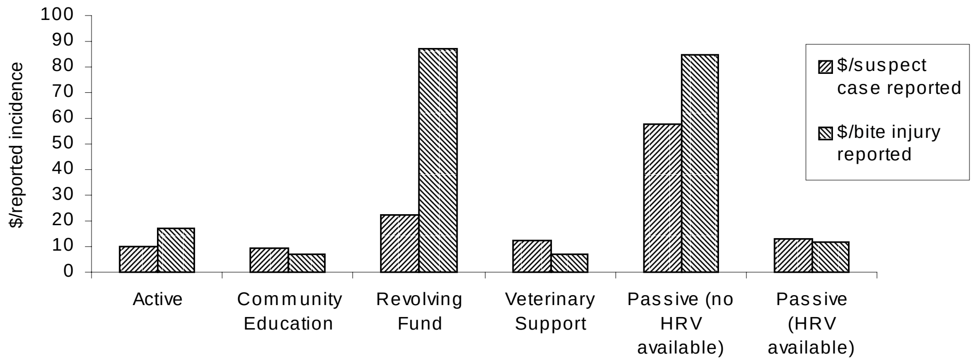
4.3.1.4 Costs of rabies surveillance.

Total costs of rabies surveillance in Tarime District and cost-effectiveness of different strategies in terms of reporting and detection of rabies are shown in Table 2 and Figure 7.

Table 2 : Costs of rabies surveillance in relation to strategy adopted.

Strategy	Total cost for District ($)	$/suspect case reported	$/per bite injury reported	$/sample submitted	$/confirmed case	$/village
Active	7827	10.19	16.97	44.28	101.81	55.90
Community Education	4888	9.36	7.26	17.47	26.21	33.34
Revolving Fund	4308	22.62	87.07	54.27	67.85	30.76
Veterinary Support	1976	12.23	7.32	18.40	36.86	14.11
Passive (no HRV available)	510	57.38	84.62	-	-	3.64
Passive (HRV available)	1482	12.81	11.96	518.78	625.04	10.58

Figure 7 : Cost-effectiveness of different surveillance strategies (including costs of human rabies vaccine).



5 DISCUSSION.

This study demonstrates that significant improvements in the detection and reporting of rabies cases could be achieved in rural communities with the adoption of relatively simple strategies. With these measures in place, figures obtained for the incidence of dog rabies and the incidence of human bite injuries from suspect rabid animals were higher than previously reported in Tanzania. This suggests that official case incidence data for rabies in Tanzania significantly under-estimate the true magnitude of the rabies problem in the country.

The highest incidence of cases of human bite injuries from suspect rabid animals was reported in those villages that emphasized community education through meetings, posters and the viewing of a video. In these villages, people bitten by rabid animals also reported to the hospital for treatment most promptly. However, the costs of community education were relatively high in this study because they included proportional purchase and maintenance costs of a four-wheel drive vehicle. In many parts of rural Tanzania, no electricity is available and a vehicle would be necessary to transport a portable generator and video equipment to each village. Although public health education could be given without the video, our experience suggests that showing the video had the greatest impact in terms of public awareness. Each showing was a major event and stimulated great interest throughout the village.

The incidence of reported cases of dog rabies was greatest in villages adopting active surveillance measures, with livestock officers paid an allowance each month to follow-up suspect cases. This strategy also resulted in prompt post-exposure treatment of human bite victims. Active surveillance was less effective in terms of reporting human bite injuries than the community education measures, consistent with a greater emphasis of active surveillance on detecting animal rabies cases and a greater emphasis of community education on prevention of human disease. Although active surveillance was the most expensive strategy adopted here, the strategy was one of the most cost-effective because of the high rate of detecting suspect cases. Nonetheless, the total costs may be too high to be sustained by the limited budgets available to government veterinary services. Furthermore, although reported case incidence was high, few samples were submitted for laboratory diagnosis and few cases confirmed. Although incentives were paid for each sample submitted, livestock officers reported difficulties in retrieving carcasses and transporting samples from the village to the District Veterinary Office.

The revolving fund was established with the aim of improving disease reporting by generating incentives for livestock officers on a sustainable basis. In addition, the scheme aimed to increase the availability of veterinary products for local farmers. However, in these villages, reporting of animal rabies cases and human bite injuries was poor and the scheme could not be sustained. After the initial provision of veterinary drugs, livestock officers failed to report for further supplies to the District Veterinary Officer (DVO) and hence no diseases were reported. In addition, the DVO was unable to recover the initial investment in the drugs. The high demand for cash income to meet immediate family needs may explain why profits generated through the scheme could not be reinvested in the revolving fund.

The simple provision of rabies collection kits and discussions with the DVO improved detection of rabies in the veterinary office support villages in comparison with control villages. Although few samples were submitted, rabies awareness was improved with relatively little input and cost.

Our conclusions about the efficacy of detection of rabies depend, in part, upon the assumption that the true incidence of rabies was the same in each of the study groups. Although there may have been different foci of infection in the Districts in 1998, there was no obvious reason to expect a higher incidence in community education or active surveillance villages than in other study villages. However, in such a limited short-term study, we cannot rule out the possibility that results were biased by local patterns of infection.

The most significant factors affecting the incidence data were the availability of human rabies vaccine and liaison between veterinary and medical sectors in documenting cases. The independent effect of each of these factors could not be evaluated in this study as collaboration was established between vets and doctors at the same time that human vaccine became available. The availability of human vaccine is clearly a priority for the regions, not only in terms of preventing human disease, but also for providing a cost-effective means of measuring rabies incidence. Clearly, there is little incentive for bite victims to report cases when treatment is unavailable. Although post-exposure treatments were recorded in this period, the rabies vaccine was purchased in Kenya as no rabies vaccine was available through government services. The greater proximity of Tarime District to the Kenyan border, and the large proportion of Tarime families with relatives in Kenya, may explain why the incidence of reported human bite injuries was higher in 1995-1997 in Tarime District than Musoma District. No rabies immunoglobulin treatment was recorded at any time.

Although this study demonstrated clear improvements in reporting of suspect rabies cases, a total of only 8 were samples submitted for laboratory diagnosis over the 10-month study period and the incidence of confirmed rabies remained much lower than that of suspected rabies. Even with relatively expensive active surveillance measures, logistic difficulties in rural Tanzania prevented high rates of submission. Given these problems, which are not easily resolved in the short-term, there is a strong case for collecting and reporting the incidence of suspect cases. While hospitals submit official monthly reports on the incidence of human bite injuries from suspect rabid animals, official veterinary records tend to report confirmed cases only, which clearly underestimates the true impact of the disease. Results from a parallel study in the Mara Region (Kaare and Cleaveland, 1997) have shown that villagers and extension workers are familiar with the clinical signs of rabies, with 39/47 (83.0%) suspect animal cases subsequently confirmed positive. Incidence data from suspect rabies cases could thus provide a valuable source of information on temporal and geographical trends.

In summary, significant improvements in the detection of suspected cases of rabies and the prompt treatment of human bite injuries may be achieved through reliable provision of human rabies vaccine at District hospitals, greater liaison between veterinary and medical staff, and by simple community education measures. Where rabies is endemic and clinical signs are well recognized by villagers, comparative analysis of reported case incidence data may provide a valuable source of epidemiological information that is currently under-exploited. Furthermore, these data indicate that the magnitude of the rabies problem in Tanzania is likely to be much greater than officially recognized.

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TECHNICAL QUESTIONNAIRE ON TECHNIQUES USED IN EUROPE FOR RABIES AND ORAL VACCINATION SURVEILLANCE.

J. Barrat[1] and T. Müller[2]

Surveillance of rabies and monitoring results of vaccination campaigns cannot be executed without reliable laboratory techniques of laboratory diagnosis of rabies and serological tests.

This paper summarises the results of a technical questionnaire that was sent to different European countries to collect data on the techniques used to perform rabies diagnosis and to monitor the impact of vaccination campaigns of foxes. This was decided during a meeting held in Portoroz (Slovenia) in 1996.

This technical questionnaire has been sent to the European veterinary services to analyse the practical realisation of the technical procedures used for rabies diagnosis and control of oral vaccination campaigns against rabies.

Thirty one answers have been received from 29 countries : Germany, Austria, Belgium, Bulgaria, Cyprus, Croatia, Denmark, Estonia, Finland, France, Georgia, The Netherlands, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldavia, Norway, Slovakia, Czech Republic, United Kingdom, Slovenia, Sweden, Turkey, Ukraine, Uzbekistan.

The questionnaire was divided in 3 parts :

1. Rabies diagnosis : fluorescent antibody test and cell culture test.
2. Serological surveillance of foxes : cell culture test and/or ELISA.
3. Biomarker examination.

This paper will be focused principally on the diagnosis topics of the questionnaire. The results are shown with the number of laboratories giving a precise answer / the number of laboratories that have answered to a given question.

1 ANALYSIS OF THE ANSWERS TO THE QUESTIONNAIRE.

1.1 Rabies diagnosis.

The reliability of laboratory diagnosis of rabies depends mainly on the regular practice of the techniques. Which means that if training technicians is important, it is also very important to maintain this trained status by regular practice and by regular quality control of the work performed.

This regular practice of laboratory diagnosis needs a more or less centralised structure of laboratory diagnosis in the country because it is the only way to allow a regular practice of the tests.

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1.1.1 Technicians performing the diagnosis.

31 laboratories answered to this part of the questionnaire. In 21 laboratories fewer than 5 technicians are involved in rabies diagnosis, which should allow regular training and hence the reliability of diagnosis.

Only 2 laboratories have “full time“ technicians. Most often (16/31) rabies diagnosis is generally more than 75% of the activity of technicians involved in other diagnosis work.

1.1.2 Fluorescent antibody test.

The **number of examinations** performed in a laboratory ranges between 150 and 3500 in the rabies infected countries (i.e. .between one diagnosis every other day and 9 every day). The "low" daily activity is also a financial problem regarding the conservation of diagnosis conjugate because the use-by date will be reached before the end of the vial.

Most often (23/27), the fluorescent antibody test is performed on an **impression** of brain material, **smears** are prepared in 13 laboratories. Nine laboratories use both impression and smears. Both techniques assume that the specimen is in a good state to make a thin smear/impression that will be easy to examine, making FAT more reliable. The study of discrepancies between techniques when FAT and MIT or FAT and CCT are used shows that the percentage of discrepancies is significantly higher when specimens are autolysed than when they are in a good state.

Different sections are routinely examined. Ammon’s horn is tested in 26 laboratories, cerebellum in 19, medulla oblongata in 19 and cortex in 15. Twenty three laboratories examine at least Ammon’s horn with other parts of brain. Four out of 23 laboratories examine routinely salivary glands.

Once the slide is prepared, **fixation** is performed. Fixation is easier for thin specimens that have been allowed to dry correctly on the slide; once again the importance of the state of conservation appears. To obtain this, it is very important to avoid any autolysis between the discovery of the animal and the diagnosis, i.e. rapid, cool, transport the laboratory. Twenty four laboratories fix the slides in acetone, 7 heat the slide to fix the specimen. Two laboratories use both heat and acetone fixation. When acetone is used, the fixation time ranges between 5 minutes and 4 hours, 10 out of 21 laboratories fix for 30 minutes. Fixation is generally made around –20°C (14 laboratories out of 21), 4 laboratories fix at room temperature. Acetone bath is changed daily (8/21), twice a week (3/21), weekly (6/21), twice a month (3/21) or monthly (1/21), generally the higher the number of diagnoses performed, the more frequent the changing of acetone.

Twenty six laboratories use a commercial **conjugate**. Twenty three use it at the "normal" dilution, 3 dilute the reconstituted conjugate more then it is recommended by the producer. It is a classical way to save money but "over-diluted" conjugates may not be stable and should be used only on the day of dilution. They ma also not recognize weakly positive material.

Eleven of 15 labs use glycerol associated with a buffer as **mounting medium** for the slides. The pH of this medium is generally set around 7.0, which is not the optimal pH for fluorescence of FITC (>8.5); only 3 laboratories use such an alkaline mounting medium.

The **microscopes** used to examine these slides are generally equipped with a mercury bulb (23/27). Halogen bulbs are used in 7 laboratories. Both bulbs are suitable for FITC which is excited by blue light (490nm). The objective magnification ranges between 10 and 100. Fifteen laboratories use magnification less than 50 which will give a clear image even with thick specimens that cannot be clearly read with a 90X or 100X magnification objective. The eyepiece magnification ranges between 4 and 13, which gives a global magnification ranging between 100 and 1000. The "mean" combination is 10X eyepiece associated with a10 to 40X objective.

The slides are generally examined by 2 technicians (13/22). This double reading is a good way to have a reliable diagnosis. The stained and examined slides are kept for at least 1 month (up to 24).

A "safety" sample is collected by 23/25 laboratories. This piece of brain tissue is generally kept frozen (-20°C) for at least 1 month (up to 24).

Seven countries that perform or have performed oral vaccination campaigns look for the **possibility of vaccine induced rabies**. This test is made in the laboratory that performs the diagnosis.

Different **controls** may be used to validate the fluorescent antibody test :

- Positive CVS controls (mouse brain) are used by 18/24 laboratories.
- A positive specimen from the day before is used as a control by 14/23 laboratories.
- A negative control (mouse brain) is used by 11/22 laboratories.
- A negative specimen from the day before is used as a control by 11/22 laboratories

These controls are used in every staining process by 16/21 laboratories. Others use controls once or twice a week or once or twice a month.

1.1.3 Cell culture test.

Cell culture test is used for rabies routine diagnosis in 14 laboratories.

Two **cell lines** are used : neuroblastoma cells and BHK_{21}. Ten laboratories use neuroblastoma cells, but only five use the cell line registered in the ATCC as CCL 131. Four laboratories use BHK_{21} cells, but only 2 of them use the "classical" BHK_{21} c13 line registered in the ATCC as CCL 10.

Different **samples** are taken in the brain. Ammon’s horn is always sampled, other parts of the central nervous system are collected according to the following table :

Ammon’s horn	**Medula oblongata**	**Cerebellum**	**Cortex**	**Frequency**
YES	YES	YES	YES	6
YES	YES	YES	NO	3
YES	NO	YES	YES	1
YES	NO	YES	NO	1
YES	YES	NO	NO	1
YES	NO	NO	NO	2
YES	NO	NO	YES	1

Only 2 laboratories examine routinely the salivary glands.

Once sampled, the brain tissues are homogenised. The **grinding medium** is generally a cell culture medium (11/16), sometimes PBS (3/16). Seven laboratories out of 14 add fœtal calf serum to the medium, 4 others use new born calf serum or another serum. The serum concentration ranges between 5 and 50%, generally 10% of serum is added to the grinding medium.

The cell culture substrate may be microplates (used by 5 laboratories) or lab-tek slides (used by 5 laboratories). Three laboratories use both substrates.

Eleven of 14 laboratories inoculate cells in suspension, four use DEAE dextran during the incubation of the test.

The **incubation** ranges between 1 and 6 days. Two labs incubate for 1 day, 3 for 2 days, 2 for 3 days, 3 for 4 days, 1 for 5 or 6 days. Six labs change cell culture medium after 24 hours incubation which eliminates the gross particles of brain tissue.

Different **controls** should be used :

1) Positive controls may be made with CVS (in 12/13 laboratories) or with a positive specimen obtained the day before (in 7/6 laboratories)

2) Negative controls are prepared either with a negative mouse brain (in 10/12 laboratories) or with a negative specimen obtained the day before (in 8/6 laboratories).

These controls are generally used for every cell culture test session (in 10/13 laboratories).

1.2 Serological surveillance of vaccination campaigns.

Two aspects should be monitored during the follow-up of oral vaccination campaigns, the bait intake and the seroconversion percentage in the fox population.

Serological follow-up may be performed either with cell culture tests or with ELISA tests.

1.2.1 Cell culture seroneutralisation for surveillance of oral vaccination campaigns.

Eleven countries use a cell culture test to determine the level of neutralising antibodies during the surveillance of oral vaccination campaigns.

The **sample** is generally either an exudate obtained from the thoracic cavity or a serum. The transport takes 1 to 15 days. In 6 countries, the transport of the serum to the lab lasts 2 to 3 days. In order to have good quality samples, the best way is to collect blood from the heart or from large vessels as soon as the fox has been shot rather than working on animals that have been thawed. It is also a good way to avoid any cytopathic effect of the serum / exsudate because of bacterial toxins or contamination of cells.

During the test, a **pre-dilution of the serum** may be done, 1:2 to 1:10. Seven labs out of 12 always pre-dilute the serum.

Heat inactivation is either made on undilute serum (6) or on diluted serum (5).

Dilutions are made either in tubes (5) or in microplates (8). When a microplate is used to dilute the serum, the same plate is used for the entire reaction (7/8).

The **dilutions** are generally made in cell culture medium complemented with fœtal calf serum. The dilution step is generally 1:2 (4) or 1:3 (5) but may range between 1:2 and 1:50.

The **challenge virus** is CVS. Nine laboratories out of the 11 that answered to this question use the ATCC registered CVS 11 (n° VR 959). A hundred infectious doses of virus are used per dilution, and the range of acceptability is 50 - 200 (i.e. 1.7 - 2.3 in $\log_{10}$). The infectious titre of the virus is given in $TCID_{50}$.

The **neutralisation** step lasts 60 or 90 minutes (respectively 5 and 6) at 35° or 37°C (respectively 1 and 9).

BHK_{21} **cells** are used in 12 laboratories, but only six use BHK_{21} c13 line registered in the ATCC as CCL 10. Ten labs use these cells as a suspension and only one as a cell layer.

Replicates of the different dilutions are made in 10 laboratories (2 replicates in 7 laboratories and 4 in 3).

The **incubation** lasts 1, 2 or 3 days (respectively in 7, 4 and 1 laboratory) at 37°C.

During **fixation** the concentration of acetone ranges between 20 and 100%. Eight laboratories out of 12 use 80% acetone. Fixation is made for 20 or 30 minutes (11/12) at –20°C (4), +4 (3) or at room temperature (5).

The **conjugate** used to stain the cells is generally the one used for rabies diagnosis (7/12).

Different methods are used to **read** : count positive fields (3), estimation of the fluorescence of the layer (1), count fluorescent foci (2), qualitative reading of the well (6).

The **microscope** is more often equipped with a mercury bulb (9/12) than with halogen. The magnification of the objective ranges between 10 (7/11) and 40. The eyepiece is generally a X10 (9/11). Only one lab indicates the field index of the eyepiece, this index is used to determine the diameter of the observed field. This parameter is important when the reading technique consists of counting fields because the observed surface may vary from 1 to 9 for the same magnification.

The use of **controls** is summarised in the following table :

	YES	NO
WHO positive control	9	2
OIE dog positive serum control	7	2
„Internal“ positive control	8	2
Naive control	7	2

Positive controls are used in every test (12), naive controls are used in every test (10/12).

Titres are **calculated** with Spearmann Kärber method (6), neoprobit graphic method (1) or both (2), Reed and Muench method is used in 4 labs.

The **neutralising dilution** of the serum is the one that inhibits 50% (6) or 100% (4) the virus.

In order to assess the reliability of the test, control graphs should be made for the CVS titre (8/12), positive control (7/12) and naive control (5/12).

1.2.2 ELISA test for surveillance of oral vaccination campaigns.

ELISA tests are used in 3 countries to control the antibody level of foxes. Two of them use a commercially available test.

Heat inactivation is made in 1/3 lab.

Three dilution patterns are used : one dilution, serial dilution 1:32 to 1:256 or 1:100 to 1:12800.

The test volume is 100µl.

The antigen is G protein for the commercially available tests or entire virus. The G protein is the target of neutralising antibodies. The conjugate used is a protein A conjugate (1/3) or an anti dog conjugate (2/3). The enzyme is always peroxydase and OPD is the chromogen of the reaction.

Different controls are used : blank, naive and positive (3/3).

A densitometer is used for reading and results are expressed in equivalent units.

1.3 Biomarker examination.

The detection of the biomarker indicates that the fox has eaten at least the embedding of the bait. This examination is also a good way to follow-up the evolution of fox populations (age structure).

The **specimen** is either a piece of bone or a tooth. Eight laboratories out of 30 work on bones (7 on jaw and one on a non identified bone). Canine tooth is examined only in one country and incisor is used in 21.

The **cutting** of the specimen is made with a diamond coated saw in 9 countries. The section is a transversal one in 9/9 countries, 2 of them examine also longitudinal sections.

Tetracycline gives a good fluorescence in ultraviolet light, the **microscope** is equipped with a mercury bulb in 8/9 countries. The magnification of the objective is low (less than 20 in 6/9 laboratories) or medium (40 in 2/9 laboratories). The eyepiece magnification is generally 10 (6/9), which makes a global magnification ranging between 63 (2/9) and 400 (2/9).

Presence / absence of **tetracycline** is read in 8/9 laboratories and only 3 laboratory count tetracycline lines. Eight laboratories indicate the number of persons who read the slides, only 5 of them use a "double check" procedure for reading.

Age determination is done in 4/5 laboratories. Two differentiate only adults and juveniles. The cut off age is set at 5 or 6 months (3 laboratories) or 1 year (1 laboratory). Different techniques may be used to estimate the age : wear of teeth, radiology and microscope examination. The microscope is then generally equipped with a X10 objective and a X10 eyepiece, which gives a global magnification of 125.

2 Conclusion, what could be the ideal surveillance system ?

Rabies surveillance may be divided in two distinct parts, rabies diagnosis itself and surveillance of oral vaccination of foxes against rabies. In fact both "domains" of rabies surveillance need :

- The collection of good quality specimens in the field
- The preservation of these specimens during transport to laboratories
- Reliable techniques in laboratories
- Rapid transmission of information.

2.1 Collection of specimens in the field.

2.1.1 Rabies surveillance.

The best specimens are animals that seem ill or are found dead. From a diagnostic and epidemiological point of view the probability of finding rabies virus antigen in the brain of these animals is much higher when compared to others. These animals can be regarded as indicators for the presence of rabies in the field.

Animals "randomly" culled for surveillance of vaccination are not a good sample. It has been shown several times that these animals are of only limited value for the determination of rabies incidence in a given area.

2.1.2 The follow-up of vaccination campaigns.

Detection of tetracycline and serological examinations need fresh specimens.

Culling operations (for example through night shooting) must be organised for this purpose. Blood is taken from the heart or from large vessels as soon as the animal is killed. The head is sent rapidly to the laboratory for diagnosis (detection of vaccinal or field rabies) and biomarker detection.

Collection of dead animals does not provide serum samples fresh enough for laboratory analysis.

2.2 Transport of specimens to the laboratory.

For optimum diagnosis, rapid transport of specimens kept cold remains the best way. Preservation techniques may be used but they may reduce the choice of available techniques.

For surveillance campaigns, heads may be frozen before examination, which will allow rabies diagnosis and tetracycline examination in fairly good conditions later.

For serological surveillance, blood must be taken as soon as the animal is culled. Serum is then harvested and frozen. Liquid sampled from carcasses that have been frozen is not a good sample because many non specific factors may induce false positive or negative reactions both in ELISA and neutralisation tests.

2.3 General recommendations for diagnostic procedures in the laboratory.

To compare results of surveillance, correlation of results is the first thing to assess. The standardisation of the techniques is the second step.

With respect to diagnostic procedures, there exist three main international references dealing with laboratory techniques in rabies which can be regarded as the current standard works of rabies diagnostics :

- Meslin, F.-X., M.M. Kaplan, and H. Koprowski (1996),WHO, Laboratory techniques in rabies, 4th edition, Geneva,
- O.I.E. Manual of standards for diagnostic tests and vaccines (1996),
- European Pharmacopoeia (1998)

2.3.1 Fluorescence antibody test.

- The suitability of an anti-rabies conjugate for FAT in rabies routine diagnosis has to be proven with respect to its sensitivity and specificity.
- Commercially available anti-rabies conjugates should be diluted according to the producers instruction, especially when it contains of a mix of monoclonal antibodies.

- Positive and negative controls should be used in every staining process.
- Rabies-positive samples have to be proven for the presence of vaccinal or field induced rabies.

The regular daily practice of FAT is the only way to maintain the quality of rabies diagnosis. That is why a centralised structure is necessary. It is much better to have one national lab that performs 5 diagnosis a day than 10 regional labs that receive 1 specimen every other day. This structure is also a good way to use expensive reagents like conjugate completely before the expiry date.

2.3.2 Inoculation tests.

- The cell-culture isolation test is the method of choice for virus isolation and it is more rapid and as sensitive as the mouse inoculation test. Neuroblastoma cells stated in the American Type Culture Collection (ATCC) as CCL 131 should be used for the cell culture test.
- The inoculation test should be used in case of FAT suspect results and in case of FAT negative results with known human exposure.
- Positive and negative controls should be used in every staining process. It is important that the controls are treated in the same manner as the test samples.

2.4 Inter-laboratory comparison tests.

At the end of the meeting in Portoroz in November 1996, one of the recommendations was that inter-laboratory tests should be undertaken. One national laboratory is tested and then, if regional laboratories exist, these laboratories are controlled by the national one.

During the last two years, the first bilateral inter-laboratory comparison tests were conducted at an international level including countries involved in oral vaccination such as France, Germany and Switzerland. This work will be continued and extended as part of FAIR project financed by the European Community.

For the future, inter-laboratory comarison tests should be extended to other European countries. The test should deal with the different aspects of rabies surveillance :

1) For **FAT diagnosis**, one reference laboratory sends control and test slides to the different participating national laboratories. These slides are examined in the routine conditions used in the participating labs. In case of discrepancies, a second set of slides is prepared and sent.
2) For **serological testing** of foxes in oral vaccination surveillance programs, the first thing to control is the inter-laboratory correlation of neutralizing antibody (nAb) titres or cut-off values. To reach this goal, a panel of pooled fox sera of different titres and different conservation should be sent by a reference laboratory to the different participating national laboratories. This test will allow the comparison of nAb-titres obtained by the participating laboratories based on the same panels with the technique that they use routinely. This control is necessary to compare the results obtained by different countries.
3) The same kind of inter-laboratory test should be undertaken for **biomarker** detection and **age** determination.

Complete surveillance needs regular examination for vaccinal rabies virus and the final control of titre of baits sampled during the vaccination campaigns.

RABIES IN A TWO-WEEK OLD CALF NEAR KAMPALA A CASE REPORT

E. S. Bizimenyera[1]

1 INTRODUCTION.

Rabies is a contagious rhabdoviral infection of all warm blooded animals affecting the central nervous system and salivary glands. Transmission is usually through the bite of a rabid animal via saliva rich in virus. The incubation period varies inversely with the proximity of bite to the central system, but has been reported as varying from 21-80 days in dogs to up to 209 days in horses and cattle.

However in laboratory infections in cattle rabies has been known to occur within 21 days. It is widely held that *Bos taurus* breeds succumb faster to rabies than *Bos indicus* breeds. Furthermore young animals are more susceptible than adults. The clinical disease first manifests as change in natural behaviour, excessive salivation, excitability and mania and ends in motor paralysis and death. In man and cattle mortality is 100%.

According to the region and the biotype of the virus, dogs, foxes (arctic and red foxes), bats are reservoir of the virus. Cattle and man get infected through bites from rabid animals.

2 CASE HISTORY.

The present case was a female calf born on 29th January 1998 that was attacked by a stray dog 2 days after birth. The dog was reportedly chased off by the dam (a local zebu cow) when the dog entered the kraal/shed at night. The dog mysteriously died after about four days from that incidence. The calf started showing inability to suckle on 8th February 1998, when a veterinarian was called in. But its condition progressively deteriorated. The Ambulatory clinic of Faculty of Veterinary Medicine was called in on 18th February 1998 and the clinician diagnosed rabies. The following day, the calf was euthanased and the head submitted for histopathological diagnosis to the pathology department in the veterinary faculty.

3 CLINICAL MANIFESTATION.

Clinical manifestation was first noted on 8th February 1998, with drooling of saliva and inability to suckle. The calf developed hoarse bellowing with extended neck. Salivation became more profuse and frothy at the mouth (Photograph 1). The calf would charge and make aggressive postures and fall down. There was incoordination of the gait in the hind legs with knuckling. These signs steadily grew in intensity each day.

By 19th February 1998 the calf had lost the anal sphincter reflex and there was total incoordination of hind legs (Photograph 2). Because it posed a danger to its dam, the milker and the other people at home, the calf was euthanased and the head submitted to the histopathological laboratory. The laboratory showed severe perivascular cuffing in some parts of the brain. Negri bodies were seen in Purkinje cells and in neurons of the hippocampus. Based on these histopathological findings, a confirmatory diagnosis of rabies was made.

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4 DISCUSSION AND CONCLUSION.

The occurrence of clinical rabies in a 2 week old calf was rather unusual for in this case the incubation period was only eight days. A case of rabies has never been reported in the faculty of veterinary medicine Makerere University involving a four week old puppy. Unlike the widely held view that *Bos indicus* breeds do not quickly succumb to rabies, this case was unique in that though it was a zebu, it came down with clinical rabies within only eight days.

Rabies is a rapidly fatal disease threatening livestock and human beings country wide; it has become one of the most serious zoonoses in Uganda. Livestock farming in Uganda revolves around cows. This serves to remind the farming community, that rabies is a zoonotic, highly fatal infection that can be acquired through contact with saliva of rabid animals. Calves are fond of licking farmers and animal attendants. Therefore, current vaccination campaigns that ordinarily target dogs should also include cows and other livestock.

Figure 1 : Clinical signs of rabies, note the alert facial expression, the drooling of saliva and erect ears.

Figure 2 : Clinical signs of rabies, incoordination in hind limbs, inhability to swallow pieces of grass stuck in the mouth.

A REVIEW OF CLINICAL RABIES ADMITTED TO MULAGO HOSPITAL UGANDA 1990 - 1998

E.A. Mworozi[1] and R. Winyi Kaboyo[2]

1 INTRODUCTION.

Human Rabies is a serious viral infection mainly of the nervous system but also affects multiple organs. It presents typically as a viral encephalitis.(Nelson, 1996; Kenneth; Report of the committee on infectious diseases, 1991)

Rabies has been reported in all continents except Australia and Antarctic. It is usually transmitted by contamination of a wound with saliva from a rabid animal and is virtually 100% fatal once symptoms develop. To date only 4 cases of clinical rabies have recovered (Nelson, 1996) Rabies can also be transmitted through scratches by claws of rabid animals because animals lick their claws. Also saliva applied to mucous membranes, e. g. the conjunctiva, may be infectious. Human to human transmission can also occur (Human to Human transmission of rabies via corneal transplant - Thailand. MMWR, 1981).

In the USA human rabies has virtually been controlled to about 1-2 cases per year but it is a relatively common problem in Asia and Africa as a result of canine rabies especially the rabid dog'(Kenneth) In Asia and Africa, poor reporting precludes accurate data on prevalence and incidence of rabies.(Nelson, 1996) In Uganda according to the Departmental annual Reports (Ministry of Agriculture Animal Industry & Fisheries) from 1992 to 1996 there has been a declining trend in the number of rabies cases from 50 in 1992 to 9 in 1996 (Rutebarika, 1997).

Clinical rabies in humans characteristically produces an acute febrile illness with rapidly progressive central nervous system manifestations due to encephalitis including anxiety, dysphagia and convulsions (Nelson, 1996; Kenneth; Report of the committee on infectious diseases, 1991). Usually the illness goes through five stages i.e. incubation period, prodrome (non-specific symptoms),acute neurological phase (most symptoms here) coma or recovery phase (Kenneth). That is to say that rabies presents two clinical forms, a furious form and a paralytic form. The incubation period varies. It can be as short as 9 days and as long as 7 years or more but is usually 20-40 days and is shorter if the site of bite is on or near the head (25-48 days) than when it is on the extremities (46-78 days) (Kenneth). Kirva (1975) has described a case of human rabies in Mulago hospital in 1975 no other cases have been described.

Usually patients are admitted during the acute neurological phase, which lasts 2-3 days. In the USA on average patients are admitted 4,4 days after the onset of symptoms and the admission diagnosis is rabies in less than 1/3 of patients. The admission diagnoses include viral encephalitis, Guillain - Barre syndrome, cerebral vascular accidents (CVA), tetanus, psychosis etc. 90% patients have neurological symptoms on admission (Kenneth).

2 DIAGNOSIS.

Diagnosis of rabies in humans is usually on clinical grounds but the definitive diagnosis is by post-mortem whereby histology shows Negri bodies in the brain, virus isolation or using immunofluorescence techniques to determine rabies antigen (Nelson, 1996; Kenneth ; Human to Human transmission of rabies via corneal transplant - Thailand. MMWR, 1981; Wandeler, 1997).

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Antemortem diagnosis using hair follicles has been developed but this is not available in Uganda. However detection of neutralising antibodies in serum or cerebrospinal fluid of the patient is a diagnostic of rabies in the absence of previous or concomitant vaccination.

Diagnosis of rabies is not difficult if the patient is known to have been bitten by a potentially rabid animal and presents clinically with hyperactivity and hydrophobia. Hydrophobia and aerophobia are virtually pathognomonic of rabies. Rabies should be considered in a rapidly progressive central nervous system disorder. Ideally any suspected rabies deaths should be confirmed by laboratory examination.

3 TREATMENT.

The treatment of rabies is non specific and is mainly supportive, which can be intensive or non intensive. Patients with rabies should be isolated.

4 PROGNOSIS.

Clinical rabies is a rapid progressive and fatal disease with almost 100% mortality. Death usually occurs within a few days of onset of symptoms (Nelson, 1996; Kenneth; Wandeler, 1997).

5 CONTROL OF RABIES.

This is by prevention through vaccination of animals that transmit rabies e.g. dogs, cats etc. with anti rabies vaccine and the post exposure vaccination with anti rabies vaccine or anti rabies vaccine and anti rabies serum of human beings. In Uganda cell culture vaccines - Human Diploid vaccine (HDCV) or Vero cell culture vaccine (Verorab) has been used. Currently the Verorab is being used in Uganda according to WHO recommendation. It is given intramuscularly on days 0 (2 doses), 7 (1 dose) and 21 (1 dose) (WHO Recommendations on Rabies Post exposure treatment and correct technique of intradermal immunisation against Rabies, 1996).

6 OBJECTIVES OF THIS STUDY.

(1) To establish the magnitude and outcome of clinical cases of rabies admitted to Mulago Hospital 1990 - 1998.

(2) To establish the post exposure management of persons bitten by animals.

7 METHODOLOGY.

This was a retrospective study, which reviewed the case notes of patients admitted with a provisional diagnosis of rabies from 1990-1998. The case files were obtained from the Hospital records department. Patients who fulfilled the clinical presentation of Rabies were included in the study:

8 RESULTS.

A total of 12 patients were admitted with a provisional diagnosis of rabies. After being reviewed by senior doctors, 4 patients did not fulfil the criteria for the study, i.e. having clinical rabies. One patient, a 60 year old male who had a history of a dog bite 8 months earlier, presented with weakness of the lower limbs and inability to talk and swallow. He was finally diagnosed as cerebral vascular accident and treated accordingly.

The 2nd patient, a 20 year old male who had a history of a dog bite (time not given) presented with one day history of being uncooperative and drowsy. On examination he was found not to have signs of rabies and was diagnosed as a dog bite and treated accordingly and discharged. The 3rd patient was 12 years old and had a history of a dog bite one month earlier but presented with a history of barking like a dog and restlessness. Examination revealed no signs of rabies and he was observed for one day, given anti rabies vaccine and discharged.

A 4th patient was 25 years old with a history of a dog bite 3 weeks earlier with a painful swelling of the left gluteal region and left thigh. No signs of rabies were found and he was given anti rabies vaccine and antibiotics for the swelling and discharged. Patients 2-4 would be described as having "imagined", not real, rabies (rabies hysteria) .

The remaining 8 patients, 6 males and 2 females, were confirmed as clinical rabies and treated accordingly. Apart from one patient who came from Luwero and another from Mukono, the patients came from Kampala District and the surrounding areas.

The patients were aged 12 to 65 years and all had a history of dog bites 2 to 10 weeks earlier. None of the dogs involved were reported to have been immunised with anti-rabies vaccine or serum, 3 of the dogs were killed after biting a person. None of the patients was given anti rabies vaccine at the time of the dog bite. Four patients were bitten on the lower limbs and 3 on the upper limbs. Other patients did not have this information. Four of the 8 patients were given anti rabies vaccine and 3 anti rabies serum at the time of presentation with symptoms suggestive of rabies.

The main presenting clinical feature are shown in Table 1.

Table 1 : Summary of the symptoms for the rabies patients.

Symptoms	Number	%
Difficulty in swallowing	7	88
Mental confusion	6	75
Fever	5	63
Barking like a dog	4	50
Vomiting	3	38
Spasms	2	25
Hydrophobia	2	25
Excessive salivation	2	25
Restlessness	2	25
Numbness of the affected limb	2	25
Headache	1	13

Difficulty in swallowing, mental confusion, fever and backing like a dog were common symptoms.

Apart from one patient who presented on the 5th day after the onset of symptoms, the rest presented within 1 to 3 days after development of symptoms.

All the patients diagnosed as clinical rabies were given supportive care i.e. IV fluids NG tube, sedation and tranquillisers as well as antipyretics and antibiotics where necessary.

All the 8 patients who were diagnosed as rabies died. The duration of stay in hospital was 1 to 7 days, but the majority died within 1 to 3 days of admission. No autopsy was done on any of the patients.

9 DISCUSSION.

As seen from this review and from previous studies human rabies is not a common admission in Mulago and other hospitals especially in urban areas. The incidence of human rabies depends on the incidence of rabies in animals in the affected areas and the immunisation coverage of the animals in those areas. In the case of Uganda rabies is mainly transmitted by dogs and to a lesser extent by cats and foxes. Although the incidence was low in Mulago Hospital i.e. about 1 patient per year in this study (1990 - 1998), there is an urgent need for improved vaccination coverage of dogs.

Rabies is a fatal disease with almost 100% mortality as was the case in this study. Hence, even one case is a very serious problem. Only four cases of clinical rabies have been reported in literature to have recovered.

The clinical presentation of the 8 patients who were diagnosed rabid is similar to those reported in other studies e.g. in one study in the USA. Also 4 out of 12 patients (33%) suspected to have rabies did not have rabies i.e. they had hysterical rabies. This has also been reported in other clinical studies e.g. in the USA in symptomatic patients on admission the diagnosis of rabies is made in less than 1/3 of the patients because the differential diagnosis of rabies in adults is varied. This could be because rabies is a feared disease hence a history of a dog or animal bite raises well founded anxiety. It is also common that early in the course of the disease a variety of diagnoses are commonly considered e.g.

viral encephalitis, polio, Guillain-Barre syndrome, respiratory tract infection, psychosis, tetanus, cerebral vascular accidents, etc …

Although it was noted that all the patients were bitten by mainly stray dogs of unknown vaccination status, none, of the patients was given post exposure vaccination with ARV, yet most of them were given tetanus toxoid which indicates that the victims visited health facilities after the bite. On the contrary most of the patients were given ARV at the time when they presented with symptoms suggesting of rabies which, was too late. This raises questions on the post exposure management by the health care providers. It could also be that the patients presented late to the health workers where anti rabies vaccine was available or if not should have been referred, otherwise these patients could have been given anti rabies vaccine in time using the recommended post exposure treatment guidelines.

In this review the mortality rate was 100% for the eight patients who had clinical rabies, which is similar to other studies. Most of the patients died within the first 3 days of admission which has also been found in other studies, confirming the fact that rabies is a rapidly progressive disease. As in other developing countries because of the socio-economic conditions, logistics and cultural practices no autopsy was done to confirm the diagnosis of rabies.

10 CONCLUSIONS.

1. Rabies is not a common problem in Mulago Hospital since 8 patients were admitted in the period 1990 - 1998 (approx. 1 patient per year).
2. The mortality rate was very high (100%)
3. There was inadequate post-exposure management of dog bites.
4. There is inadequate prevention and control measures against rabies in Uganda.
5. There is limited collaboration between the Ministry of Health and Veterinary Department in the prevention and control of rabies in Uganda.

11 RECOMMENDATIONS.

1. A countrywide surveillance and monitoring of animal and human rabies should be carried out.
2. Animal bite incidents that come to the healthcare system should be fully investigated and given post exposure rabies prophylaxis or treatment where necessary.
3. Rabies surveillance, prophylaxis and control should be incorporated in the general health care system in Uganda.
4. Medical workers should be more educated on the post-exposure prophylaxis and treatment of animal bites.
5. Public awareness of rabies and post-exposure prophylaxis and treatment should be encouraged and emphasised.
6. Preventive measures against human and animal rabies should be put in place i.e correct administration of anti rabies vaccine and anti rabies serum.
7. Closer collaboration between the Ministry of Health and the Veterinary Department in the prevention and control of rabies should be encouraged and promoted.

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RABIES IN UGANDA
A RETRO- AND PROSPECTIVE VIEW

L. Siefert[1], L. Ojok[2], N. Kadoli[3], J. Opuda-Asibo[3], S. Kahwa[4].

The professional stakeholders from key-Departments of Makerere University's Faculty of Veterinary Medicine present their experience over a period of some 25 years in the areas of rabies diagnosis, control and surveillance. The major gaps emerging over the last 25 years are identified and proposals are made to shift from a less effective reactive approach to a more rewarding pro-active preventive program embracing domestic and wild mammals and man.

1 INTRODUCTION.

Rabies is endemic in many areas of Uganda.

Circumstantial and clinical rather than tested evidence and opportunistic data collection presumably only reflect the tip of the epidemiologic iceberg predominantly in the central region of Uganda.

Verifiable data from peripheral areas, including known old foci, are rather scanty. In most instances the foci of infection remain obscure since the carnivores attacking with or without provocation have been destroyed and are unavailable for diagnosis.

2 RETROSPECTIVE VIEW.

2.1 Diagnosis.

This relied on the conventional clinical approach supported by circumstantial evidence, rarely on the efforts of individuals to forward for confirmatory histopathologic diagnosis carcasses or brains of animal and human patients suspected to have been affected by rabies. Official professional response to pet- or livestock-owners' concern about provoked or unprovoked dog bites depended on a number of factors :

- on an individual veterinarian's professional conduct,
- risks anticipated / involved / experienced,
- cost-recovery of the entire intervention,
- eventually the chances to assist a patient or concerned party effectively both with a confirmatory diagnosis and, based on that, combined passive and active immunisation; a confirmatory diagnosis was considered valid if
  - Negri bodies were demonstrated by HE in target sites. This often required to work without any or rather limited protection from the risk of infection when the patient had to be captured, euthanased, necropsied and the specimens processed after long journeys not conducive to their viability;
    - occasionally on biological transmission experiments;

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- this method was intrinsically delaying timely interventions by at least one week because of the histopathological techniques almost exclusively used by then.

2.2 Pre and postexposure immunoprophylaxis.

Treatment was unavailable or if at all available too costly to be affordable until recently, either because of the excessively high direct import costs, or indirect costs levied illegally by certain health official on subsidised or free vaccines. The considerable risks associated with the pro and metaphylactic use of older types of rabies vaccines in people.

2.3 Substantial losses.

2.3.1 Previous Research.

The last serious attempts were made in the mid-seventies to identify the reservoirs of rabies in domestic and wild hosts, especially the epidemiologic significance of jackals in the West-Nile region of Uganda, a high risk area (WAMUTI & SIEFERT, unpublished).

2.3.2 Training and capacity building.

Both a veterinary specialist and a technician were trained in Germany during the late seventies and early eighties to build the capacity for improved control and diagnosis of rabies in Uganda, including baited vaccine applications.

The economic and eventually the civil wars terminated this promising development in Uganda, including the modest achievements of rabies diagnosis and control of the seventies. Worst, it almost destroyed the professional ethics of the veterinary profession. In view of the structural losses, loss of means vital to transformation and problem resolution, loss of trained manpower, loss of productive understanding of resource utilisation it is obvious that rehabilitation will be an arduous upstream task for everybody concerned at a senior level, be it in education and training or in project implementation. What had been so easily destroyed is now so difficult to rehabilitate: more want more with less efforts. But the efforts are essential to rabies surveillance and control. The teaching, training and research profession needs to demonstrate the positive examples that rabies control is possible even in an impoverished environment implementing the benefits of protection rather than demonstrating the efficiency of destruction. However, all stakeholders need to identify realistic priorities, need to collaborate, extend the network of rabies surveillance both into the livestock and wildlife sector.

2.3.3 Lost opportunities : progress made but not yet made routinely available.

Donation in 1995 1996 of two batches of FAT reagents to MU"s FVM demonstrated the major advantages of this technique, viz. buying valuable time - at a higher cost - needed for timely post-exposure treatment especially of the most vulnerable children (Table 1).

Progress made in vaccine production, costing, use and elimination of side-effects improved compliance rates at least among the more affluent owners of least exposed pets.

3 PRIORITIES IN A THIRD WORLD UNIVERSITY OR A UNIVERSITY IN THE THIRD WORLD.

Disease patterns must be investigated to make future colleagues understand and design appropriate approaches to rabies surveillance.

Future colleagues implement tomorrow what has been decided and planned today; let them get involved today.

Modelling has become a powerful and cost-effective tool to anticipate alternative scenarios, more so where eventually only less control can be exerted in the wildlife sector. This must be backed by research economics, viz. cost-effective analytical approaches.

Table 1 : Tests carried out on brains submitted for rabies diagnosis and their results.

	subtotal	**positive**	**negative**	**%**
Bovine*	23	13****	10	57
Caprine*	1	1 ****	0	100
Canine*	21	9****	12	43
Jackal* *Canis sp.*	2	2****	0	100
Egyptian mongoose** *Herpestes ichneumon*	1	1****	0	100
Marsh mongoose* *Atilax paludinosus*	1	0	1	0
Banded mongoose*** *Mongo mungo*	4	0	4	0
Bushbuck***** *Tragelaphus scriptus*	2	2*****	0	100
Total	55	28	27	

* originating from FVM's ambulatory area, viz. 15 km-radius
** place of origin: distance approximately. 50km from Kampala
*** all originating from Queen Elizabeth NP (2/4 tested FAT negative)
**** NEGRI-bodies (LENDRUM) - FAT : same in 15 tests: BOV positive 2 / negative 9; CAN positive 3 negative 1
***** circumstantial evidence only
note, all specimens were tested between 1993-98; 2 bovine brains were tested in 1988

Diseases like rabies are significant determinants in interactive population dynamics, especially among predator - prey relationships; impact of increased man-made domestic carnivore reservoirs on wild carnivore populations requires modelling; programmes for domestic carnivore populations health surveillance need to be designed and tested, in collaboration with SPCAs in the least offensive or destructive way.

Endemic problems require endemic solutions.

- Vigilance is required with regard to genetic drift and shift in particular.
- Diagnostic labs must encourage in every respect their cost-effective use; they need to be established at universities or teaching labs need to have strong links with existing labs.
- The power of collaboration of different professions as well as of different regional universities must be explored.
- The rich ecosystems of the extended Congo rainforest need an equally rich, i.e. innovative interdisciplinary approach to the complexity of disease transmission.

Today's admirers are tomorrow's users.

4 SPECIFIC REQUIREMENTS: TASKS FOR TRAINEES.

Refinement of models, modern diagnostic approaches to lyssaviruses in decomposing carcasses.

Investigation of epidemiological role of hitherto neglected species : bats and their predators (e.g. monitor lizards), shrews, squirrels.

Identification of major foci and focused control.

Safe, cost-effective, humane, legal handling of rabid animals by support staff. paravets, care takers

DETECTION AND IDENTIFICATION OF RABIES AND RABIES-RELATED VIRUSES USING RAPID-CYCLE PCR

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ABSTRACT

The rapid identification of suspect rabies infection is essential in human cases to ensure appropriate post-exposure treatment of contacts and in animal cases to allow specific control strategies to be decided and implemented. We describe here the use of high speed Air Thermo-Cycler PCR as a diagnostic tool for the detection of rabies and rabies-related viruses. Using this technique we were able to diagnose rabies in a human within 5 hours. Furthermore, the application of automated sequencing of the resultant product enabled a definitive characterisation of classical rabies within 16 hours. The utility of this assay was confirmed further by the successful detection of representatives of the six lyssavirus genotypes.

SUMMARY OF PRESENTATION.

The UK approach to rabies control and thus our own research is the result of a number of factors peculiar to the country.

- UK has been rabies free for many years. Rabies vaccination of animals is currently prohibited, hence the animal population is naïve to rabies.
- High densities of potential host species, notably dogs and foxes, live in urban areas. Many people enjoy seeing wildlife in their garden and foxes are therefore commonly fed by householders in urban and suburban areas.
- The potential exists for the occurrence of lyssavirus genotype 5 and 6 infection in the free-living bat population.

As in other rabies free countries our status is maintained by a combination of strict quarantine and surveillance measures. Should rabies be confirmed there would be a rapid control response the details of which would depend on the circumstances of the outbreak. Of particular importance would be the genotype involved, the animal species involved and details of known, presumed or potential contacts. Our requirement is thus for a rapid test of maximum sensitivity and specificity together with genotype and epidemiological information.

A reverse transcriptase polymerase chain reaction (RT-PCR) test has been in use in the laboratory for sometime and has been found to fulfil all the above criteria. Briefly, RNA is extracted from the test sample and a lyssavirus N gene specific primer then used to produce cDNA. Initial PCR amplification produces a 606 bp fragment and a second heminested cycle then generates a 586 bp product (Heaton *et al.*, 1997). RNA is extracted under Category III microbiological containment but all subsequent work is conducted on the open bench paying strict attention to contamination control. After product sequencing, the data are incorporated into our in-house database and used for epidemiological analysis. Specific probes are used to confirm product specificity by Southern blot analysis (Heaton *et al.*, 1997). A PCR-ELISA has also been developed as a means to increase test sensitivity (Whitby *et al.*, 1997).

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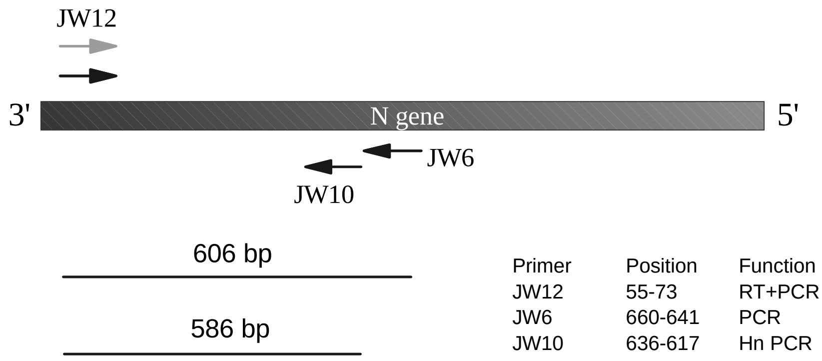
Table 1 : Heminested RT-PCR

Hn RT-PCR (Heaton *et al.*)



The standard PCR machine uses a metal block to heat and cool 50 µl samples for amplification. Both heating and cooling the block take several minutes resulting in a 4 hour first round and a 2 hour second round duration. A positive diagnosis can be confirmed by either Southern blot or sequence analysis, a final result being obtained two days after sample receipt (Table 2). We have successfully screened over 600 lyssaviruses of all types using this method.

Table 2 : Duration of diagnosis using standard PCR.

Stage	Duration	Cumulative Time
Extraction of RNA	2 hours	2 hours
RT stage	1 hour	3.5 hours
1st Round	4 hours	8 hours
Gel confirmation of product	1 hour	Day 1
2nd Round	6 hours	Day 1/2
Gel confirmation of product	1 hour	Day 2
ELISA	10 hours	Day 2
Southern Blot	Normally Overnight	Day 3
Confirmatory sequence analysis	Normally Overnight	Day 3

The rapid-cycle PCR machine consists of an air filled box heated by a halogen bulb and cooled by a fan. Glass capillary tubes containing only 10 µl heat and cool within 1-2 seconds in the machine. A 40 cycle run is therefore completed within 20 minutes. As a result we are now able to complete both PCR stages within 2 hours, obtaining a positive diagnosis within 5 hours of sample receipt. The acquisition of a rapid sequencer will enable us to obtain sequence data within 12 hours of sample receipt (Table 3).

Table 3 : Duration of diagnosis using rapid-cycle PCR.

Stage	Duration	Cumulative Time
Extraction of RNA	**2 hours**	**2 hours**
RT stage	**1 hour**	**3.5 hours**
1st Round	**30 min**	**4 hours**
Gel confirmation of product	**1 hour**	**5 hours**
2nd Round	**20 min**	**6 hours**
Gel confirmation of product	**1 hour**	**7 hours**
Confirmatory sequence analysis	**4 hours**	**12 hours**

A comparison of the standard rabies diagnostic methods is given in Table 4. In our laboratory we use the FAT and RTCIT for all samples but for ethical reasons the MIT is only used in cases where there is human involvement. We are fortunate that our government considers the disadvantages of cost and the need for stringent contamination control to be outweighed by the speed and accuracy of results obtainable using the PCR technique.

Table 4 : Rabies diagnosis techniques.

Technique	Advantages	Disadvantages
FAT	Speed (minimum 30 min) Low cost	Reduced sensitivity on degraded samples and non genotype 1 isolates
Histopathology	Low cost	Relatively slow (1 day) Variable specificity & sensitivity
Mouse inoculation test	Gold standard Simple	Slow (up to 30 days) Precluded for highly contaminated samples Ethical consideration
Rabies tissue culture infection test	Relatively cheap	Relatively slow (up to 4 days if 1st passage successful)
Polymerase chain reaction	Specific and sensitive Speed (< 1 day) May be used to generate sequence data	High cost (capital & operating) Requires stringent contamination control

Table 5 summarises the results of a study we conducted to compare the sensitivity of FAT and PCR using laboratoryly infected mice stored at either 4°C or 37°C immediately after euthanasia. All samples were positive when stored at 4°C for up to 15 days. Those stored at 37°C remained PCR positive throughout the 15 day laboratory period but were FAT negative when stored for longer than 72 hours.

Table 5 : FAT versus PCR.

FAT	PCR
Rapid Variable sensitivity	Highly sensitive and specific

VLA Study		
Samples stored at 37° C for 72 hours	FAT positive	PCR positive
Samples stored at 37° C for 360 hours	FAT negative	PCR positive
Samples stored at 4° C for 360 hours	FAT positive	PCR positive

Table 6 indicates the current direct cost of our PCR system. The capital and staff training investment is considerable but is justified in our own situation by our need for rapid results and the application of molecular methods to rabies research in general. The rapid-cycler is both faster and cheaper than standard PCR machines and permits a much greater sample throughput (Table 7)

Table 6 : Cost of PCR.

	Standard PCR	**Rapid-cycle PCR**
Equipment	£ 5-6,000 US$ 8-10,000	£ 3,000 US$ 5,000
Cost per test	£ 10 US$ 16	£ 6 US$ 10

Table 7 : Sample throughput.

Standard PCR	**Rapid-cycle PCR**
48 samples	48 samples
Maximum 3 cycles/day (12 hours)	10-20 cycles/day
144 samples daily	1000 samples daily

In summary, PCR has become a valuable tool in our laboratory being faster than both the RTCIT and MIT and more sensitive and specific than the FAT. When combined with sequence analysis the sample genotype can be rapidly confirmed and epidemiological analysis undertaken. In addition, all work following RNA extraction can be safely undertaken outside Category III containment.

Value of PCR : Faster than MIT and RTCIT
More sensitive and specific than FAT
Rapidly establishes genotype
Rapid epidemiological analysis
Test conducted outside containment facilities

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RABIES IN WILDLIFE IMPLICATIONS FOR CONSERVATION AND PUBLIC HEALTH IN UGANDA.

G. Kalema[1]

Rabies is a common disease in domestic dogs in Uganda and other parts of the world (Bleakley, 1983; Karuiki, 1988; Sayer and Rottcher, 1993). Controlling and eradicating rabies continues to provide a constant challenge for veterinarians and public health professionals. Part of the reason for not succeeding in eradicating rabies is the lack of population control in dogs. Stray dog populations are very difficult to reduce because of the lack of education among the general public to neuter and vaccinate their pets. This has implications for conservation when dogs and owners live close to boundaries of protected areas like national parks and wildlife reserves. The epidemiology of rabies in the eastern and southern regions of Africa is primarily associated with domestic dogs (family or neighbourhood dogs) with a secondary cycle in wildlife, especially jackal and mongoose, and in certain foci within a country, this situation may be reversed (Bleakley, 1983; Karuiki, 1988; Sayer and Rottcher, 1993). Their infected dogs either stray on to the protected area or infected carnivores like jackals, lions, hyenas, leopards and cheetahs can stray on to farmland and come into close contact with these dogs.

Rabies is transmitted mainly through infected saliva and a bite from an infected host is enough to transmit the disease, which can either be self limiting by quickly killing off the host or spread if the host was able to bite another animal before death. Humans tend to be dead end hosts, and bites from dogs and jackals have resulted in fatal disease and death (Karuiki, 1988). Most animals tend to die very quickly when infected with rabies. It is speculated that lions can get rabies from hyenas by feeding on the same carcass through contact with infected saliva. Although rabies is usually diagnosed in single cases in both domestic and wild species, group or pack outbreaks have been reported (Sayer and Rottcher, 1993). In one instance in wild dog in Kenya, 18 members of a pack of 20 died or were lost within 2 months and rabies was confirmed in three out of the four retrieved carcasses (Sayer and Rottcher, 1993). It is thought that Jackals may be able to maintain a reservoir in the parks (Sayer and Rottcher, 1993). In a 20 year review of 1858 rabies cases in Kenya up to 1988, 1170 were dogs and 564 were other domestic animals, especially cattle. Other domestic animals included sheep, goats, cats, pigs and donkeys. Wildlife rabies was confirmed in 52 jackals, 25 mongooses, 18 honey badgers, 16 bat-eared foxes, 3 civet cats and 3 hyenas (Karuiki, 1988). Rabies has been confirmed in many other species in Africa including lion and camels (Sayer and Rottcher, 1993). In Europe after trying to eliminate the wild vector, the red fox, to control rabies in rarer species, without much success, it was decided to give oral vaccination in bait. This seemed to have achieved much more control of rabies, as long as a certain percentage of foxes was vaccinated (Macdonald, 1993). Therefore oral vaccination can be used as a tool not merely for control, but also for protection of rare species (Ginsberg and MacDonald, 1990). The same method could be applied to endangered wild species like the African wild dog which is down to less than 5000 individuals (Fanshawe *et al.*, 1991), to protect them from rabies after a suitable oral vaccine has been found. Other very rare species like the Ethiopian wolf and Blandford's fox in south-west Asia have had confirmed cases of rabies (Macdonald, 1993) and could benefit from vaccination.

Systemic vaccination of domestic dogs with rabies and canine distemper vaccine has advantages of reducing the infected hosts, but also results in an increase in the dog population which is not necessarily desirable especially around boundaries of protected areas. Diseases like rabies and canine distemper can keep the dog population to a more acceptable level by killing off their hosts at an early age and sometimes even before reproduction age. Therefore for the purposes of conservation the method

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of oral vaccination of wild vectors and susceptible hosts appears to be the most promising both for prophylactic and strategic vaccination in the face of a disease outbreak. Canine distemper has been diagnosed in lions in Serengeti and resulted in the death of approximately one third of the lion population (Roelke-Parker, 1996). A vaccine was developed to counteract this outbreak consisting of both rabies and canine distemper virus antigen or antibody and is now being used to vaccinate dogs at the boundaries of Serengeti National Park. This vaccine has already started being used in dogs living around some protected areas in Uganda and in other rural dogs by the Uganda Society for Protection and Care of Animals (USPCA). Wild dogs were vaccinated against rabies because of a population decline from Rabies related deaths by 1992 in Serengeti (Gascoyne *et al.*, 1993a) and an Aitong pack in Meru in 1989 (Alexander *et al.*, 1992). In Serengeti the stress due to handling by biologists could have had an effect of death in the wild dogs (Burrows, 1992). Oral vaccination has the advantage of avoiding stress due to handling of animals, is more easily administered and seems to work just as well as injectables (Bleakley, 1983; Macdonald, 1993). According to Bleakley (1988), in a vaccination trial of jackals in Zimbabwe, 6 jackals were tested where jackal 1 got a placebo bait as a control, jackal 2 got an intramuscular injection, jackals 3 and 4 got oral instillation, jackals 5 and 6 got sponge bait, it was found that the oral instillation and injectable were the most effective against an experimental challenge of rabies a month later. They survived with this challenge and rechallenge six months later and produced good antibody titres before this initial challenge. However one jackal that was injected died of rabies 5 month later, this long incubation period in a carnivore could be epidemiologically important.

Rabies has also been diagnosed in wild caught primates from South East Asia and South America, and specifically a few monkey in Uganda (C. Rutebarika, personal communication). Zoo animals are at less risk than free-living individuals but vaccination is sometimes warranted in captive situations, where there is danger of exposure to the vector for example vampire bats (*Desmodus rotundus*) in Latin American countries (Fowler, 1986). There have been at least 16 confirmed cases of rabies in the United States in non-human primates which include rhesus and crab eating macaques, capuchins, squirrel monkeys, marmosets and a chimpanzee since 1929, and in two of these cases the disease was probably the result of vaccination with the live attenuated vaccine (Ott-Joslin, 1993). The incubation in primates is probably similar to that in humans, however an experimentally inoculated monkey and one that was bitten by a rabid dog exhibited clinical signs after 100 days and 6 months respectively. The long incubation period has serious public health implications especially with people who regularly handle primates in their work. In Uganda Wildlife Authority (UWA), Uganda Wildlife Education Centre (UWEC) and among the general public people come into close contact with primates when handling problem monkeys, baboons, chimpanzees that have raided crops and those that have been orphaned and confiscated. The Uganda Government Wildlife Statute of 1996, has delegated control of vermin species to the districts, which means that vervet monkeys and baboons which are soon to be classified by UWA as vermin will be handled by the general public, who will need to be educated to minimise the risk of getting such a disease like Rabies from these primates in problem animal control. A bite from a primate can be fatal in humans handling them. This is all the more important for valuable endangered problem animals like the great apes which are of major conservation and tourism importance in Uganda. Mountain gorilla numbers are down to 650 in the world with Uganda having about 320 and are therefore very endangered. Chimpanzees whose numbers are down to less than 3000 in Uganda are also threatened with extinction.

Therefore wild caught monkeys should always be considered as animals at risk and should be kept under close observation for 6 to 12 months after arrival (Ott-Joslin, 1993). Any animal inflicting a bite should be closely monitored for neurological signs. Rabies in non-human primates is usually of the paralytic form, but the animal can become aggressive and bite if provoked, self mutilation has occurred in monkeys diagnosed with Rabies (Ott-Joslin, 1993). All these symptoms can be seen in other diseases and Rabies can easily be overlooked as a differential diagnosis. Spread of rabies to humans can be controlled by routinely vaccinating all humans handling wild-caught primates from endemic areas. Non-human primates should never be vaccinated with modified live vaccines. However they can be vaccinated with killed vaccines which have been shown to produce high antibody titters and protect against death from street virus in rhesus macaques (Ott-Joslin, 1993). Thus animals and people in high risk situations should be vaccinated using killed vaccine. People should also avoid being bitten and having contact with saliva of non-human primates. Protective clothing including gloves and masks should be worn when handling primate tissues, and newly wild-caught primates, to also protect against other zoonotic diseases.

According to Kodikara and Wimalarate (1998), Sri Lanka recently recorded its first case of Rabies in an Asian elephant. An eighty four year old female elephant was presented with a clinical history of tiredness and lethargy with an appetite and no aversion to water. The following day the elephant was found to be unsteady and three days later she became aggressive and restless, and there were secretions from the temporal glands. On the sixth day she was completely off food, had developed paralysis of the trunk and was unable to stand in spite of repeated attempts. At this time she was found to be blind, and the condition deteriorated rapidly until she died on the ninth day. At post-mortem examination the brain appeared congested and vascular and a brain smear examined by direct microscopy was negative for Negri bodies but positive for rabies antigens by the direct fluorescent antibody test performed at the Medical Research Institute, Colombo. A serum sample further confirmed the diagnosis. In this particular case there was no history of an animal bite, however bats were found in the environment where the animal lived. Therefore it is possible that the elephant was infected through a bite of a rabid dog or an infected bat. Vampire bats in Latin American countries are also known to carry Rabies (Fowler, 1986). Following this particular case, if an elephant in Uganda is presented with neurological signs, rabies will be included as part of the differential diagnosis.

To date there has been no documentation of rabies in protected areas in Uganda although it has been seen in urban wildlife (C. Rutebarika and L. Siefert, personal communication). However it is almost inevitable that rabies has occurred in protected areas like Queen Elizabeth National Park where cats and dogs were allowed to be kept in the park and local farmers and owners are right at the border sometimes crossing the park boundaries, while wild animals also cross on to their land. With the establishment of formal veterinary work in Uganda Wildlife Authority in 1996, rangers are being trained to monitor, record and report ill health in wild animals to the veterinary unit. This should help to detect trends and diagnose quickly through clinical signs the symptoms of Rabies disease in various animal species. The rangers, wardens and researchers are also going to be educated about the public heath implications including how to avoid getting rabies from animals and what to do if bitten by an animal. Veterinarians are vaccinated for Rabies, and so will be all support staff handling animals on a regular basis. In conclusion, Rabies is an important disease of conservation and public health significance in Uganda. Rapid diagnosis, strategic vaccinations, destruction of rabid animals where appropriate, protective clothing, prompt treatment and last but not least, education could go a long way in controlling this fatal disease.

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DISCUSSION

1 AFTER PAPERS.

O. Hübschle to J. Barrat : You said the negative control is mouse brains, certain animals react differently e.g. cat may show non specific fluorescence, can't you get a mix-up?

It is important to have negative controls and most labs that use negative controls use mouse brains because it is easier to use. Distinguishing non specific fluorescence on negative controls and negative specimens is really a question of training. It is also difficult to make negative controls for every species.

S. Ndaomba to E.S. Bizimenyara : I would like to know the site where the calf was bitten since the incubation period was very short.

I did thorough checking and I found a small scar on the muzzle. However, the dam is still alive.

Undo (Uganda) comment on E. Mworozi presentation : He said that it is a desease of adults, in 1998 we had 65 dog bites. Most cases were of children under 10 years . All cases were under 20 years.

Among people with clinical rabies, adults tend to be bitten by stray dogs and children tend to be bitten by domestic dogs.

O. Hübschle to J. Bowen Davies : How many rotten samples did you tested with PCR?

I can't tell you that because I did not do the test. I wasn't there at that time.

S. Cleaveland : (comment) In Tanzania, it is difficult for some of the people to interpret pictures and correctly identify the animals from the pictures.

O. Hubschle : The 50% hit note for clinical diagnosis of rabies is only for cattle. It is higher in dogs, almost 100%. Regarding the distemper/rabies vaccine, dogs still continue to die after vaccination campaigns, more investigations are needed.

S. Ndaomba : Dr King's presentation shows clearly that vets and human medics do not communicate. What recommendations can this group make? In Malawi, efforts have been made, but as yet to no avail.

A. King : The SEARG proceedings are rarely circulated to all the role-players in the countries. This should be improved. Also more money is needed to invite medical personnel to SEARG meetings.

F.X. Meslin : It would be wise to get more medics, but it is difficult to identify the correct people. Often there is not much interest by the medics. When there is more realisation of the cost to Departments of Health, they may take more interest.

M. Kaare : Can rural people afford the rabies /distemper vaccine?

A. Kloeck : Intervet is not charging for the distemper component. The vaccine price is about 0.40 US$ per dose.

G. Kalema : Vaccination has lowered death rates. Why does not the (programme) increase?

S. Cleaveland : There may be lower demand for dogs. There is some internal mechanisms for lower pup populations. Next meeting, I should be able to say.

P. Kitala : Will this project continue after the project ends?

S. Cleaveland : All role players will be brought together to discuss the management of rabies as a routine in the park.

S. Cleaveland comment to A.Kloeck's lecture : the vaccination strategy used in Tanzania was a central point vaccination in the different villages, campaigns were done every 10 months and this gave a vaccination coverage of nearly 70% of the dog population. Vaccinating dogs seems to stabilise the dog population.

O. Hubschle : great interest of combined vaccination (rabies - distemper)

S. Ndaomba : in Malawi, the problem is the absence of communication between the veterinarian and the medical worlds. He could not come with a medical doctor.

A. King : there is also a problem of diffusion of information. For instance, the proceedings are of-ten found unopened on a desk, while every country representative of WHO received 10 copies of it. Collection of data is sometimes inexistant, in some countries, medics say "yes rabies "exists" and that is all;

FX Meslin : problem is that rabies is not a priority compared to other veterinary problems

M. Kaare : how can the Intervet vaccine be imported by rural communities?

A. Kloeck : Intervet does not charge for distemper. The cost of the vaccine is nearly 40 US cent per dose.

Session 4 :

Human and animal rabies surveillance and control

URBAN RABIES CONTROL INITIATIVE IN KAMWOKYA II PARISH, KAMPALA CITY, UGANDA.

J. Kinengyere[1] and R. Winyi Kaboyo[2]

ABSTRACT.

A programme for controlling rabies was carried out over a period of three months in Kamwokya II parish of Central Division. It comprised of community sensitisation and education, pet registration and free rabies vaccination.

1 INTRODUCTION.

Rabies control is one of the public health challenges in Kampala city, where human and dog population is estimated to be 1 million people and 6000 dogs respectively.

On average 35 people with dog bite wounds report to the district veterinary office per year. (Annual Rep D.V.0. Kampala 1996-1998) This figure could be higher since some victims report directly to health centres and others do not report at all.

Some of the biting dogs are killed by residents and others run away. The true incidence of rabies in the city has not been determined since rabies confirmatory tests are not always done. A number of the city suburbs e.g. Nabweru are sparsely populated and harbour wild animals such as foxes. These sometimes approach homesteads looking for food and may attack dogs and other domestic animals.

Rabies has also been reported in cattle and goats in the peri-urban areas within a radius of 10 kilometres from the city centre; in 1997, one goat was reported in Nakawa division; in 1998, two bovines in Busega, one in Nabweru and two in Kiteezi. The latter were confirmed positive for rabies on laboratory examination at the Faculty of Veterinary Medicine, Makerere University.

The following measures are normally taken to control the disease in the city :

- Central point vaccination of dogs and cats and home vaccinations at individual's request.
- Biannual elimination of stray dogs and cats.
- Public sensitisation through radio programmes. Residents are urged to confine or control the movement of their dogs.

2 OBJECTIVES.

An intensive rabies control programme was conducted in Kamwokya II parish of Central Division from October to December 1998 with the following overall objective : to reduce the incidence of rabies and dog bites in the area. The specific objectives were to :

- Improve rabies vaccination coverage for dogs and cats.
- Determine vaccination coverage of dogs and cats.
- Increase community awareness and education on rabies.

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3 TARGET AREA.

Kampala City which is administratively equated to a district, is divided into five divisions namely Nakawa, Makindye, Rubaga, Kawempe and Central in which Kamwokya II parish is located. The divisions are divided into parishes which are again subdivided into zones.

Kamwokya II parish has the highest human population density in the district of 21000 persons per km^2 (Population Census 1991). It is a slum area of low socio-economic status where the majority of residents are educated up to primary school level and earn an average of US $ 355 per annum. ((U Sh 480000).

Kamwokya II parish was deliberately chosen for the urban rabies control initiative because of the following reasons:

1) The high number of people bitten by dogs within the parish who reported to the DVO Kampala.
2) The low rabies vaccination returns over the years which were less than 1 % of total vaccinations carried out in the city by the Kampala district veterinary office.

Table 1 : dog bites in Kampala city 1996-1999.

Year	No.of dog bites reported Kampala City.	No. of dog bites Kamwokya II	% dog bites in Kamwokya II
1996	36	18	50.0
1997	38	13	34.2
1998	30	10	33.3
1999 (Jan-Mar)	22	4	18.2
TOTAL	**126**	**45**	

In contrast, the high income, low population density areas of the city were considered to be at lower risk for rabies transmission. In these areas dogs were more likely to be confined within fenced compounds and their owners to have them regularly vaccinated.

4 METHODS.

This initiative was carried out under four broad activities:

4.1 Sensitisation phase 1.

A sensitisation programme was carried out for the community and run as follows:

4.1.1 Sensitisation seminar.

A meeting of veterinary and medical staff, law enforcement personnel, local leaders and head teachers of some schools in the parish was convened and the participants were educated about care of pets, dangers of rabies and its control. Two documentary films on rabies were shown to enable participants to know more about rabies and pass on the right messages to their communities.

This seminar was also aired on national media to increase awareness country wide.

Community participation was one of the issues emphasised since, in the past, control programmes were not very successful due to limited participation by the communities.

Leaders were requested to choose contact persons, venues and dates for sensitisation talks and pet vaccination.

4.1.2 Visits to schools and local council meetings.

The veterinary staff visited 6 schools, both Nursery and Primary. Children were targeted because most dog bite cases are reported in the age group 5-15 years . Children are also good at carrying information to their parents and it was deemed a good method of sensitising both adults and children.

Messages about care of pets i.e. feeding, housing, health care and vaccination at appropriate times were given. They were also told what to do when bitten by a dog i. e.

- Wash the wound with plenty of water and soap and apply antiseptic.
- Try to identify the dog and inquire from the owner about its vaccination status.
- Visit a health centre immediately. The centres which can handle suspected rabies cases were enumerated as Nsainbya, Rubaga and Mulago hospitals, Kampala City Council clinic, African Air Rescue (AAR) clinic and the British Council clinic.
- Report the case to the veterinary office and local leaders so that they can follow it up.
- Residents were requested to kill the stray dog and call on the veterinary personnel to take a specimen for confirmatory tests.

Posters and photographs were used in these sessions and some were left at the schools for continued education of pupils.

Local council meetings were convened in four zones for all residents. The veterinary personnel gave basically the same information as in the schools.

Residents were strongly discouraged from seeking treatment from a herbalist purporting to treat rabies.

4.2 Pet registration.

Dogs and cats were enumerated and registered in order to ascertain their numbers and to determine the vaccination coverage after the vaccination exercise.

With the help of local leaders from each zone, a home to home registration exercise was carried out. A registration card indicating the name of dog/cat owner, village, zone and pet description such as colour, sex, age, breed and change of ownership was issued for each pet. This card also acts as a vaccination record since it indicates all the vaccination dates. Owners were requested to bring these cards on the day of vaccination.

A total of 82 dogs and 8 cats were registered.

4.3 Sensitisation phase II.

Two rabies films were shown to residents in Kamwokya II parish on 19^{th} and 20^{th} December 1998. These films had been translated into Luganda, the local language so that most people could easily follow. The four venues for the shows were selected by the residents themselves and publicity was by radio announcements on four major F.M. stations. In addition a van with loudspeakers was driven through the area to inform the people. It was emphasised that these film shows would be free to encourage people to turn up in large numbers.

Vaccination dates and venues were announced on radio, by the film van and printed posters were put in strategic points in all zones.

4.4 Rabies vaccination.

Free rabies vaccination was carried out on 22nd and 23rd Dec. 1998 to coincide with school holidays since children are known to be very keen in taking pets for vaccination.

An inactivated rabies vaccine Rabdomun (Pitman-Moore GmbH) was used, 1 ml was given by the subcutaneous route.

Vaccination results are presented in the Table 2.

Table 2 : Result of identification and vaccination campaigns in Kamwokya II parish.

	Dogs	Cats
Registered	82	8
Registered and vaccinated	35	5
Vaccinated and not previously registered	27	6
Registered but not vaccinated	19	1
Vaccination coverage (%)	75.6	137.5

Interpretation of results:

a) 75.6 % of registered dogs were vaccinated. The unvaccinated but registered pets can be explained as follows:

13 were below 3 months of age which is the recommended age at first vaccination.

8 had been vaccinated less than one year before so were not due for revaccination yet.

b) The number which was vaccinated but not previously registered can be explained : 27 dogs and 6 cats were not registered during the registration exercise but were still presented for vaccination; due to the good publicity given to the exercise, even pets from beyond the target area such as Kamwokya II, Bukoto and Mulago were brought for vaccination.

5 IMPACT OF THE EXERCISE.

The major impact of the exercise lies not only in the numbers vaccinated but in the increased awareness of the public about dangers of rabies. Public sensitisation did a lot to enlighten the general public in and outside the target area.

1) From the questions asked during this time it can be concluded that the majority of the residents had been ignorant about the dangers of rabies and its control.

2) This exercise in Kampala led to increased awareness in other parts of the country. After the radio programme, the Veterinary office got inquiries from other districts inquiring about anti - rabies treatment. Four cases were received from Nakasongola, two from Ibanda subdistrict, three from Mpigi and two from Masindi district, one of whom was later reported to have died. Some people realised they had been bitten by possibly rabid dogs but had only received wound treatment and no rabies post exposure treatment.

6 DISCUSSION.

Vaccination programmes in Kampala are usually publicised by radio announcements followed by vaccination at designated points. This always leads to low numbers of vaccinates, unknown vaccination coverage and increasing dog bite victims.

Despite the above efforts, there are still large numbers of uncared for dogs, some of which are stray and others domesticated

The Initiative therefore used a different method i.e. community sensitisation, registration, mobilisation, vaccination at fixed points later followed by a home to home mop-up method.

1) During the sensitisation phase it was realised that most people lacked essential knowledge about rabies and its control. This was deduced from the kind of questions asked during the seminars.

   a) Sensitisation of the public about rabies should be encouraged all over the country and also in other countries since it is an important aspect in controlling rabies in both domestic and wild animals. This will greatly reduce the occurrence of the disease.

   b) The rabies film greatly assisted in enlightening residents about rabies. It was shown from 7.30 p.m. when most people have finished their work. It was short (about 45 minutes) and it was translated into Luganda, the local language so that everyone could follow it very well. The film shows were at four different venues in the parish.

c) Showing these films just before the day of vaccination was meant to increase awareness of the community about the dangers of rabies so as to encourage pet owners to present their pets for vaccination in large numbers.

d) Home visits in the sensitisation process are beneficial and should be carried out as part of the routine activities of veterinary personnel.

e) A few people, despite the vigorous sensitisation, were still reluctant or not bothered to vaccinate their pets.

2) Registration prior to vaccination should be adopted because it helps to determine the vaccination coverage and provides a basis for future planning and improvement.

a) The registration exercise was at first viewed with suspicion as pet owners thought the figures were for taxation purposes by city authorities. It was accepted by most people later after explaining that this was not so and that it would be a useful record in future for the owners and the community. In case of a dog bite, the vaccination status of the offending dog could easily be ascertained from the owner's registration card.

b) A few dog owners thought the registration card actually meant that the dog had been vaccinated and did not turn up on the day of vaccination until the zone leaders called them from their homes.

Registration helped to establish that the dogs owned by people in Kamwokya II are not as many as had been assumed. It was found that most of the dogs which bite people in this area come from surrounding areas and come to scavenge for food due to the poor garbage disposal in the parish.

3) Community participation should be encouraged at all stages since people will value more and adopt better those measures which involve them in decision making.

4) Existing laws governing keeping of pets in the city should be enforced by the Kampala city authorities.

5) Interdisciplinary co-operation between medical and veterinary personnel should be encouraged to help combat this deadly disease.

6) A method of reducing the number of stray dogs and cats being used by The Uganda Society for the Protection and Care of Animals (USPCA) is sterilising of stray dogs and cats.

ACKNOWLEDGEMENT.

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7 RECOMMENDED FURTHER READING.

The proceedings of the different meetings of SEARG.

MENCZER K. – 1999 - Newsletter of the Uganda Society for the Protection and care of Animals (USPCA) Vol 1 No. 1

PERRY B.D. *et al.* – 1995 - Increasing rabies vaccination coverage in urban dog population of high human population density suburbs: a case study in Nairobi, Kenya.

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EARLY EXCRETION OF RABIES VIRUS IN SALIVA OF FOXES AND DOGS.

J. Barrat[1], M. Aubert[1] and J. Blancou[2]

1 INTRODUCTION.

The classical vehicle of rabies virus during the transmission of the disease is saliva. Several techniques give estimations of the shedding of rabies virus in saliva.

When examining dead animals data are fixed on the moment of death, the examination of salivary glands shows then the presence of the virus or of its antigens in the gland tissue without information of what is in saliva itself, the examination of saliva may also be difficult because of a small amount of saliva or heavy bacterial contamination.

Sampling saliva on alive animals on the moment of euthanasia gives the same kind of data as the ones collected on dead animals, but it is then possible to collect better specimens of saliva and larger volumes.

The regular examination of experimentally inoculated or suspect restrained animals gives more interesting information on the kinetics of excretion but needs an assessed sampling system.

2 PRESENCE OF VIRUS IN SALIVARY GLANDS OF RABID ANIMALS.

2.1 Presence of virus in salivary glands of naturally infected animals.

In canine rabies area, Vaughn et al. (1965) isolated rabies virus in 28 out of 45 dogs (62%) with a mean titre of $10^{4.5}$ mouse intracerebral lethal dose for 50% animals ($MICLD_{50}$) per 0.03g of tissue.

In arctic and sylvatic rabies area, the results of salivary glands examinations are shown in Table 1.

Table 1 : isolation of rabies virus in salivary glands of naturally infected animals in arctic and sylvatic rabies area.

species	positive / examined	mean titre*	ref
red fox	22/101	n.d.	Selimov *et al.*,1980
arctic fox	23/198	4.5	Vaughn *et al.*,1965

* in log($MICLD_{50}$ / 0.03g tissue)

In red fox sylvatic rabies area, red foxes, badgers, roe deers and stone martens were controlled for the presence of rabies virus in salivary glands (Table 2). These species correspond to the most frequent wildlife victims of sylvatic rabies and all of them except stone martens showed a high percentage of presence of rabies virus in salivary glands in these natural conditions. The comparison of the titres and percentages obtained in Switzerland (Wandeler *et al.*, 1974) and in France 10 years later (Barrat, unpublished data) showed no difference neither in these wild species nor in domestic dogs. This absence or non detected evolution of the virus was experimentally confirmed on foxes (Aubert *et al.*; 1991) : two isolates of fox virus obtained on naturally rabid red foxes in 1976 and in 1986 in France induced rabies within the same mean delay between inoculation and death but the older strain did it with a larger dispersion of delays. Monoclonal antibodies showed a difference in epitopes of the site 2 of the nucleocapsid of the two strains.

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Table 2 : isolation of rabies virus in salivary glands of naturally infected animals in sylvatic rabies area in Europe.

species	positive / examined	mean titre*	ref
red fox	18/21 (87.5%)	n.d.	Matouch,1978
dog	759/816 (93%)	3.4	Wandeler *et al.*,1974
	17/20 (85%)	2.14	original data,1985
roe deer	7/9 (78%)	1.4	original data,1985
badger	68/82 (83%)	3.5	Wandeler *et al.*,1974
	23/24 (96%)	3.4	original data,1985
stone marten	18/36 (50%)	1.5	Wandeler *et al.*,1974
	15/25 (60%)	1.29	original data,1985

* in log($MICLD_{50}$ / 0.03g tissue)

2.2 Presence of virus in salivary glands in experimental infections.

The inoculation of high doses of a red fox strain to red foxes does not show any correlation between the inoculated dose and the infection of salivary glands as shown in Table 3 (Blancou *et al.* 1979).

Table 3 : isolation of rabies virus in saliva and salivary glands after experimental infection of red foxes with a fox strain.

Inoculated dose of virus	virus in saliva	virus in salivary glands
$10^{5.15}$ MIC LD_{50}	3/5	5/5
$10^{3.45}$ MIC LD_{50}	3/5	5/5
$10^{3.17}$ MIC LD_{50}	3/5	5/5
10^{3} MIC LD_{50}	3/6	5/6
$10^{2.85}$ MIC LD_{50}	2/5	5/5
$10^{2.72}$ MIC LD_{50}	4/5	5/5
$10^{2.15}$ MIC LD_{50}	3/6	5/6

2.3 Presence of virus in salivary glands of dogs under experimental infections.

The same experiment conducted in dogs with a street strain isolated in a dog Morocco in 1985 gave similar results (Blancou *et al.*, 1990) :

Table 4 : isolation of rabies virus in salivary glands after experimental infection of dogs with a dog strain.

Dose of virus	virus in salivary glands	titre of virus in salivary glands (MIC LD_{50})
$10^{4.8}$ MIC LD_{50}	2/3	$10^{0.7}$, $10^{0.6}$
$10^{2.8}$ MIC LD_{50}	2/3	$10^{2.5}$, 10^{2}
$10^{0.8}$ MIC LD_{50}	3/3	10^{4}, $10^{2.7}$, $10^{0.4}$
$10^{-1.2}$ MIC LD_{50}	1/1	$10^{3.1}$

2.4 Conclusion.

The presence of virus in salivary glands depends on several parameters such as the host species, the strain of virus, the length of incubation and the inoculated dose. This presence of virus determines the co-adaptation in the host-virus system.

But the sole examination of salivary glands does not bring any information on the kinetics of the excretion : when did it begin?, is it constant?.

3 DETECTION OF RABIES VIRUS IN SALIVA OF FOXES UNDER EXPERIMENTAL CONDITIONS.

3.1 Material and method.

3.1.1 Animals.

3.1.1.1 Red foxes.

Wild red foxes were captured in May-June (i.e. at 2 to 4 month of age) in rabies free areas in France. The animals were first put in quarantine till autumn and then experimented.

At the beginning of any experiment, the absence of rabies neutralising antibody is controlled on every fox involved in the experiment.

3.1.1.2 Mice.

Four to six week old females OF1 specific pathogen free mice were purchased from IFFA Credo (69210 L'Arbresle, France) for back titration of the challenge virus.

The presence of virus in saliva was assessed by intra-cranial inoculation to 2 days old suckling OF1 mice.

3.1.2 Virus strains.

3.1.2.1 GS3-1 fox strain.

GS3 batch is an homogenate of sub-maxillary salivary glands of naturally infected red foxes submitted for rabies diagnosis in 1976. The salivary glands have been homogenised at a 1:5 (w/v) dilution. The supernatant is then aliquoted in 0.75 ml glass ampoules that are immersed in liquid nitrogen. Two days later, one ampoule is thawed and titrated intracerebrally in mice.

This batch has been passaged on one single fox whose sub-maxillary salivary glands have been used to prepare the GS3-1 batch according to the same procedure.

3.1.2.2 GS7-1 fox strain.

Sub-maxillary glands of naturally infected foxes in 1986 have been used to prepare the GS7 batch. This batch was passaged on one single fox to prepare the GS7-1 batch.

GS7-1 was passaged in another fox to prepare GS7-1-1 batch.

3.1.2.3 Ma85 dog strain.

This batch has been prepared identically from sub-maxillary salivary glands of naturally infected dogs in Morocco in 1985.

3.1.3 Sampling tools.

Saliva specimens were collected using a "salivette" kit (Sarstedt, Molsheim, ref 51.1534).

Blood specimens are collected at the jugular vein on vigil foxes manually restrained. Once the clot is formed, tubes are centrifuged and the serum is kept frozen at –30°C till the analysis.

3.1.4 Diagnosis tests.

When animals died, submaxillary salivary glands and brain were examined by FAT (Dean and Abelsett *in* Laboratory techniques in rabies, 1973) and cell culture test (Barrat *et al.*, 1988).

Neuroblastoma cells and suckling mice were used to detect rabies virus in saliva.

3.2 Results.

3.2.1 Assessment of the saliva collection system.

The ideal saliva sampling system must :

- be sterile to avoid contamination of the sample for inoculation tests
- allow a precise determination of the weight of saliva that has been collected to be able to determine the titre of the saliva
- protect rabies virus from inactivating factors like heat, light, dryness
- allow a recovery of diluted saliva as complete as possible.

A saliva sampling system (salivette, ref 51-1534, Sarstedt) which is classically used for man was adapted to fox for this purpose.

In order to estimate the decrease in the virus titre of the saliva due to the sampling system, the following preliminary experiment was conducted.

Saliva has been collected in healthy foxes that received a subcutaneous injection of pilocarpin (2 mg per animal).

A serial dilution of a virus suspension was prepared in cell culture medium (DMEM) for a classical LD_{50} determination in mice. Fifty µl of each dilution were then mixed with the same volume of pure saliva and 50µl of these spiked saliva dilutions were distributed on the cotton swab of a salivette. One minute later (i.e. the average time between collection of saliva on the fox and dilution of this saliva with DMEM in the experimental station) 200µl of DMEM were added (1:5 final dilution).

The salivettes were then centrifuged (3000 g at +4°C) to recover the spiked saliva. A new IC titration was then performed in mice with the recovered spiked saliva.

Four assays were performed. Results are given in Table 5.

Table 5 : Titre reduction observed with the Salivette system.

Test	1	VS31	VS32	VS33	VS34
Initial mouse titre in log($MICLD_{50}$ / ml)	5.89	6.05	6.05	6.05	6.05
Final suckling mice titre log($MICLD_{50}$ / ml)	5.48	5.04	5.41	4.76	5.5
Decrease in titre in log	0.41	1.01	0.64	1.29	0.55

The observed decrease in titre ranged between 0.41 and 1.29, the average decrease is 0.78 log (i.e. the titre is divided by 2.5 to 19.5 with a mean of 6).

3.2.2 Excretion of rabies virus in foxes.

3.2.2.1 Experiment one.

The experiment (Blancou *et al.*, 1990) involved 40 foxes in two groups. In each group, 10 pairs of animals were experimented, each pair was composed of an inoculated animal and a contact one. These 7 to 11 month old foxes were paired 3 to 6 weeks before the beginning of the experiment to avoid any "behavioural" fight. In every cage, one fox received 1 fox IM LD_{100} (i.e. nearly $10^{1.5}$ mouse IC LD_{50}) in the temporal muscle and the contact animal 1 ml of placebo (cell culture medium used to dilute the virus).

The back titration on mice of the virus suspension showed that animals of the first group received $10^{1.9}$ mouse IC LD_{50} of GS3-1 strain and $10^{1.5}$ mouse IC LD_{50} of GS7-1. The second group of foxes was inoculated with $10^{1.9}$ mouse IC LD_{50} of GS3-1 strain and $10^{1.8}$ mouse IC LD_{50} of GS7-1. These titres are not different from the expected theoretical dose of $10^{1.5}$ mouse IC LD_{50}.

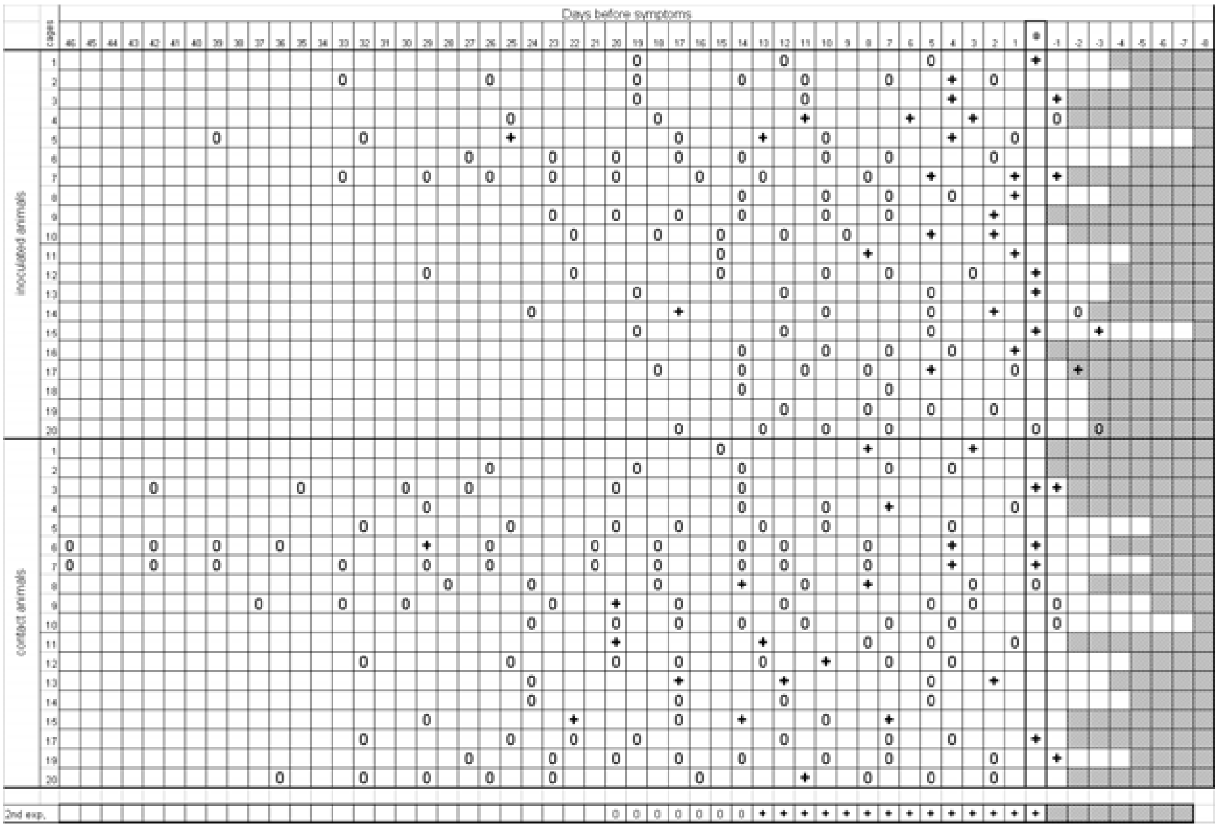
Saliva specimens were collected weekly during the first step of the experiment and twice a week during the second step.

No significant difference between strains GS7-1 and GS3-1 was noted regarding the excretion pattern in saliva and the titre in salivary glands (Aubert M. *et al.*, 1991), that is why data are grouped.

In both inoculated and contact groups, thirty one foxes excreted the virus in saliva. The earliest detection occurred 14 days after inoculation in 2 inoculated animals and in one contact fox. Once excretion had begun, it was continuous for 17 foxes and intermittent for the 14 others.

The comparison with clinical data showed that excretion began 0 to 29 days before the clinical phase, i.e. 1 to 33 days before death (Figure 1).

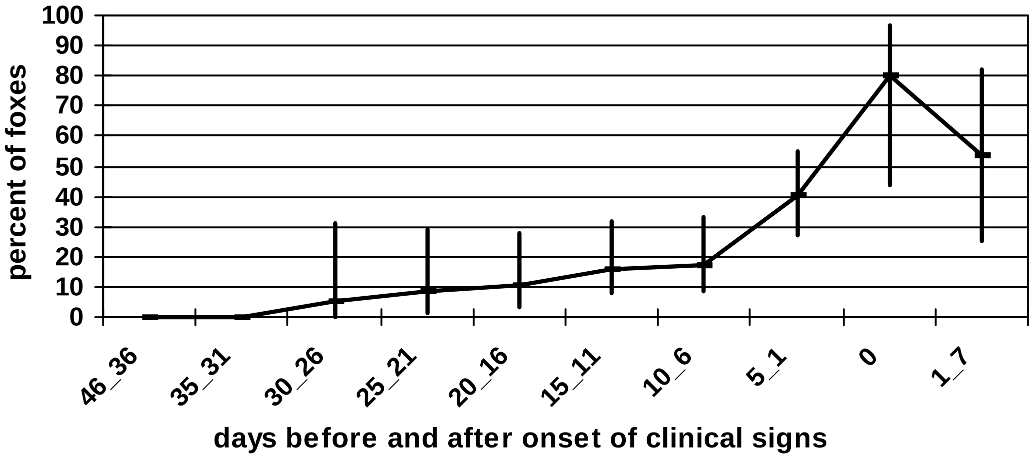
Figure 1 : Excretion pattern observed in 40 experimental foxes.



0 = absence of isolation of rabies virus in saliva
+ = isolation of rabies virus in saliva
grey squares = death of the animal

The highest percentage of foxes excreting rabies virus was observed at the onset of symptoms (Figure 2).

Figure 2 : Percentage of foxes shedding rabies virus before and after the onset of symptoms.



After the death of the animals, rabies diagnosis was performed, all 40 animals have been found positive for rabies. Rabies virus was isolated from sub-maxillary salivary glands of 34 animals. Two of the six animals whose salivary gland were negative excreted virus in saliva. These data are shown in Table 6

Table 6 : Isolation of rabies virus in saliva on alive animal and in salivary glands after death.

		Isolation in saliva on alive animals: Positive	Negative	Total
Isolation in salivary glands after death	Positive	29	5	34
	Negative *	2	4	6
	Total	31	9	40

* the dilution and homogenisation process used for the salivary glands gives a negative result when titre is under $10^{2.2}$ mouse IC LD_{50} per gram of tissue

3.2.2.2 Experiment two.

In that experiment, one single fox was inoculated intramuscularly with 200 fox IM LD_{100} (i.e. $10^{3.8}$ mouse IC LD_{50}) of GS7-1-1 strain. Saliva samples were taken daily between inoculation and death (20 days later)

Excretion of virus in saliva began 7 days after inoculation, i.e. 13 days before the onset of clinical signs. The excretion was detected every day up to the death.

When the fox died, brain and salivary glands were controlled positive for rabies.

4 EXCRETION OF RABIES VIRUS IN DOGS.

Five laboratory beagles have been inoculated with an homologous street strain, Ma85 batch. Each dog was inoculated in the temporal muscle with 1 ml of a Ma85 virus suspension containing $10^{3.5}$ mouse IC LD_{50} (i.e. roughly 1 dog IM LD_{80}).

Specimens of saliva have been collected before and during the clinical phase and treated like the foxes ones. None of them allowed the isolation of rabies virus.

Four out of these five dogs died of rabies. The laboratory diagnosis was performed on these animals. The four dogs that died of rabies were positive in brain and only two of them were positive in salivary glands.

5 CONCLUSION.

The main conclusion of these experiments is that the shedding of rabies virus is hard to demonstrate on live animals. The follow-up of rabies virus excretion in saliva may be influenced by many factors related to :

- the technique used to detect the virus, saliva sampling and virus growth
- the ill animal, is it a natural case or an experimental one? If so, the different factors that may influence the shedding of rabies virus should be considered such as the strain that is studied, the route of inoculation and the dose, the frequency of saliva sampling

In the homologous system (red fox strain in red fox), the inoculated dose of red fox virus is related to the mortality delay in red fox. It has been shown here that foxes inoculated with a low dose of virus (1 IM LD_{100}) may excrete rabies virus in saliva very early in the course of the disease. This early excretion is also not continuous, at least with the detection tools used in this experiment.

The human and animal health and epidemiological implications of this very early excretion of rabies virus in saliva cannot be ignored.

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HUMAN TO HUMAN BITES ASSOCIATED WITH CLINICAL RABIES

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ABSTRACT.

A patient with clinical rabies inflicted severe bite wounds on a care giver, for whom rabies post exposure treatment (PET) was prescribed. The incident was investigated and the circumstances of the human-to-human bite are described. The failure of proper referral of rabies suspects is exposed. An attempt to justify PET is also made.

1 INTRODUCTION.

Rabies is still a public health concern in Uganda, where on average 15 human deaths are recorded per year. World wide this number is estimated to be between 35000 annually (WHO, WSR 1996).

The most important vector of the disease is the dog. in Africa 93% of all human PET were due to dogs (Warrel, 1994). In Tanzania more than 90% of all confirmed cases of rabies originated from dogs and only 3.4% from wildlife (Loretu, 1988). In Uganda, dogs accounted for 95.8% of the 5418 PET given between 1990 and 1994. In the same period three (0.06%) PET were given after human to human bite incidents involving clinically rabid children biting their mothers, according to Ministry of Health surveillance report.

Three more human-to-human bites necessitating PET were reported in Luwero, Mubende and Pailisa districts in 1996. These reports were more thoroughly investigated and the Mubende case is hereby presented.

2 METHODS.

Interviews were held with the human bite victim, hospital staff, relatives and local leaders from where the index case hailed. Also interviewed were the district health and veterinary officials. Case notes of both the index case and the human bite victim were reviewed. The investigations were carried out retrospectively to establish :

(i) The nature and circumstances of the exposure of the index case.

(ii) The vaccination and ownership status of the animal initially exposing the index case.

(ill) The management and referral of the index case.

(iv) The final outcome of the bite incident.

3 RESULTS.

Subject No.1 was an 8 year old boy who was brought to Entebbe Grade "A" Hospital on 18/6/96. He was extremely anxious, excited and made hoarse sounds and talked of imaginary situations. There were several self inflicted wounds on the lips, tongue and arms; excessive saliva mixed with blood from the oral cavity. Three of the incisor teeth were broken as a result of biting hard objects. He was

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very aggressive and had to be restrained with a rope. A tranquillizer (Largactil 50mg iv) was given. No antirabies vaccine (ARV) or hyper immune globulin (HIG) was recommended and none was given. Subject No.1 was diagnosed as a clinical rabies case.

Subject No.2 was an adult male of about 40 years old. He had been bitten on the right wrist and thumb while restraining subject No.1, the index case, who was his son. The bites had penetrated intact skin causing bleeding.

No deliberate first aid like wound washing and applying antiseptic had been done. The bite victim was recommended for the 2-1-1 PET. He was immediately given 0.5 ml i.m. on two sites using a cell culture vaccine (Verorab Pasteur Merieux Lyon). The two were discharged that same day.

Two weeks later on 4/7/96, the investigators visited their home in Miseebe village, Buiera sub-county, Mityana county. The following were established:

- The index case had died on 19/6/96 in the evening, 24 hours after discharge from hospital.
- He had been bitten by a stray dog of unknown vaccination status on 7/5/96.
- He was taken to a private clinic in Mityana town 15kms away on the same day of the bite. The wounds were washed, dressed and antibiotic cover given.
- No antirabies vaccine or hyper immune sera was given nor recommended by the clinic.
- On 15/6/96, 5 weeks post-bite the patient started complaining of a sore throat and weakness. In the next two days mental confusion and other typical signs of rabies set in. On the third day, he was taken to Entebbe Grade "A" hospital on the advice of a relative who suspected rabies.
- The investigators were informed of many unrestrained, unowned (stray) dogs, jackals and foxes in the area which is heavily forested and bordered by Nakalama Tea Estate. A number of such dogs were seen moving freely within the village.
- One resident, a maternal uncle of the index case, revealed that in August 1995, his son had been bitten by a suspected rabid fox. Antirabies PET had been given to save his life. No medical form was produced to support this claim.
- The wounds of subject No.2 were healing well enough for him to carry on with his normal work.

4 DISCUSSION.

Transmission of rabies to humans can be broadly classified as bite related and non-bite related. The latter is very rare and has been documented in the following cases:

(i) Corneal grafts from rabies infected donors.

Year	Country	Cases	Age	Sex	Reference
1978	USA	1	37	F	(Houff *et al.* 1979)
1979	France	1	36	M	(Sureau *et al.* 1981)
1981	Thailand	*2	25 41	M F	(Sureau *et al.* 1981)
1987	India	*2	62 48	M M	(Gode and Bhide 1988)
1994	Iran	*2	32 40	M M	(Wkly Epid. Rec. 1994 Vol. 44)

* Single donor source

(ii) Air borne spread whereby transmission of rabies occurred in two people in a cave in Texas, USA. Accidental exposure to aerosol among laboratory workers has also resulted in transmission (Afshar, 1979).

(iii) Ingestion has been reported in a woman who in early stages of rabies transmitted the disease to her breast feeding baby (Afshar, 1979).

(iv) Other non-bite routes have been reported to be coitus (Meyer 1957), licking of the vagina and licking of the anus (Baer *et al.* 1982). None of these has been conclusively proven.

Worldwide transmission of rabies is almost always bite related. Ninety percent or more are due to dog bites even in those areas where wildlife rabies is predominant (WHO, 1984). In Uganda of the 15 human deaths reported in 1996, 14 (93.3%) were due to dog bites and one (6.7%) to a fox bite (WHO, WSR 1996). Dog bites have therefore come to be closely associated with rabies causing great fear and anxiety in many communities.

Transmission of rabies through human-to-human bites and hence saliva exposure has never been virologically proven although it remains a theoretical possibility (Heimick *et al.* 1987). Infected human saliva had enough virus to cause experimental infection in dogs, rabbits and guinea pigs (Meyer, 1957).

Human bites associated with clinical rabies are rare. in Uganda of 11916 PET given between 1990 and 1996. Only 6 (0.05%)or about 1:2000 were a result of a rabid human being biting another person according to MOH, VPH Surveillance Reports. It has reported in the literature without conclusive proof that in the year 1600, Malphigi's mother died after her daughter's bite (Italy). In 1886, a man died after an atypical paralytic "rage" 4 weeks after the bite of a person with rabies (France) (Hemick *et al.,* 1987).

Fekadu has recently reported two cases of human to human transmission in AddiS-Ababa, Ethiopia (Fekadu, 1997).

In the Mubende case, no laboratory diagnosis was done. However, after a careful review of the history, clinical presentation, epidemiological factors relating to the index case a rabies diagnosis was made. The clinically rabid index case had severely bitten and probably exposed his father to rabies which is almost 100% fatal, no chances could be taken but to recommend and give PET.

5 CONCLUSION AND RECOMMENDATION.

Cases of human to human bites associated with clinical rabies are very rare. Even when they occur there is no conclusive evidence yet that rabies transmission can occur.

This could be because, as observed by Meyer (1957) "The main reason human to human transmission has not often been published is doubtless that all persons in intimate contact with saliva of a rabid person are treated the minute the diagnosis is proved by laboratory test".

The investigators recommend that :

1. Since in most developing countries, Uganda inclusive, rabies diagnosis is based mainly on clinical grounds only, (WHO, WSR 1996) PET should begin once a clinical diagnosis of rabies is made in the biting individual (index case). This will avert the anxiety and the remote possibility that rabies transmission could have occurred.
2. Health workers should be able through careful history taking, to identify potential rabies cases early enough so that they start PET immediately.
3. If a health unit (Government or Private) does not have rabies PET, the unit should have knowledge where PET can be obtained and refer the victim accordingly.
4. Community education, whether by health or veterinary workers, should discourage belief in witchcraft with regard to rabies, since this can cause delay in getting proper medical care.
5. Persons involved in nursing and handling rabies patients should wear protective clothing (gloves, masks). Extra care should be taken to avoid bite injuries by using thick gloves, tranquilizers for the patient so as not to get exposed to rabies through aerosol or direct bites.

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DOG BITES, RABIES AND PATTERNS OF TREATMENT

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SUMMARY :

From 1994 to 1998, 220 cases of dog bites were reported to the Small Animal Clinic, Makere University. Two hundred and ten of the cases were on other animals while ten were on human beings. Swabs were taken from all 210 cases of dog bite wounds and the surrounding normal skin in dogs, cats and goats presented. Swabs were also taken from the gingival mucosa of 100 dogs that had come for annual vaccination boosters. Aerobic cultures together with antibiotic sensitivity tests using disc diffusion assay were made from these swabs. 32% of the bacteria isolated were *Staphylococcus intermedius*, 20% *Escherichia coli* while 12% non-lactose-fermenting coliforms. *S. intermedius* was the most common on the surrounding normal skin of the infected wounds all over the body. Gingival mucosal swabs revealed low *S. intermedius* load indicating no correlation between canine oral bacterial load and bite wounds. 45% of the isolated *S. intermedius* were resistant to penicillin while multiple antibiotic resistance was recorded amongst the other isolates. Many isolates were significantly sensitive to cotrimoxazole. Only 8 cases were confirmed rabies. One hundred and eighty five of the cases had had rabies vaccination up to date. All 210 cases requested revaccination or vaccination. All 10 human cases received anti-rabies treatment from human clinics. The most frequent treatment was rabies immunisation (100%), tetanus immunisation (75%), antibiotic administration without prior sensitivity test (100%) combined with routine wound dressing. None of the victim developed rabies.

1 INTRODUCTION.

Bite wounds from dogs are common clinical cases presented to many human and veterinary clinics (Callaham, 1980; Cowell *et al.*, 1989). The majority of these wounds are commonly contaminated either at the time of injury or later. Wound infection usually arises from the skin at the bite site or mouth of the biting dog. In humans post dog bite wound infection has been reported by many authors,(Feder *et al.*, 1987). Kolata *et al.* (1974) reported that up to 10% of canine emergency admissions are due to other dog bites. Many clinicians always assume infection following dog bite and administer antibiotics of their choice without any clinical laboratory results to support their therapeutic regime.

Goldstein *et al.* (1987) and Talan *et al.* (1989) reported *S intermedius* to be the most common isolates of dog bites in man. Dog bite in relation to rabies, bacteriogram, sensitivity tests and pattern of management have been the foci of this investigation.

2 MATERIALS AND METHODS.

Sterile swabs were used to obtain samples from 210 untreated dog bite wounds not more than 12 hours old and gingiva of normal dogs from 100 vaccination cases received in the Small Animal Clinic, Makerere University during the period January 1994 to December 1998. Samples were also taken from areas adjacent but not involved in the injury. The swabs were immediately plated on to MacConkey agar plates and incubated at 37°C for 24 hours. Identification of the micro-organisms was done by colony, Gram stain, catalase, coagulase and sugar fermentation reactions. Antibiotic-impregnated discs containing 4µg penicillin, 5µg erythromycin, 5µg novobiocin, 10µg ampicillin, 10µg streptomycin, 25µg tetracycline, 25µg cotrimoxazole, 30µg neomycin and 200µg sulphadimidine were used. Normal skin contaminants were ignored from the recordings. Dogs that did the biting were monitored for 3

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months to 5 years for evidence of clinical rabies. Vaccination records and clinical management of the victims were compiled and data collected was analysed using the Chi^2 test.

3 RESULTS.

Seventy percent (70%) of the bites were dog to dog followed by cats (21%), goats (10%) and humans (10%). There was no significant difference in the number of cases over the 5 years although 1997 recorded the highest (55) as shown in Table 1.

Table 1 : Number of dog bites reported at the Small Animal Clinic, Makerere University, Kampala.

	1994	1995	1996	1997	1998	Total
Cats	10	11	8	9	9	**47**
Dogs	25	30	36	40	22	**153**
Goats	0	2	1	3	4	**10**
Humans	3	2	1	3	1	**10**
Total	**38**	**45**	**46**	**55**	**36**	**220**

Sixty-eight per cent of the samples collected yielded some growth. *S. intermedius* (32%), *Pseudomonas* sp. (14%) were the most common bacteria isolated from the bite wounds with the other staphylococci being very rare. The highest proportions of pathogens were located on the lower abdomen. Lactose-fermenting coliforms (44%) and fecal streptococci (26%) accounted for the highest fraction of bacteria isolated from the oral cavity while negligibly from the bite wounds. Skin contaminants comprised a wide variety of non-pathogenic bacteria (55%). Table 2 shows the pattern of bacterial percentage distribution encountered.

Table 2 : Percentage of different types of bacteria isolated from 210 dog bite wounds, skin and 100 mouths of dogs in Kampala.

Type	Percentages of isolated bacteria		
	Mouth	Wound	Skin
No isolates	35	40	55
Pseudomonas	0	14	2
E coli	20	10	15
Pasteurella	0	2	1
Coliforms	44	2	2
Streptococcus sp.	26	6	5
Staphylococcus intermedius	15	32*	15

* $P<0.05$ with skin as reference

Various antibiotics showed varying sensitivities to various isolates with no statistically significant differences. Variations existed between the same isolate from different body parts. Resistance of *S. intermedius* to penicillin recorded 5 out of 20 isolates from normal skin and mouths (20%) and 10 out of 35 isolates from the infected wounds (29%). However, most isolates of the *S. intermedius* were sensitive to other antibiotics tested The majority of *Streptococcus* isolates were resistant to cotrimoxazole (55%), novobiocin (53%), neomycin (80%) and streptomycin (80%) but few were resistant to penicillin (13%) or tetracycline (15%) and all were sensitive to chloramphenicol or erythromycin. Enterobacteria group exhibited the widest resistance to antibiotics used. Penicillin showed the least sensitivity.

Only 8 out of 220 dogs were confirmed rabid while 185 out of 210 dogs had had rabies vaccination up to date. None of the humans had had prior rabies immunisation. Request for immunisation/re-imunisation of all victim against rabies (100%) were made and done combined with tetanus immunisation (75%) as well as antibiotic administration without prior sensitivity test plus wound dressing (100%) were carried out. None of the victims developed rabies.

Percentage average sensitivity and resistance of *S. intermedius* from various body parts of dogs in Kampala to various antibiotics

Antibiotic	Percentage of *S. intermedius* sensitivity to antibiotics	Percentage of *S. intermedius* resistance to antibiotics
Streptomycin	48	52
Tetracycline	52	48
Neomycin	55	45
Chloramphenicol	45	55
Cotrimoxazole	75	25
Ampicillin	35	65
Novobiocin	62	38
Sulphadimidine	65	35

4 DISCUSSION.

A number of microbial studies of animal bite wounds of man have been reported, and most of them contend that the oral flora rather than the skin flora are the source of infection with bacteria (Goldstein *et al.*, 1978). Particular attention has been focused on *Pasteurella multocida* (Francis *et al.*, 1975) and more recently on *S. intermedius* (Goldstein *et al.*, 1978; Talan *et al.*, 1989) as potentially important pathogens. There have been few studies of the microbiology of wounds inflicted by dogs on other dogs, even though such injuries are common and the source of infection may be the same.

In this study the organisms most commonly associated with bite wound injuries were *S intermedius*, *E coli*, non-lactose-fermenting bacteria and Streptococci. Alpha-haemolytic streptococci were the most frequently cultured pathogens from dog bite wounds of man in one study (Goldstein *et al.*, 1978). Some studies have suggested that anaerobes are important infections in dog bite injuries (Goldstein *et al.*, 1978) and since it was not possible to isolate strictly anaerobic organisms it makes this study in-complete.

Although S. intermedius is regarded as a significant cause of pyoderma in dogs (Medlau *et al.*, 1986), healthy dogs also frequently carry this organism, the anal region being thought the most important site (Devriese *et al.*, 1987). The finding that *S. intermedius* was isolated more frequently from both wounds and normal skin at the rear end of dogs is consistent with this view (Table 2). The organism was, how-ever, rarely detected in gingival specimens, suggesting that the skin flora were a more important source of wound contamination. Indeed, the organisms found most frequently in gingival swabs, fecal streptococcl, were isolated only rarely from wounds.

The management of dog bite wounds, whether in animals or in man is controversial, particularly with regard to the administration of antibiotics (Caflaham, 1988). Studies elsewhere have determined that no single agent is consistently active against the bacteria that can be isolated from such injuries (Goldstein *et al.*, 1986) and the findings in Kampala are in agreement with it. Human studies suggest that antibiotic therapy is not required for the majority of bite wounds; liberal irrigation and debridement with suturing of the wound where necessary is sufficient to prevent infection (Guy *et al.*, 1986; Mai-maris *et al.*, 1988). Although this treatment is also very effective in dogs (Cowen *et al.*, 1989), in cases in which veterinarians consider antibiotics necessary, the present study indicates that cotrimoxazole is the most likely antibiotic to be effective against the most common aerobic and facultatively anaerobic pathogens. Although chloramphenicol was also effective against most of the isolates its widespread use is discouraged because of the danger of emergence and spread of resistance plasmids to serious human pathogens.

It was not possible to determine the contribution of strict anaerobes in this study although Callaham (1988) reported it in man while Dow *et al.* (1986) reported it in dogs and cats. Studies involving anaer-obes would help complete the picture well.

Although not all dog bites can develop into rabies this study has demonstrated significantly that rabies still remains one of the most feared diseases and a significant proportion of the population associates dog bite with rabies and will take an appropriate measure to combat possible development of rabies even if prior precaution had not been undertaken. Additionally dog bite wound as a potential source of tetanus is adequately, though not significantly, appreciated by many people and is beginning to form part of a standard pattern in dog bite wound management.

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DEVELOPMENT OF AN ORAL DOG RABIES VACCINE RABIDOG® (SAG2)

Anne-Françoise Berthon[1]

As we are about to enter the 21st century, much progress has been achieved in the field of rabies diagnosis and control. Since the first vaccine made by Pasteur with a dried rabbit's spinal cord, many safe and effective parenteral vaccines for human and veterinary use are available. Most of these veterinary vaccines such as RABIGEN® MONO (Virbac), derivate from the Pasteur virus strain, inactivated, and produced on cell line.

National massive dog vaccination campaigns are carried out in countries such as Mexico, South Africa, Thailand … where millions of dogs are injected yearly with rabies vaccine free of charge for the pet owner. Nevertheless, rabies is still present in these countries, as well as in many others in Africa, Asia, Latin America … Parenteral vaccination is not good enough as there are unreachable dogs – stray dogs or community dogs. For these dogs, an attractive oral vaccine combined to a pertinent action plan seems to be the solution to develop to eradicate rabies in the 21st century.

The development of an oral rabies vaccine for dogs was encouraged by the success obtained with oral vaccination of foxes in Europe. Indeed, in Europe, rabies came back in the 1960's through the Eastern European countries. Infected foxes, unreachable by parenteral vaccination contaminated pets and domestic animals. Several methods were tried to stop its progression such as gazing of fox dens and night shooting, but these measures were unpopular and ineffective. Switzerland, as a pioneer country, developed the first oral vaccine for foxes. They later switched to Virbac's RABIGEN® ORAL vaccine for safety reasons. After 20 years of oral vaccination, of which the last 8 years were with RABIGEN® ORAL, Switzerland became rabies free in 1999. In France, oral vaccination allowed containment of rabies in the north eastern quarter of the country only, and has now pushed it back to the German border. It has been mathematically proven that without oral vaccination, the number of rabies cases in France would not have stopped increasing to this day.

In France, oral vaccination of foxes is carried out by the use of helicopters. Each area is carefully selected on a map and precise routing is prepared. The product used contains the liquid SAG2 vaccine in a plastic blister coated by a special bait specifically designed for foxes: the bait flavor is fish (a very strong attractant). The bait contains a polymer enabling it to physically resist dropping from helicopters flying above 100 m high. The shape of the bait allows foxes to bite into the capsule, puncture it and ingest the liquid vaccine.

Due to the success of the bait-vaccine, a dog specific bait was developed : RABIDOG® ORAL in collaboration with CNRS, CDC, CNEVA, IRVT, Allerton Provincial Veterinary Laboratory.

The vaccine strain used is called SAG2. It is a live, attenuated, pure virus produced on cell line. It was selected by the use of monoclonal antibodies from the first oral vaccine used in Switzerland -–SAD Bern. SAD Bern still has some residual pathogenic effect on mice due to the presence of arginine in position 333 of the envelope glycoprotein. The codon coding for this amino-acid was changed from AGA to GAA, thus with two nucleotid changes it is impossible for SAG2 to revert to the vaccinal mother strain. This double mutation leas to the replacement of arginine by a glutamic acid and is responsible for the loss of pathogenicity of SAG2 when administered to adult mice by the IC route. The innocuuity of SAG2 was tested on more than 30 target and non target species including baboons, the most sensitive non human primates for rabies.

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Therefore, SAG2 has passed successfully the safety requirement recommended by WHO. This led to the signature of a “Memorandum of Understanding” between WHO and Virbac laboratories aiming at the development of oral vaccination of dogs in needing countries. The product developed for this purpose is called RABIDOG® ORAL.

Compared to the fox bait, it is very different and species specific:

- The shape of the bait allows an excellent prehension by dogs of all breeds and sizes.
- The flavor of the bait has also been changed to liver, more attractive for dogs.
- The SAG2 vaccine is lyophilized allowing better conservation in hot climates and storage at + 4°C (instead of – 20°C).

This also avoids discarding plastic blisters in the environment.

The coating of the bait is very thin, thus allowing the dog’s saliva to reconstitute the liquid vaccine within seconds, to put it in contact with oral mucosa and tonsils. However, it is thick enough to protect the bait.

The stability of RABIDOG® ORAL allows distribution under a temperature of 40°C during 5 days. Since distribution is done daily, we are sure to give an effective bait to the dogs in the street. Storage at +4°C can be up to 2 years.

Finally, the “chocolate” color of the baits has been changed to “cement / dirt” color so as not attract children’s attention. The smell of the bait is furthermore repulsive to man.

Dogs fed or unfed were showed to have 90 % acceptance of these baits within seconds.

Of course, the efficacy of SAG2 was extensively demonstrated in dogs in several experiments. SAG2 protects dogs against lethal challenges. It was also shown that the dog bait gave better results in dogs than the fox bait.

There is a difference in the monitoring of dog vaccination by seroconversion following oral and injectable vaccination due to different mechanisms of action of the vaccines: With injectable vaccination; we expect average seroconversion rates. With oral vaccination, these rates are different and the threshold of 0.5 IU/ml is not representative of protection. It has been shown when using the recommended effective titer of vaccine, that seroconversion can take more than 6 weeks and even not be detected. However, all protected animal showed an anamnestic response after challenge with a rabies virus (C. Rupprecht, CDC Atlanta). Anyway, since oral vaccination targets unreachable dogs, it is not possible to bleed them afterwards and monitoring of vaccination consists in counting the number of baits consumed.

The method of distribution of these baits should be adapted to each country’s situation. Three methods have been tested:

- central point distribution to pet owners
- door to door distribution
- wildlife model distribution (around garbage dumps)

All have advantages and drawbacks. Cost varies from one country to the other but oral vaccination of dogs will be cost effective compared to PET.

The first oral vaccination of dogs will start in South Africa in the Kwazulu Natal area. It is expected to increase the dog vaccination coverage in complement of parenteral vaccination as baits will handed out to “unreachable” dogs. Latin America and Asia will also develop this type of vaccination in order to eradicate rabies in the 21st century.

DOG ECOLOGY SURVEY QUESTIONNAIRE WITH REFERENCE TO IMPROVING RABIES AWARENESS AND CONTROL IN RURAL SUBURBAN AND URBAN AREAS OF SWAZILAND.

R.X. Dlamini[1]

ABSTRACT.

In this study a questionnaire survey was used to establish if the Veterinary department's rabies control strategies were in harmony with dog keeping practises and to identify areas that need improvement. One hundred households were sampled in each settlement type, namely rural, suburban and urban. Almost all dogs in rural and suburban areas and about 50% in urban areas were free-ranging and semi-dependent on humans. Dogs of less than 2 years age made 31% of the population (high turnover) and a significant number were not vaccinated during the previous vaccination campaign. Management of dogs was predominantly by children therefore there is need to redirect rabies awareness campaigns to children. Feeding and watering of dogs were poor especially in rural areas. Dogs were predominantly used for security (average =90%) which is in conflict with the tie up order.

1 INTRODUCTION.

Domestic dogs account for more than half of all rabies cases occurring in Swaziland (Veterinary laboratory records) and they are the only major vector species in the country. The rest of the cases occur in victim species such as cattle, goats, etc. For the past 5 years the country has been vaccinating more than 70% of the dog population. Despite such good coverage rabies cases still occur. Butler (1995) suggests that good annual vaccination coverage can not effectively control rabies if there is a high turnover of dogs.

The stock diseases act of 1965 stipulates that in case of an outbreak of rabies infected places should be declared rabies guard areas. In such areas, a tie up order is enforced. Vaccination campaigns are then conducted, following which dogs that are not vaccinated and/or not tied up are destroyed. This is enforced in complete disregard of dog keeping practices and whether the owner have the capacity to follow the tie up order. This dog ecology survey questionnaire attempts to find out the following:

1. Why apparent good annual rabies vaccination coverage of dogs fails to control the disease?
2. Who should be the target for rabies awareness campaigns i.e. who manages the household dogs?
3. Why many tie up orders fail?
4. Whether dog-keeping practices are the same for the three settlement types, namely urban, suburban and rural.
5. How frequently are people bitten by dogs, and how are dog bite wounds treated?

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2 METHOD.

A questionnaire was designed following World Health Organisation (WHO/WSPA 1990) guidelines. The questionnaire was written in both official languages English and SiSwati. It had three broad sections namely :

(a) general household information

(b) dog numbers, sex ratios, dog / people ratios and dog husbandry practices

(c) information on post dog bite treatment people received.

The questionnaire was conducted just before the annual vaccination campaign and only information on events that occurred since the previous vaccination campaign was considered. The sampling frame consisted of all urban, suburban and rural settlement areas within a radius of 30 km from the regional veterinary office in Nhlangano. However areas which were subjected to a tie up order in the past five years were excluded. Samples were drawn at random and the first 100 households were surveyed. If there were less than 100 households another sample area was drawn and surveyed to add up to 100 questionnaires per settlement type. These questionnaires were conducted by closely supervised high school boys.

3 RESULTS.

The results are in figure 1 and tables 1 to 3.

Figure 1 : Age distribution of female and male dogs.

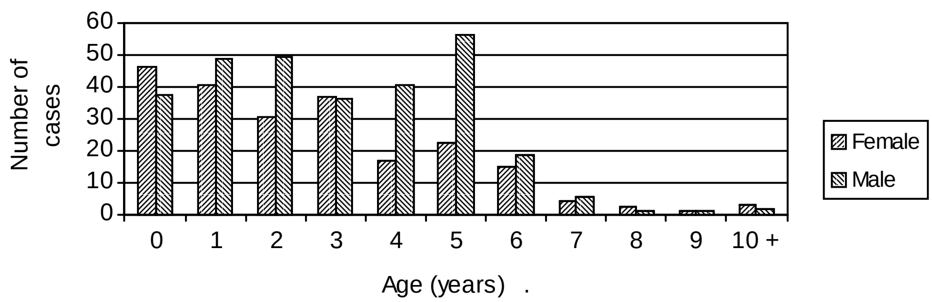

Table 1 : General household information collected by questionnaire.

	RURAL	SUBURBAN	URBAN	TOTAL
Name of Area	**Mzinsangu**	**Ndubase**	**Nhlangano**	
No of households interviewed	100	100	100	**300**
Mean number of people per household.	9.3	8.5	6.6	**8.1**
Number of households with:				
(a) dogs	68	88	94	**250**
(b)no dogs	32	12	6	**50**
Households toilet facilities:				
(a) indoor	0	1	89	**90**
(b) outdoor	33	92	11	**136**
(c) none	67	7	0	**74**
Enclosure (fencing) of household.				
(a) Fenced well (dog can not come out)	0	4	58	**62**
(b) Partially fenced (dogs can come out)	10	34	32	**76**
(c) Not fenced	90	62	10	**162**

Table 2 : Dog numbers, sex ratios, dog / people ratios and dog husbandry practices, information collected by questionnaire.

	RURAL	SUBURBAN	URBAN	TOTAL
Name of area	**Mzinsangu**	**Ndubase**	**Nhlangano**	
Total number of dogs	138	199	224	**561**
Total males	71	110	130	**311**
Total females	67	89	94	**250**
Male / Female ratio	1:1.06	1:0.81	1:0.72	**1:0.80**
Most important uses of dogs				
(a) Breeding	1 (1%)	0 (0%)	0 (0%)	**1 (1%)**
(b) Pets	2 (3%)	2 (2%)	6 (6%)	**10 (4%)**
(c) Herding	0 (0%)	0 (0%)	0 (0%)	**0 (0%)**
(d) Hunting	9 (13%)	4 (5%)	0 (0%)	**13 (5%)**
(e) Security	54 (83%)	83 (93%)	86 (94%)	**223 (90%)**
Dogs per household	1.4	2.0	2.3	**1.9**
Dogs: People ratio	1:6.8	1:4.2	1:2.9	**1:4.6**
Dogs per capital	0.15	0.24	0.34	**0.24**
Total number of litters	48	48	40	**136**
Total puppies	172	196	186	**554**
Number of dogs:				
(a)Given away	13	33	50	**96**
(b)Disappeared	9	9	14	**32**
(c)Intentionally killed	2	1	7	**10**
(d)Killed in traffic accident	1	10	14	**25**
(e)Died of rabies	0	0	8	**8**
(f)Died from other diseases	14	49	12	**75**
Feeding				
(a) Commercial dog food	0 (0%)	2 (2.3%)	40 (43%)	**42 (17%)**
(b) Cook special pot	18 (25%)	23 (26%)	25 (27%)	**66 (26%)**
(c) Get family left-overs	54 (74%)	62 (71%)	22 (24%)	**138 (54%)**
(d) Other	1 (1%)	1 (1%)	6 (6%)	**8 (3%)**
Source of water				
(a) River	14 (21%)	15 (17%)	1 (1%)	**30 (12%)**
(b) Home source	45 (66%)	66 (75%)	87 (94%)	**198(80%)**
(c) Other	9 (13%)	7 (8%)	5 (5%)	**21 (8%)**
Management of dogs				
(a)Father/owner	6 (9%)	11 (13%)	10 (11%)	**27 (11%)**
(b)Mother	13 (19%)	13 (15%)	22 (24%)	**48 (19%)**
(c)Children	49 (72%)	64 (72%)	61 (65%)	**174 (70%)**

Table 3 : Information on household members bitten by dogs and post bite treatment they received.

	Rural	Suburban	Urban	Total
Number of households surveyed	100	100	100	**300**
Number of households with				
(a) at least one family member bitten by a dog	20	18	11	**49**
(b) no family member bitten	80	82	89	**251**
Household members bitten by				
(a) Household dog	1	7	7	**15**
(b) Neighbours/community dog	17	10	4	**31**
(c)Unknown dog	2	1	0	**3**
Treatment received.				
(a) Rabies post exposure vaccination	5	4	0	**9**
(b) Local wound treatment	3	3	0	**6**
(c) Traditional bite treatment	12	11	11	**34**

4 DISCUSSION.

Households in urban areas have fewer people (average =6.6) as compared to suburban (Average = 8.5) and rural (average = 9.3) households (Table 1). However there are more dogs per urban household. (average =2.3) as compared to suburban (average = 2.0) and rural (average = 1.4) households. Urban households generally share boundaries whilst rural households are far apart with fields in between. Therefore the density of dogs in urban areas is higher as compared to rural areas. Rural and suburban dogs are generally free ranging, i.e. "neighbourhood dogs" since households do not have dog proof fences.

By law urban dogs are not supposed to leave their owner's property, but in this study 42% of properties did not have dog proof fences (Table 1). This result in uncontrolled breeding and spread of diseases. Stray dogs are also responsible for a significant percentage of human attacks. A number of stray dogs are killed in traffic accidents, especially in urban areas.

The dogs most vulnerable to rabies appear to be those between 0-2 years old. It is this age class that is least vaccinated the previous vaccination (year), mainly because they were born since that last vaccination or they were too young to be vaccinated during the campaign. In this survey dogs less than 2 years old made about 31% of the total population. This suggest a high turnover of dogs and it explains why even though the countries' annual vaccination coverage is above 70% rabies cases still occur.

Management of dogs is predominantly by children (average = 70%) and to a lesser extent mothers/wives (average = 19%) and fathers/owners (average = 11%) in all three different settlement types (Table 2). On the other hand extension information on dog keeping practices, importance of rabies, etc, is usually given to the men (fathers/owners) who attend community meetings on behalf of their households. Rabies vaccination campaigns are also conducted in September when schools are open. Therefore to improve coverage, rabies related information should be given to schoolchildren and vaccination campaigns should be conducted when schools are closed. A significant number of households do not feed (average =3%) and/or water (average = 8%) their dogs. Even the majority of those households that feed their dogs do not use commercial food. Therefore most dogs suffer from malnutrition, especially in the rural areas. To supplement their poor diet the dogs have to scavenge in the community. Hunger and thirst forces the dog to set itself free and stray in the community at least once every day. Educating owners and/or children on dog keeping practices can result in better restriction of dogs within the premises and reduce contact with other dogs and spread of diseases.
The most important use of dogs is security (average = 90%) followed by hunting (average = 5%) and as pets (average = 4%) for all three settlement types (Table 2). The main intended use (i.e. security) encourages people to look for vicious dogs and may be the reason why so many households (49) had at least one member bitten by a dog in a period of 12 months (Table 3). Of special significance was the number of households whose members were bitten by their dogs (15). Households tend to keep many dogs to feel more secure, especially in urban areas. To reduce the dog population households should be encouraged to keep fewer trained guard dogs.

Of 49 people bitten by dogs only 9 had the attention of a physician and the majority (34) used the traditional dog bite treatment methods (Table 3). It is surprising that all 11 people who were bitten by dogs in town used the latter treatment only. Traditionally some hair is plucked from the dog that bit you and burnt. The ash is then rubbed into the wound. In general rural people seem to be more informed on rabies as compared to suburban and urban people.

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THE DISABILITY-ADJUSTED LIFE YEAR (DALY) AND RABIES

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ABSTRACT.

In 1993, the World Bank and the World Health Organization introduced a novel methodology for assessing the public health burden of disease. The disease burden on a population by any number of diseases are comparable using this measure, which is expressed as *disability-adjusted life years (DALYs)*. Here, we outline the methodology for calculating this measure, and present a preliminary estimate of a DALY score for rabies based on data obtained from secondary literature sources. The estimation shows that rabies causes 1.11 million lost DALYs globally on an annual basis. If this were ranked alongside the selected other "diseases and their sequelae" considered in the original ranking for global disease burdens, rabies would rank 86th, above other infectious diseases such as onchocerciasis and dengue fever. The importance of understanding the burden of disease and the usefulness of this measure in influencing resource allocation decisions is outlined.

1 INTRODUCTION.

In 1993 the World Bank published it's World Development Report "Investing in Health," (World Bank, 1993) in which it introduced a novel methodology for assessing the Global Burden of Disease. This has been embraced by the World Health Organization (WHO) as a tool for prioritising interventions in the health sector (WHO, 1996); interventions aimed at improving health can be prioritised based on their impact in reducing disease burden and on the cost-effectiveness of the intervention. Whether or not an improvement in health status is cost-effective can be assessed in terms of the amount of money spent per DALY averted (Murray, 1994).

The DALY takes in to account both disability and death. Different degrees of disability (morbidity) are given different weightings, based on a standardised scale of ability to perform certain functions and duration of illness. This standard scale makes different degrees of disability as well as death comparable in numerical terms. For example, 1 year of disability of a weighting of 0.6 is equivalent in DALY terms to 1.5 years of disability with a weighting of 0.4 (both leading to 0.6 DALYs lost). Death is given a weighting of one. The burden of a death is age-specific: it is based on the number of healthy years of life lost due to a death at that age, with reference to a standard life-table. Because of the rapid clinical course of rabies and almost certainty of death in clinical cases, we assume here that there is no morbidity associated with clinical rabies, and so simplify the calculation of the DALY by only considering mortality. Clearly, aspects of clinical rabies, such as fear, productive time lost due to treatment seeking and other factors do have some impact on the burden of rabies in a population. However, these are of marginal significance in comparison to DALYs lost due to premature death as a result of infection, and we therefore feel justified in simplifying our estimate by excluding them. Our estimate is, therefore, conservative.

For the DALY, all but two parameters have been standardised in order to allow comparisons to be made between different sections of the human population. The key point is that any social variables, such as income or geographic origin, *do not* affect the outcome, in order to maintain equity in the measure (Murray, 1994). The variable parameters are age at onset of disease and sex.

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- *Sex:* The authors of the global burden of disease study based the life expectancy at each age on the maximum life expectancy observed in any modern day population (Murray, 1994), that is of Japanese women, who have a life expectancy at birth of 82.5 years. Due to what is termed in the study as "observed biological differences," the male life expectancy at birth is optimised at 80.5 years. These life expectancies are then applied to the whole human population, in the form of a standard life table – the West 26 Life Table (Murray, 1994), and the number of DALYs lost due to death at a particular age can be calculated from this.
- *Age:* In calculating the DALY, life is valued differently at different ages (see Murray (1994) for details). Essentially, from birth to age 25, the number of DALYs lost due to premature death increases with age. From age 25 onwards, however, the number of DALYs lost due to premature death decreases with age. This is an attempt to capture different social roles, again assumed to be identical between different parts of the human population, for any given age group.

The concept of the Disability Adjusted Life-Year and its use in allocating resources has not gone without criticism. For example, the issue of using standardised West 26 life tables as a basis for life expectancies may be unrealistic in a regional setting, such as sub-Saharan Africa. Assigning a greater value to specific ages is also contentious, as is the issue that healthy life lived now has a greater value than healthy life lived in the future – called the time preference. These issues are discussed in the World Bank Report (World Bank, 1993), while details of the various criticisms can be found in Gwatkin (1999), Paalman (1998), Treasure (1999) and Williams (1999). We have used the West 26 life table in this estimate to make our results comparable to those of the World Bank study.

The DALY equation:

$$-\left[\frac{DCe^{-\beta a}}{(\beta+r)^2}\left[e^{-(\beta+r)(L)}(1+(\beta+r)(L+a))-(1+(\beta+r)a)\right]\right]$$

where :

D = disability weight (set to 1 for death)
r = discount rate (set at 0.03)
C = age weighting correction constant (0.16243)
β = age weighting parameter (0.04)
a = age of onset
L = time lost due to premature mortality for death at a particular age, based on a standard life table

2 METHODS.

The parameters used in this estimation were derived from a number of published sources; the total mortality is an average of the official World Health Organization (WHO) figures from 1992 to 1997. The specific data used in this DALY estimation are discussed below. To allow direct comparisons to be made between our result and the Global Burden of Disease study (World Bank, 1993), we used a 3% discount rate and the West 26 Life Table.

Parameters.

The total number of deaths world-wide was taken to be 34,000, an approximation based on the figures published annually by the World Health Organization's World Survey of Rabies (see Table 1).

Data on the age distribution of fatalities was obtained from Eng *et al.* (1993), a detailed study of human rabies in Mexico. In that study, 60% of rabies cases were found to occur in children. The age distribution found in that same study is shown in Table 2, which had a sex distribution skewed towards males, who accounted for 53% of deaths, while females accounted for 47%. The age distribution of deaths shown in Table 2 was used for both sexes.

These data were chosen because they present detailed epidemiological data including the parameters necessary in calculating a DALY score. We are aware of the limitations in using such data from one country to calculate disease burden on a global basis; for a first estimate, however, we feel that this is justified, and certainly it presents no greater limitations than averaging similar figures (if available) from many countries. We are developing regional estimates of disability-adjusted life-years lost due to rabies using age and sex distributions specific to the regions in question.

Table 1 : Officially reported rabies cases world-wide (data from the WHO World Surveys of Rabies – WHO, 1994; 1996a; 1996b; 1996c; 1997a; 1998; 1999a).

Year	Total reported rabies cases world-wide
1992	34931
1993	31223
1994	34110
1995	35583
1996	33209
1997	33221
Average	**33713**

Table 2 : Age description of cases as reported by Eng *et al.* (1993) in a study in Mexico.

Age	Proportion of rabies deaths
0 – 12	0.6
13 – 19	0.1
≥ 20	0.3

3 RESULTS

Using the published data described, the age and sex specific disease burdens shown in Table 3 have been calculated.

Table 3 : Global DALY score calculated for rabies.

	No. deaths		DALYs per death		DALYs lost to rabies	
age class	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
0 – 12	10812	9588	36.8	37.0	397882	354756
13 – 19	1802	1598	36.8	37.0	66314	56126
≥ 20	5406	4794	22.3	23.7	120554	113618
					Total DALYs lost : 1112249	

n (deaths) = 34000

A total of 1.11 million DALYs lost due to rabies is calculated on the basis of these data. Rabies would rank rabies 86th if compared to those "diseases and their sequelae" originally considered using data from 1990 (WHO, 1996). The disproportionate number of young people who die of rabies (60% of deaths) is the principle cause of the high ranking.

The strength of the DALY measure lies in the *comparative*, rather than *absolute*, scoring of disease burden. Table 4 shows how the DALY figure we calculate for rabies compares with a selection of other diseases. Note that a DALY score can be attributed to chronic as well as infectious diseases.

Table 4 : Rabies DALY score relative to other selected diseases. Non-rabies data from WHO (1999b)

Disease	Total DALYs lost (X1000)
Malaria	39267
Hepatitis	1700
Ascariasis	1292
Trichuriasis	1287
Trachoma	1263
Rabies	1112
Parkinson's disease	1109
Iodine deficiency	1078
Onchocerciasis	1069
Dengue	558

4 DISCUSSION.

One hundred health conditions were considered in the first global DALY assessment undertaken by the World Bank and the World Health Organization. According to the 1999 World Health Report (WHO, 1999b), the most significant single cause of DALYs lost were acute lower respiratory infections, causing 82,344,000, or 6% of all DALYs lost. Infectious diseases as a whole accounted for 23.4% of DALYs lost (323,993,000) globally. Rabies was not considered explicitly, which reflects its low profile from a public health perspective.

Our estimate is based on a global mortality of 34,000 per annum, based on reported figures. Rabies deaths are grossly underestimated. The following data illustrate the potential extent of under reporting; Ethiopia reported 22 human rabies deaths nationally in 1995 (WHO, 1997a), while Laurenson *et al.* (1997), in an intensive study (therefore more likely to be closer to the true rate) estimate that in rural areas, the incidence per 100,000 is between 2.25 and 45, which is equivalent to between 1305 and 26,100 deaths nationally, on the basis of a national population of approximately 58 million. Problems with reporting are not necessarily the fault of the health authorities, as there is much evidence to show that affected individuals simply do not present for treatment.

Using our figure, rabies ranks 86th alongside those diseases for which a DALY score was calculated. This is a higher ranking than, for example, onchocerciasis or dengue fever. Onchocerciasis control receives approximately 25 million US dollars annually (WHO, 1997b), through the Onchocerciasis Control Programme. It should be borne in mind however that onchocerciasis control is highly cost effective, and that much of this funding is spent on maintaining the highly evolved infrastructure required by the control programme.

This 86th rank is based on a rough calculation, and is a conservative estimate. However, even with these conservative figures, we have shown that rabies is a serious public health problem - for which the disease burden is concentrated in developing countries. It should be borne in mind, of course, that many diseases were *not* considered in the original work, and that any ranking is only relative to those that *were* included.

Because of the near certainty of death once clinical rabies becomes apparent, and the rapid course of the disease, we are assuming that disability *per se*, in terms of lost quality of life over a period of time, is negligible for rabies. It should also be noted that DALY burden estimated in Table 1 does not take into account any morbidity resulting from "the trauma and fear of rabies associated with animal bites in rabies-endemic areas" (Warrell and Warrell, 1995). This, however, is not likely to significantly affect the outcome of the DALY measure, and for ease of calculation we exclude morbidity altogether. Therefore, the disease burden we are concerned with here is that of loss of life as a direct result of infection with the pathogen.

In terms of policy-making, a more representative disability-adjusted life year value at a global and at regional scales is necessary if governments and institutions are to be convinced that it is worth investing resources in rabies control programmes, and that such investment will result in cost effective returns, in terms of an improved health status for the population. Rabies is a preventable disease, either through vaccination of the human population, or by preventing transmission from the animal host by vaccinating that population. In Ethiopia, Ayalew (1985) found that 97.5% of potential exposure as a result of animal bites were due to dogs. The virus is maintained mainly in a domestic (and often free roaming) dog population, and disease control by a number of methods is available and effective in dealing with these infections. It is essential, therefore, to prioritise rabies control and to develop control programmes that target the virus within the zoonotic reservoir.

This first attempt at determining the burden to rabies is a starting point from which further work will follow. A more in depth estimate of a DALY for rabies is in preparation, for a specific region of sub-Saharan Africa, using data specific to that region.

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DISCUSSION

1 AFTER PAPERS.

K. Moshoeshoe : Did people register but not arrive for vaccination. What were the reasons?
J. Kinengyere : Some had a "don't care attitude" but eventually agreed to have dogs vaccinated.

G. Bishop : How can foxes shed virus 29 days before clinical symptoms? How do you explain that?
J. Barrat : We do not know, other "long" periods have been observed (20, 25, 27 days). The mortality delays of control and inoculated animals were similar in that experiment, so one can estimate that the inoculated dose of virus was identical to the "natural" one. The consequence of this is that such long delays before clinical symptoms may be observed in naturally rabid red foxes in Europe.

Agaba : What are the implications in dogs.
J. Barrat : More research is required. One cannot compare results obtained in wildlife in France with dogs in Uganda.

A. Mutemwa : Cooperation between medics and vets appears very suspect in this case.
R. W. Kaboyo : In the written text, there is sufficient evidence of cooperation.

S. Ndaomba : If the victim went to the clinic, why did the clinic only treat the wound and not refer the case to experts?
R. W. Kaboyo : Clinic may not have requested a full history. More education is required.

F. Kamunvi comment : People have a choice to go to the medical clinics or traditional healers. They may be given the wrong treatment and advice. This is still a problem in Uganda.

Moshoeshoe : which is the impact of this initiative?
J. Kinengyere = it has been well accepted by the community that asks for an annual continuation.

Moshoeshoe : dog bites are principally done by stray dogs, what is done to control this?
J. Kinengyere = trials to eliminate stray dogs are made once or twice a year, dogs owners are required to keep their dogs at home. There is also a sterilisation program of stray cats and dogs in Kampala

Mutemwa : what is the action of the vet in the decision of post exposure treatment.
RW Kaboyo = the vet has to carefully collect the information, there is also an educational activity assumed by vets in the communities.

Ndaomba : ????????????
RW Kaboyo = there is a need of education and the role of the vet is also in improving the links with the communities. The collaboration between medics and vets exists but it should be improved.

G. Bishop comment to AF Berton paper : in 2010, there should not be any human rabies case in South Africa. Baiting trials have shown with freeze dried bait, the acceptance of the bait is near 90%. The only problem couls be the temperature of the bait , it seems that dogs do not like cold baits.

A. King : does the calculation of DALY score for rabies include the awfulness of death?
E. Fevre = no because there are individual variations.

FX Meslin : what is the scale at which DALY scores work?
E. Fevre = regional level at the beginning and then to the continent level and then at a world scale.

2 GENERAL DISCUSSION.

S. Cleaveland, question to W Haupt : have we information about the influence of HIV on the protection given by antirabies vaccines?

Work has been done in India : 14.30 % of vaccinated people seroconvert over 0.5 IU per ml 37 days after vaccination. The groups are different (risk = 0.001) the geometric mean titre in IU/ml. In such cases, different options are available : rabies immunoglobulins, double injection of one dose in two places, 8 sites intradermal vaccination.

P. Kittala, question to FX Meslin : how was determined the 0.5 IU cut off, how is it reliable?

It is a long story, it is based on American works on the protective minimal value. Three vaccination protocols have been agreed by the last expert committee on rabies in 1996 : the 5 IM injections and two intradermal schedules. The "2,1,1" protocol is an alternative to the 5 IM protocol that should be used when no rabies immmunoglobulins have to be used (i.e. for level 2 contamination).

CLOSING ADDRESS

Sam Okware[1]

Ladies and Gentlemen,

First of all I wish to convey the apologies of the Hon. Minister of State of Health, General Duties who, because of other urgent state duties cannot be here with us to close this conference.

In the last 3 days, you have been discussing a very important subject : that is rabies which is an old but often forgotten public health problem. Rabies is a major zoonosis and its importance lies in the fact that, once one is infected and clinically develops symptoms, mortality is almost always 100%. Secondly, post exposure treatment of exposed individuals is very expensive especially for countries in our region, and yet the disease is preventable.

It is therefore important that this conference comes up with guidelines on prevention strategies that can be implemented both at National and regional levels.

The challenge we face therefore is to ensure easy accessibility to care and proper treatment against rabies. There is need to review and improve the referral system for rabies patients. In our efforts to control this disease the role of the community is of critical importance. The community participatory approach is cost effective, sustainable and results oriented.

This is so because involvement of dog owners is crucial for attaining success in any dog vaccination programme whether in the rural or urban areas. There is need for the major stakeholder to integrate their activities at community, national and regional / international levels. This will inevitably reduce costs, improve service delivery and harmonise rabies prevention and control efforts in each of the member countries and within the region. The greatest challenge to all of us in this region is therefore to focus and implement multisectoral collaboration between the Ministry of Health and that of Agriculture and Veterinary Services.

The tools for the control of rabies are available but we need more resources for research into affordable and appropriate technology. As we enter the 21st century the SEARG has a duty to promote, expedite and harmonise research efforts. Research should therefore be part and parcel of future programmes for rabies prevention and control.

According to a number of presentations made in this conference, rabies diagnosis is still mainly based on the clinical presentation. There are fewer samples reaching the laboratory for examination. This scenario is not good enough if we are to get a more accurate and reliable epidemiological situation of the disease in our region. No efforts should be spared in ensuring that laboratory diagnosis is revitalised. The more cost effective, reliable and faster techniques should be introduced and used in the examination of both animal and human specimens. More investment should therefore be made in improving our rabies diagnostic capabilities across the region. This is a prerequisite in designing and implementing cost effective rabies surveillance and control programmes at all levels.

We must now focus on the future of the SEARG in the next millennium. The role of the group should be expanded to the countries of the region who are not yet members. The recommendations made in this conference should be closely monitored and implemented for the benefit of all member countries. Appropriate policies should be defined and implemented so as to strengthen the existing relationships between national governments.

The SEARG should encourage technical co-operation between developing countries and the international community to be able to benefit from the rapidly changing technology.

I should take this opportunity to thank all the 13 countries in the region who have sent delegates to this conference. The Ministry of Health wishes to thank the SEARG for initiating, directing and promoting collaboration between international agencies and pharmaceutical companies from whom we have

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[1] Commissioner Health Services / Community Health

always received support. I wish also to sincerely thank the World Health Organization for their financial contribution and participation in this Conference as they have always done in previous ones. Our colleagues in the Ministry of Agriculture, Animal Industry and Fisheries are also acknowledged for the collaboration that exists between our two ministries. This has enabled us to jointly host this meeting and to focus on rabies as both an animal and human problem. This government is most grateful to the SEARG member countries for having chosen Uganda to host this meeting here in Entebbe.

Let me wish all the participants a pleasant and safe journey back home. It is now my great privilege and singular honour to declare the 5th Southern and Eastern African Rabies Group Conference officially closed.

THANK YOU!

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