



**Ministry of Agriculture and Rural
Development
Department of Animal Health**

Rabies Control Strategy

November, 2011

Addis Ababa

Table of contents

Page

I. Background	2
II. Strategy	4
1. Major intervention areas	4
1.1 Provision of safe and effective vaccines	4
1.2 Compulsory vaccination of all dogs and cats found in cities and towns	5
1.3 Destroy all infected and dangerously contact animals.....	5
1.4 Destroy all stray and uncontrolled dogs and cats.....	5
1.5 Quarantine and movement control.....	5
1.6 Strengthening the diagnostic capabilities	6
1.7 Sectors collaboration.....	6
1.8 Public education	6
2. Share of duties and responsibilities	6
2.1 Federal veterinary services.....	7
2.2 Regional veterinary services	7
2.3 Zonal veterinary services	8
2.4 Woreda veterinary service	9
2.5 Diagnostic laboratories.....	10
ANNEX I. NATURE OF THE DISEASE	11
1. Etiology and its persistence	11
2. Epidemiology	13
2.1 Distribution.....	13
2.2 Host range and susceptibility.....	13
2.3 Incubation period.....	14
2.4 Modes of transmission	15
3. Diagnosis	16
3.1 Clinical signs	16
3.2 Pathology	22
3.3 Laboratory tests	23
3.3.1 Specimens required/transport.....	23
4. Differential diagnosis	23
5. Safety precautions	24
6. Resistance and immunity	25
6.1 Innate and passive immunity	25
6.2 Active immunity	25
6.2.1 Vaccination	26
7. Control and Prevention	29
7.1 Principles.....	29
7.2 Methods to prevent spread and eliminate pathogens	29
7.2.1 Quarantine.....	30
7.2.2 Movement controls	31
7.2.3 Detention and disposal of uncontrolled and unvaccinated animals.....	32
7.2.4 Reporting of animal bite cases in humans	32
7.2.5 Treatment of infected animals and humans.....	33
7.2.6 Destruction of animals	33
7.2.7 Treatment of animal products.....	34
7.2.8 Disposal.....	34
7.2.9 Decontamination	34
7.2.10 Vaccination.....	35
7.3 Public awareness.....	37

I. Background

Rabies is one of the zoonotic diseases prevalent throughout much of the world and is widely known in Ethiopia. In a study conducted from 1999-2002 in and around Addis Ababa, it was reported that a range of domestic and wild animals and humans were found affected.

During this time among the 902 brain samples examined for rabies, dogs were found to be the most affected (89.7%) followed by cats (4.2%) and cattle (3.4%).

The recent history of rabies outbreak affecting the red fox (wolf) in Bale Mountain National Park and some occasional media reports about invasion of human settlement areas by fearless wild animals during day times are suggestive of the extent to which the disease may have been distributed across the country and established itself even in our wild life populations.

It is estimated that among the 150,000-200,000 dogs found in Addis Ababa, 50% of them roam freely without any control.

At present the ***Ethiopian Health and Nutrition Research Institute*** is the only institute which provide diagnostic services and produce about *10,000 doses of vaccine for dogs and a similar amount for human use per year.*

Even though limited amount of vaccines are also said to be imported in to the country, there seems to be no mechanism to certify their quality and safety before being used. The type of vaccines used, their handling and the storage mechanisms are not regulated.

Moreover, unreasonably excessive service charges of vaccination requested by private practitioners may also have contributed to the low number of dogs that get vaccination in those private clinics.

The low amount of vaccine produced per year and the presence of only one rabies diagnostic laboratory shows that no organized action is being taken yet to safeguard the public from this dreadful disease.

It is therefore found important to design a comprehensive prevention and control strategy that can *initially be implement in all cities and towns that are administered by municipalities and gradually expanded to cover the rest of the country* with the objective of *minimizing its incidence to an acceptable level for public health reasons and prevent its spread to both domestic and wild animals.*

For this reason the Ministry of Agriculture and Rural Development has prepared this rabies prevention and control strategy document. The document has two major components; part I, a background information briefly describing the global and national importance of the disease, and part II, strategy outlining the major intervention areas to be addressed by different actors found at each administrative structure. For a purpose of general information a description on the nature of the disease and principles of control is also annexed herewith.

II. Strategy

1. Major intervention areas

1.1 Provision of safe and effective vaccines

- ◆ Prior to any effort to be undertaken in preventing and control of rabies, sufficient quantities of safe and effective vaccines should be available for both dog, cats and human beings.
- ◆ The **Ministry of Agriculture and Rural Development** will be responsible to ensure the supply of vaccines for dogs, cats and if necessary for other domestic and wild animals in a required amount.
- ◆ The sources of vaccines may be within the country or abroad but the **Ministry will be responsible to certify their quality and safety** before being used within the country.
- ◆ The storage, transportation conditions and use of vaccines will be supervised by the veterinary services.
- ◆ All public veterinary clinics found under municipal administration will be enforced to have sufficient stock of vaccines at all times.
- ◆ **National Veterinary Institute** will be capacitated so as to produce one or more types of rabies vaccines of at least **one million doses per year**.
- ◆ **The Vaccine and biologicals quality control unit to be established together with the Animal Products Quality Control Laboratory** will conduct the regulatory check on the safety and quality of vaccines being produced or imported.
- ◆ Provision of vaccines and immune globulin to be used for humans will be the responsibility of **Public Health Authorities**. In this regard the **Ethiopian Health and Nutrition Research Institute may play a significant role**.

1.2 Compulsory vaccination of all dogs and cats found in cities and towns

- ◆ All dogs and cats found in cities and towns administered by municipalities will be vaccinated at regular intervals.
- ◆ Depending on actual needs and the availability of vaccines other domestic animals and wild life may also be vaccinated.

1.3 Destroy all infected and dangerously contact animals

- ◆ All infected animals (domestic or wild) and those animals which are exposed to a rabid animal will be destroyed and their head will be submitted to a designated laboratory.

1.4 Destroy all stray and uncontrolled dogs and cats

- ◆ A team of experts drawn from the **veterinary and public health authorities, police, municipality and wild life** will be established at various levels and conduct regular monitoring of the presence of stray dogs and cats.
- ◆ Those stray or uncontrolled dogs and cats will be destroyed by suitable means.
- ◆ Destroyed dogs and cats will be immediately removed and buried.

1.5 Quarantine and movement control

- ◆ *When outbreaks occur*, movement restriction will be imposed on dogs and cats.
- ◆ *Dogs and cats entering from abroad* will be quarantined and finally vaccinated before released unless they are accompanied with valid vaccination certificates.
- ◆ When the outbreak occurs in wild life, *domestic animals will be restricted not to have contact with affected species.*

1.6 Strengthening the diagnostic capabilities

- ◆ Both the veterinary and public health authorities will jointly assess and identify referral laboratories.
- ◆ Diagnostic capacities of federal and regional laboratories will be strengthened through provision of the **required facilities and technical training**.
- ◆ **All suspected cases** will be checked for rabies.
- ◆ **Serum samples** will be collected and checked for having protection level antibodies.

1.7 Sectors collaboration

- ◆ Authorities from **veterinary, public health, wild life and local administration** will form a joint forum to coordinate their mandated activities.
- ◆ Regular information exchange between veterinary and public health services.
- ◆ Any rabies case encountered by any one will be immediately notified to the other.

1.8 Public education

- ◆ The animal health department and public health
- ◆ through mass media, distribution of brochures and other reading materials
- ◆ Provide advisory services when people report suspected cases.

2. Share of duties and responsibilities

For the proper strategy implementation:

- Different actors that will have positive contribution need to be identified and
- Their duties and responsibilities indicated.

2.1 Federal veterinary services

- ◆ Prepare the **terms of references** for the joint committee to be established at federal, regional, zonal and woreda level
- ◆ Actively participate in the joint forum to be established
- ◆ Enable the production and supply of vaccines
- ◆ Ensure safety and quality of vaccines
- ◆ In collaboration with the Drug Control and Regulatory Authority, issue import permits
- ◆ Develop the capacity of the federal and regional laboratories
- ◆ Provide training for field and laboratory staff
- ◆ Prepare educational materials
- ◆ Conduct public education programs
- ◆ Collect, analyze and distribute rabies outbreak reports
- ◆ Monitor control and prevention activities and provide technical support to regions

2. 2 Regional veterinary services

- ◆ Assist the establishment and proper functioning of joint committee at all levels in the region.
- ◆ Actively participate in the joint forum established to oversee the status of the regional rabies prevention and control program
- ◆ Identify the cities and towns which need to be covered under the control program
- ◆ Gather relevant data on the actual figures of dogs and cats found in those areas and their vicinities
- ◆ Ensure the presence of cold chain facilities in all of the veterinary clinics in the identified areas
- ◆ Ensure the continuous supply of vaccines in the required amounts
- ◆ Insure the proper certification and identification systems are put in place for all those dogs and cats vaccinated

- ◆ Distribute and ensure the availability of proper chemicals or materials required to destroy stray, infected or dangerous contact animals in sufficient amounts at all levels in the region
- ◆ Ensure the proper functioning of the diagnostic laboratories.
- ◆ Train the professionals and sub-professionals on the measures to be taken for the prevention and control and diagnostic methods to be applied
- ◆ Public education through available mass media and educational materials.
- ◆ Gather, analyze and disseminate information concerning rabies to the federal veterinary service and other relevant institutions

2.3 Zonal veterinary services

- ◆ Actively participate in the joint forum established to oversee the status of the zonal rabies prevention and control program
- ◆ Identify the cities and towns in the zone which need to be covered under the control program
- ◆ Gather relevant data on the actual figures of dogs and cats found in those areas and their vicinities and report to the region
- ◆ Ensure the presence and proper functioning of cold chain facilities in all of the veterinary clinics in the identified areas
- ◆ Ensure the continuous supply of vaccines in the required amounts
- ◆ Ensure the availability of proper chemicals or materials required to destroy stray, infected or dangerous contact animals in sufficient amounts at all levels in the region
- ◆ Insure the proper certification and identification systems are put in place for all those dogs and cats vaccinated within the zone
- ◆ Assist the establishment and proper functioning of joint committee at all levels of the established areas of the zone.
- ◆ Public education through available mass media and educational materials.

- ◆ Gather all relevant information and report to the regional veterinary service and other relevant institutions

2.4 Woreda veterinary service

- ◆ Ensure the establishment of a joint committee from relevant organizations and actively participate in its functioning within the woreda.
- ◆ Identify the towns in the woreda which need to be covered under the control program
- ◆ Gather relevant data on the actual figures of dogs and cats found in those areas and their vicinities and report to the zonal and regional veterinary services
- ◆ Ensure the presence and proper functioning of cold chain facilities in all of the veterinary clinics in the identified areas
- ◆ Ensure the continuous supply of vaccines in required amounts
- ◆ Ensure the presence of poisons or other materials used to destroy infected or contact animals
- ◆ Establish regular vaccination schedules and make to be known to the public
- ◆ Insure the proper certification and identification systems are put in place for all those dogs and cats vaccinated
- ◆ Collect teaching materials from the region and distribute to the professionals and the public
- ◆ Public education through workshops, public gatherings etc.
- ◆ Gather all relevant information and report to the regional and zonal veterinary services and other relevant institutions within the woreda
- ◆ Submit relevant specimens to laboratories

2.5 Diagnostic laboratories

Laboratories which are identified as centers for rabies diagnosis should conduct the following activities

- ◆ Ensure their technical capability be developed through training and availability of the required facilities
- ◆ Train field veterinary personnel on the methods of specimen collection, preservation and transportation.
- ◆ Monitor the immunity status of vaccinated animals

ANNEX I. NATURE OF THE DISEASE

Rabies is almost invariably fatal viral encephalitis affecting all warm-blooded animals. It is characterized by a unique mode of transmission (usually by the bite of a rabid animal) and a long and variable incubation period (four days to many years).

1. Etiology and its persistence

- ◆ caused by a virus belonging to the *Lyssavirus* genus of the family rhabdoviridae.
- ◆ is comparatively fragile and does not survive for long periods outside the host.
- ◆ remains stable for *several months at 0–4°C* but it is rapidly inactivated by heat, direct sunlight and lipid solvents.
- ◆ is stable at pH 5–10.
- ◆ Infectivity is lost when the virus is treated with proteolytic enzymes.
- ◆ In saliva in temperate climates it can survive for up to 24 hours.
- ◆ is relatively large and contains lipid and hence is susceptible to a wide range of disinfectants, including warm soapy water and detergents.

Live animals

- ◆ Virus excretion in the saliva may commence at up to 14 days (but usually only from 7 days) before onset of clinical signs, and continues until the death of the animal.
- ◆ Not all rabid animals excrete virus.
- ◆ Clinical recovery is exceptionally rare in man with only three recorded cases worldwide and in these cases rabies virus was not detected.
- ◆ Infection and recovery is sometimes recorded in wildlife (foxes, bats) and in dogs.
- ◆ Virus may persist in these recovered animals.

- ◆ Chronic or latent infection is epidemiologically quite rare, but has been reported with some African virus strains.
- ◆ Asymptomatic non-fatal rabies in dogs has been reported from Ethiopia and some other countries but there is no indication that symptomless carriers play any great part in the spread of the disease.

Carcasses

- ◆ In addition to the salivary glands, there is neural spread of virus from the brain to various other organs and tissues during the clinical phase of the disease.
- ◆ Virus transmission to carrion animals eating *fresh rabies carcasses* is at least theoretically possible.
- ◆ Corneas removed from human donors dying with undiagnosed or unsuspected rabies have been incriminated in the transmission of the virus to graft recipients.

Animal products and by-products

- ◆ The *milk of a rabid cow may contain rabies virus* and although of very little significance in the transmission of the disease should not be used for human or animal consumption.
- ◆ Transmission of rabies from mother to suckling infant via the breast milk has been suspected in at least one human case, and is well documented in animals
- ◆ Environmental contamination, other than aerosol contamination in bat caves, is of very little significance in transmission of the disease.

2. Epidemiology

2.1 Distribution

- ◆ present in most of *Europe except the United Kingdom, Ireland and parts of Scandinavia.*
- ◆ present throughout Africa, the Middle East, most of Asia, and the Americas.
- ◆ Japan, Singapore, New Zealand, Papua New Guinea and the Pacific Islands are free of the disease.

2.2 Host range and susceptibility

- ◆ All warm-blooded animals are susceptible to rabies. However the *degree of susceptibility is different.*
 - Foxes and wolves have extreme high susceptibility.
 - Domestic cats, cattle, and rodents have high susceptibility
 - dogs, sheep, goats horses and non-human primates have moderate susceptibility.
 - Birds do not play any part in the maintenance or spread of rabies infections.
- ◆ The most important animal families in maintaining rabies cycles are:
 - *Canidae — dogs, foxes, jackals, wolves, etc*
 - *Mustelidae — skunks, martens, weasels, ferrets and stoats*
 - *Viverridae — mongooses and meerkats*
 - *Procyonidae — raccoons*
 - *Chiroptera — bats*
- ◆ Many animal species can be regarded as *accidental hosts or 'dead-end' hosts*, and these species have no epidemiological significance in sustaining rabies epidemics. These include *humans and other primates, horses, cattle, sheep and pigs*. Feral pigs under conditions of high density may be a factor in the transmission of the disease.

- ◆ In any ecosystem, in which rabies is currently endemic, *one or at the most two of the above species are responsible for perpetuation of epidemics*, although accidental infections can also occur in a wide range of other species.
- ◆ Rabies viruses appear to adapt to specific host species.
- ◆ Species-adapted *biotypes* can be identified by modern monoclonal antibody studies, and these generally seem to be quite stable genetically. Whilst biotypes may readily cause infection in another species, continuing transmission cycles are not maintained in the second species.

2.3 Incubation period

- ◆ The incubation period is prolonged and variable.
- ◆ The incubation period may vary from a few days to several years, but is typically 1 to 3 months.
- ◆ Incubation periods in excess of one year have been documented, but this is rare.
- ◆ The maximum incubation period given in the OIE Code, for regulatory purposes, is *six months*.
- ◆ Several factors influence the duration of the incubation period. These include:
 - the virus strain,
 - virus dose,
 - the distance of the bite site from the central nervous system
 - the richness of the sensory enervation at the site of virus entry into the body.
- ◆ This implies that the incubation period following a bite on the face or muzzle could be expected to be much shorter than that after a bite on the trunk or limbs.

2.4 Modes of transmission

- ◆ Following primary infection, the virus enters an *eclipse phase in which it cannot be easily detected within the host*.
- ◆ This phase may last for several days or months.
- ◆ Investigations have shown both *direct entry of virus into peripheral nerves at the site of infection and indirect entry after viral replication in non-nervous tissue (i.e., muscle cells)*.
- ◆ During the eclipse phase, the host immune defenses may confer cell-mediated immunity against viral infection.
- ◆ The uptake of virus into peripheral nerves is important for progressive infection to occur.
- ◆ After uptake into peripheral nerves, rabies virus is transported to the central nervous system (CNS) via retrograde axoplasmic flow.
- ◆ Typically this occurs via sensory and motor nerves at the initial site of infection.
- ◆ Dissemination of virus within the CNS is rapid, and includes early involvement of limbic system neurons. Active cerebral infection is followed by passive centrifugal spread of virus to peripheral nerves.
- ◆ The amplification of infection within the CNS occurs through cycles of viral replication and cell-to-cell transfer of progeny virus. *Centrifugal spread of virus may lead to the invasion of highly innervated sites of various tissues, including the salivary glands*. During this period of cerebral infection, the classic behavioral changes associated with rabies develop.

- ◆ Rabies virus is transmitted by contamination of a fresh wound with infected saliva from the bite of a rabid animal or from licking abraded skin or mucous membranes.
- ◆ The virus cannot penetrate intact skin.
- ◆ Respiratory and oral transmission can also occur.

- ◆ Post-vicinal rabies after immunization due to incomplete inactivation has occurred.
- ◆ People have died of rabies after receiving corneal grafts from donors who had died of unsuspected rabies.
- ◆ In several species of mammals rabies has been transmitted across the placenta from mother to fetus.
- ◆ Insect vector transmission does not occur.
- ◆ No evidence exists for transmission in semen or embryos.

Factors influencing transmission

The main determinant of transmission is the *population density of non-immunized susceptible key host species that are free roaming within an ecosystem.*

In this regard the presence of many stray dogs and cats in urban areas of Ethiopia can be sufficient to create significant risks for the spread of rabies in major cities and towns. The wide spread and abundant wild life populations have also a role in sylvatic (wildlife) rabies.

3. Diagnosis

3.1 Clinical signs

Dogs

There are three stages namely **prodromal, furious and dumb.**

The prodromal stage

- ◆ lasts 2–3 days, is often missed by the dog's owner.
- ◆ In this stage there often is a sudden change in temperament. Dogs that are normally friendly towards people may suddenly become snappy and uncertain, and shy dogs may become affectionate.
- ◆ The prodromal stage is followed by one of two syndromes — *furious or dumb rabies.*

- ◆ The dumb form is more common, but some dogs may alternate between dumb and furious rabies.
- ◆ The clinical course is often shorter in dumb rabies, but in both forms *death occurs 3–7 days after the end of the prodromal stage.*
- ◆ There may be increased or exaggerated sensitivity at the wound site to any sensory stimulus, especially touch.

The furious form

- ◆ the dog becomes unusually restless, seldom lying or sitting in one spot for more than a short time and if confined it moves around ceaselessly in the confined space.
- ◆ The pupils are dilated, there is loss of the corneal reflex, and sometimes a squint.
- ◆ The animal assumes a watchful, puzzled or apprehensive look (an important sign) and may snap at imaginary objects.
- ◆ There is a change in phonation (voice), often with a characteristic low-pitched hoarse howling.
- ◆ At certain periods the dog seems possessed of abnormal strength and insensitivity to pain.
- ◆ Bars of cages, furniture and other objects are frequently attacked to the point where the animal's teeth are reduced to stumps and the mouth lacerated.
- ◆ If the dog is not under restraint, this excitable energy is manifested by furious, aimless running (sometimes for long distances) and by snapping at animate or inanimate objects in its path.
- ◆ There is depraved appetite, with animals eating such items as stones, sticks or earth.
- ◆ The furious signs abate after 1–4 days and are replaced by rapidly progressing ataxia, convulsions and ascending paralysis.

The dumb form

- ◆ the dog remains quiet, is not irritable, and only bites when provoked.
- ◆ It is lethargic and may hide behind any cover. The watchful, apprehensive look in the eyes, noted in the furious form, is also present.
- ◆ There is paralysis of the hindquarters and muscle tremors. A characteristic late sign is paralysis of the jaw ('dropped jaw').
- ◆ The tongue is also paralyzed and hangs flaccidly from the mouth, and there is drooling of saliva.
- ◆ The dog is unable to eat. It is also unable to lap water, although it may try hard to do so.
- ◆ The owner may suspect oesophageal obstruction and attempt to examine the animal or have it examined by a veterinarian.
- ◆ In contrast to human rabies, hydrophobia is a rare sign in dogs and other animals.
- ◆ Paralysis increases and death supervenes within a few days, usually from paralysis of respiratory muscles.

Cats

- ◆ The clinical signs are generally similar to those of dogs, but *the furious form occurs in about 75% of cases*.
- ◆ The prodromal stage seldom lasts for more than 24 hours.
- ◆ The furious stage lasts 1–4 days.
- ◆ Rabid cats often retreat into hiding from which they ferociously spring to attack people or other animals when approached.
- ◆ Their pupils are dilated, backs arched and claws protruded.
- ◆ They may mew continuously and this becomes hoarse.
- ◆ As the disease progresses into the paralytic phase, the animal shows marked
- ◆ in coordination followed by posterior paralysis.
- ◆ The muscles of the head become paralyzed and the animal soon lapses into a coma and dies.

Horses

- ◆ Clinical signs of rabies in the horse are *highly variable* and can be easily confused with other diseases affecting the nervous system, such as cervical vertebral malformation or other viral encephalitides.
- ◆ There are three forms of rabies in the horse:
 - *the furious or cerebral form,*
 - *the dumb or brainstem form and*
 - *the spinal cord or paralytic form.*
- ◆ **Absence of aggression in horses does not rule out rabies.**
- ◆ **Clinical signs can include *colic and lameness but in most cases horses show hyperaesthesia, fever, ataxia and paresis.***
- ◆ Ataxia and paresis frequently begin in the hindquarters and progress cranially.
- ◆ Loss of tail and anal sphincter tone is common.
- ◆ The disease will progress with most animals becoming depressed, recumbent and comatose before death.
- ◆ In the furious form, periods of marked excitation and aggressiveness alternate with periods of relative calm. Affected horses become restless, stare, paw, or move their ears and draw their upper lips back and forth continually and salivate excessively.
- ◆ Sexual excitement may be intense.
- ◆ They may grind their teeth and whinny as if in great pain and show signs of acute colic.
- ◆ They may lash out with incredible fury at any perceived threat or restraint and may bite or charge other animals or moving objects.
- ◆ They often bite or rub at the bite site causing self-mutilation.
- ◆ As paralysis develops horses fall repeatedly, finally remaining down with their legs thrashing.
- ◆ Equine rabies progresses rapidly with most affected animals dying *5 days after onset of clinical signs.*

Cattle

- ◆ There is initial depression and *cessation of milk production*.
- ◆ Paralysis of throat muscles with grinding of teeth and excess salivation is common and may lead to a false diagnosis of oesophageal obstruction.
- ◆ Cattle may bellow frequently in a low-pitched voice.
- ◆ There is increased sexual excitement.
- ◆ Some animals develop one or more furious stages and may attack other animals or objects; they charge and butt, but seldom bite.
- ◆ Other animals show little excitement.
- ◆ As paralysis develops, cattle knuckle over at the fetlocks, stumble and fall frequently.
- ◆ Finally they are unable to rise, lapse into a coma and die.

Sheep

- ◆ Several almost simultaneous cases often occur in a flock, resulting from multiple attacks by a rabid predator.
- ◆ There is a period of excitement during which affected sheep move restlessly, salivate, grind their teeth, show twitching of the lips and oscillation of the
- ◆ tongue, pulling of wool and aggressive butting of other sheep or objects.
- ◆ Rams exhibit sexual excitement.
- ◆ Sheep may be either silent or emit frequent hoarse bleats.
- ◆ The excitation stage is followed by depression, increasing weakness, paralysis and recumbency.
- ◆ Sheep generally die within 72 hours of the onset of clinical signs.

Pigs

- ◆ Affected pigs tend to stand trembling in a darkened corner but may dash out and bite if provoked.
- ◆ They may rub or gnaw at the bite site.
- ◆ There is abnormal deep grunting.
- ◆ Depraved appetite is common.
- ◆ There may be alternate periods of intense activity and recumbency.
- ◆ Sows may kill their offspring.
- ◆ There is increasing dullness, incoordination and paralysis.

Foxes

- ◆ Both dumb and furious forms occur.
- ◆ There is anorexia, agitation and a *characteristic abnormal cry*.
- ◆ *Normal fear of people and other animals is lost.*
- ◆ Foxes may snarl, charge and snap at passing people, animals and even vehicles.
- ◆ As the disease progresses the animal becomes more confused and uncoordinated.
- ◆ With the onset of paralysis it falls and may be unable to rise. It may attempt to drag itself before finally lapsing into a coma and dying.

Other wildlife species

- ◆ The clinical signs are variable.
- ◆ A most important common feature is *loss of normal shyness and fear of people and other animals.*
- ◆ This makes such animals particularly dangerous to people, who wrongly interpret this behavior as indicating friendliness.

Humans

The clinical manifestations of rabies in humans can be divided into *five stages as follows.*

- ◆ *An incubation period of variable length (between 20 and 90 days in more than 90% of cases).*

- ◆ *A prodromal phase* of 2–10 days marked by non-specific symptoms, such as headache, malaise, muscular pain, loss of appetite, nausea, vomiting and a non-productive cough. The prodromal symptom, which most suggests impending rabies, is the complaint of paraesthesias (numbness or tingling) and/or fasciculations (twitching) at or about the site of inoculation of the virus.
- ◆ *An encephalitic phase* characterized by periods of excessive motor activity, excitation and agitation. Confusion, hallucinations, muscle spasms, seizures and facial paralysis occur. Characteristically, lucid periods are interspersed with the episodes of mental aberration. Brain stem dysfunction begins shortly after the onset of the encephalitic phase. Excessive salivation and difficulty in swallowing appear and hydrophobia is seen in about 50% of cases.
- ◆ Coma
- ◆ *Respiratory failure and death*, or recovery (extremely rare). The median survival after the onset of symptoms is about four days, unless intensive respiratory support is instituted.

3.2 Pathology

- ◆ There are no consistent macroscopic lesions in animals that die of rabies. Animals may be emaciated and there may be self-inflicted injury, particularly at the site of infection in carnivores, or injuries sustained in fights.
- ◆ Foreign bodies may be found in the stomach, particularly in monogastric animals.
- ◆ Microscopically, the most significant lesions are in the central nervous system and cranial and spinal ganglia.
- ◆ There is perivascular cuffing, focal and diffuse gliosis, neuronal degeneration and intracytoplasmic inclusion bodies or *Negri bodies* in the neurones.

- ◆ Negri bodies vary in size with the host, are large in dogs and cattle and are found most commonly in the neurones of the hippocampus or in the Purkinje cells of the cerebellum in cattle.

3.3 Laboratory tests

- ◆ Rabies may be suspected in animals that display neurological signs, including behavioural changes and paralysis, followed by death within 10 days. The diagnosis must be confirmed by laboratory tests.
- ◆ Animal specimens should therefore be sent to the designated laboratory approved to be capable of undertaking the required laboratory examination.

3.3.1 Specimens required/transport

- ◆ Whole brains collected after natural death or from animals sacrificed during any stage of the clinical syndrome are required for rabies diagnosis.
- ◆ Severed heads and, for small animals, whole carcasses, should be forwarded, chilled. Care should be taken not to damage the brain during slaughter
- ◆ unpreserved and formalin-fixed samples of other tissues should be collected at autopsy to aid differential diagnosis.
- ◆ Whole blood (in EDTA anticoagulant) and serum are required for the rapid fluorescent focus inhibition test.

4. Differential diagnosis

Carnivores

- ◆ Clinical signs of rabies can look similar to any illness that causes flaccid paralysis of the larynx, general depression or abnormal aggression.
- ◆ Change in behavior is the key clinical sign for wildlife and domesticated animals and this sign may be missed by the owner of an affected animal.

- ◆ The behavior changes described for rabies can also occur with canine distemper in dogs, foxes and ferrets.

Herbivores

- ◆ Clinical signs of rabies can look similar to choke or laryngeal/pharyngeal obstruction with a foreign body, any neurological disease that causes ataxia or any metabolic disease that causes depression.
- ◆ Change in behavior is a key clinical sign for wildlife.

5. Safety precautions

- ◆ Potentially rabid animals should be approached with extreme caution.
- ◆ Every effort should be made to capture and safely confine them.
- ◆ If a suspected case is first presented at a veterinary clinic it should be hospitalized away from other animals.
- ◆ Confined suspect rabid animals should be under veterinary care..
- ◆ If the animal cannot be safely captured or confined and therefore constitutes a risk to people or other animals it should be destroyed immediately.
- ◆ If destruction is to be carried out with a firearm, it is recommended to try to shoot through the heart rather than the head as fixed brain samples are used in diagnosis of the disease.
- ◆ it should be noted that a head shot with a large calibre weapon would not only destroy all useful tissue but may pose considerable danger to the shooter and other bystanders from *virus aerosols*. Smaller calibre weapons (32-calibre maximum for cats and small dogs) should therefore be used.
- ◆ Companion animals can be destroyed with a lethal injection using a crush cage if necessary.
- ◆ Thick rubber gloves, eye goggles, face mask and a plastic or rubber apron that can easily be disinfected should be worn when doing autopsies or when working with live rabies virus in a laboratory.

- ◆ Carcasses should be incinerated, and used instruments soaked in disinfectant and then boiled or autoclaved.
- ◆ If a person is bitten by a suspected rabid animal, or if a fresh wound or skin abrasion is contaminated with its saliva or tissue fluids, post-exposure treatment should be started immediately. The treatment course may be suspended if laboratory examination conclusively shows that the animal was not rabid.

6. Resistance and immunity

6.1 Innate and passive immunity

- ◆ Although all warm-blooded animals, including humans, are susceptible to rabies, the degree of susceptibility is not uniform.
- ◆ Once rabies virus infects the brain and clinical signs occur, the disease is almost invariably rapidly fatal. However, on the basis of the finding of naturally-occurring rabies antibodies, much presumptive evidence suggests that abortive infections may occur in a proportion of animals in bat and carnivore populations during rabies epidemics.

6.2 Active immunity

- ◆ Apart from the few instances of dogs surviving rabies or developing chronic infection in West Africa, Ethiopia and India, it can be assumed that the carrier state in dogs is extremely rare.
- ◆ A non-fatal form of rabies in dogs was first recognized in Senegal and Niger in 1912 and its distribution apparently extended across Zaire, Cameroon, Ivory Coast, Ghana, Nigeria and the Sudan.
- ◆ There have been no recent reports , but strains of virus capable of producing *non-fatal and chronic infection of dogs were isolated in Ethiopia in the 1950s*
- ◆ *and 1970s and similar findings were reported in India.*
- ◆ Naturally-infected dogs were capable of transmitting fatal disease to humans, in some instances over a period of years.

- ◆ *The site of chronic infection may be the tonsil.* In a recent investigation, four isolations of rabies virus were made from saliva of healthy dogs presented for vaccination over a period of 5 years in Nigeria. Only one of these isolates produced fatal disease in puppies

6.2.1 Vaccination

Domestic animals

- ◆ Modern rabies vaccines that afford a high level of immunity are available for dogs, cats and domestic livestock species. These are broadly classified into three types:
 - attenuated ('live') virus vaccines:
 - inactivated nervous tissue vaccines, and
 - inactivated tissue culture vaccines.
- ◆ Safety problems have been experienced with some attenuated virus vaccines, with occasional field reports of vaccine-induced rabies in dogs and cats. For this reason they have largely been supplanted by inactivated tissue culture vaccines, and it is recommended that only *inactivated tissue culture vaccines be used for parenteral vaccination of domestic animals.*
- ◆ Several vaccines are available that provide solid immunity in adult animals for at least three years. However some studies have demonstrated poorer immune responses in young dogs, which are not necessarily associated with interference from maternal antibodies. It is recommended that pups vaccinated under 6 months of age be re-vaccinated 6 months later.
- ◆ Within one month after primary vaccination, a peak rabies antibody titer is reached and the animal can be considered immunized.
- ◆ A single vaccination of an already infected animal will not prevent the onset of clinical rabies.
- ◆ The more extensive post-exposure therapy of vaccine and antiserum used after dangerous exposure of humans is not used in animals.

- ◆ *Mass vaccination of dogs and cats, along with elimination of stray animals and control over the movement of owned animals, is the integral part of urban cycle rabies eradication.*
- ◆ Vaccination of livestock is not essential for eradication, but may be desirable to prevent sporadic cases in these animals. Pleasure horses, valuable stud animals and any other animal that comes into frequent human contact during the incursion should be considered for vaccination.

Humans

- ◆ Modern, safe and potent vaccines are available for human use, both for pre- and post-exposure prophylaxis.
- ◆ Pre-exposure immunization may be administered to people who may be occupationally exposed to infection, such as veterinarians and laboratory diagnostic staff.
- ◆ The primary immunization course consists of three injections of HDCV (human diploid cell vaccine) over a 28-day period followed by boosters at regular intervals.
- ◆ Post-exposure prophylaxis, combined with appropriate first-aid treatment should be administered as soon as possible after a potentially dangerous exposure to the virus (eg after a bite from a suspect rabid animal).
- ◆ Post-exposure prophylaxis consists of up to five injections of HDCV, with or without human rabies immune gamma globulins, depending on the pre-existing immune status of the patient.

Wildlife

Vaccination

- ◆ Oral vaccination can be delivered to wildlife by a bait system.
- ◆ Oral vaccination is made possible by the ability of vaccine strains to produce immunizing infection through the oral/pharyngeal route.

- ◆ High vaccine virus doses are incorporated with stabilizers into suitable baits (eg chicken heads or custom manufactured sausages).
- ◆ Strategic vaccination in Switzerland, in which target areas were seeded three times per year with 12–15 baits per square km, achieved eradication of fox rabies from the country within a few years.
- ◆ Successful large-scale, campaigns against fox rabies have now been mounted in Europe, and in Canada in combination with the trap–vaccinate–release (TVR) method.
- ◆ Attenuated ('live') vaccines used in oral rabies baiting programs do have the problem of occasionally causing vaccine rabies in some target and non-target species, ie fox, raccoon, skunk and calf. In most species where the vaccine immunizes successfully there will be individuals who develop clinical rabies.
- ◆ There will always be individuals with depressed immune systems that will be at risk.
- ◆ The success of these oral vaccines also varies according to the species involved.
- ◆ Some species accept baits easily and can absorb vaccine well via the oropharyngeal mucosa and develop immunity, while others do not easily accept baits, have poor absorption via the oropharynx and develop better immunity with intramuscular injection (ie TVR).
- ◆ Other important developments have occurred in virus-vector vaccine technology. A vaccinia-rabies glycoprotein recombinant virus vaccine (V-RG) has been developed .It has now been used very successfully in the field in Europe and North America and now has a limited license for field use in the USA.
- ◆ American experience is that V-RG is an effective vaccine for foxes but not for skunks.
- ◆ Another vaccine under development is the human adenovirus recombinant. This vaccine less concern to human health experts than the vaccinia vector.

Trap–vaccinate–release (TVR)

- ◆ This involves live capturing of wildlife with cage traps and vaccinating by intramuscular injection. This method could be used for endangered species or species of wildlife that live in areas inhabited by people where population reduction methods and oral baiting methods are unsuitable, not acceptable to the public or satisfactory baits have not been developed.
- ◆ Population reduction (by shooting, gassing, poisoning) cannot be carried out in urban areas and sometimes oral baiting is unsuccessful in these areas because of the abundant food supplies available to wildlife.

7. Control and Prevention

7.1 Principles

- ◆ rabies may not have significant importance to disrupt export trade of our animals and animal products. However, it stands out as uniquely terrifying because if the clinical signs of disease appear it is almost fatal. Its prevention and control is primarily driven by the necessity to prevent spread to people.
- ◆ The first line of defense against rabies is the continued implementation of preventive and control measures.

7.2 Methods to prevent spread and eliminate pathogens

For the prevention and control of rabies, the following terms are used:

- *Infected animal* – an animal that has confirmed rabies or is believed to have rabies;
- *Dangerous contact animal* – an animal that has been in direct contact with an infected animal;
- *Suspect animal* – other animals that may have been in the same area as the infected animal.

Preventive and control measures should involve any or all of the following measures:

- Early recognition of rabies cases in animals;
- Delineation of the geographic area of the outbreak;
- quarantine or destruction of infected animals or dangerous contact animals;
- Vaccination and identification of animals;
- detention or destruction of stray animals or animals not properly controlled or vaccinated;
- Detection and management in wildlife;
- Conducting public education campaigns;
- Reporting of animal bite cases and prophylactic treatment in humans.

7.2.1 Quarantine

Infected animals

- ◆ When there are reasonable grounds for ***suspicion of rabies*** in an animal it should be ***detained and isolated***.
- ◆ Where an animal appears too dangerous to approach, it should be destroyed

Dangerous contact animals

- ◆ Contact animal could incubate the disease for many months.
- ◆ The availability of ***secure accommodation for a period of up to six months*** is a factor in deciding whether to detain or destroy suspects.
- ◆ If rabies is confirmed in an animal in quarantine, any animals kept in close proximity to the rabid animal and released within the previous 15 days would need to be recalled.
- ◆ Such animals, if previously vaccinated for rabies, should be serologically tested for rabies antibodies.

7.2.2 Movement controls

When a case of rabies in an animal has been confirmed:

- The index case should be destroyed,
 - The appropriate area disinfected and
 - Other susceptible animals on the premises should be quarantined, and vaccinated and remain there until the official veterinarian decides.
 - There will be no movement of unvaccinated susceptible animals on or off the infected premise.
- ◆ Where a rabid animal has been at large in an area and there are a number of possible contacts, declaration of a *restricted area* and introduction of general confinement and movement controls for appropriate species in that area should be practiced.
 - ◆ If a human has been bitten by a dangerous contact animal, the animal should be destroyed and the intact head submitted to the laboratory for rapid diagnosis.
 - ◆ Household pets need to be confined at home until the emergency is considered to have passed.
 - ◆ The emergency must be regarded as continuing for at least 6 months following the completion of the vaccination program or of the occurrence of the last case.
 - ◆ If wildlife involvement is suspected, consideration would have to be given to vaccination and movement restrictions of farm animals in the area.
 - ◆ In the restricted area the owner of a dog or cat is responsible to ensure that the animal is at all times securely confined within their home.
 - ◆ All dogs and cats should be vaccinated and must not come into contact with any animal within 30 days of the rabies vaccination.
 - ◆ Vaccinated animals will be permanently identified in an approved manner and recorded.

- ◆ An unvaccinated dog or cat may be moved to another place within the same area with the approval of a veterinarian provided it is either carried in a secure container or muzzled and does not come into contact with any other animal at the premises to which it has been moved.

7.2.3 Detention and disposal of uncontrolled and unvaccinated animals

- ◆ For controlling urban rabies elimination or dramatic reduction in the number of stray or uncontrolled dogs and cats should be done.
- ◆ If there has been a single rabid dog that has had little or no opportunity to bite other dogs, owners of straying dogs may be given a short period of grace to control their dogs.
- ◆ However, in a situation where a rabid animal was free to roam, then stray dogs should be controlled promptly, a restricted area declared, contacts between animals reduced to the minimum and vaccination programs implemented.
- ◆ All stray unidentifiable animals would be collected and destroyed.
- ◆ All stray animals with identification would be impounded for collection within 24 hours. Those not collected within the specified period would be destroyed.
- ◆ Any animals released back to their owners would be subject to confinement and vaccination.

7.2.4 Reporting of animal bite cases in humans

- ◆ The reporting of animal bite cases in an area where rabies has spread to a number of domestic pets and other animals including wildlife, is essential for early evaluation and institution of post-exposure treatment of the human patient by the physician.
- ◆ Qualified on-site advice on post-exposure treatment and on the epidemiology of the disease would be essential.

7.2.5 Treatment of infected animals and humans

Animals

- ◆ Animals with clinical signs of rabies or who have a high suspicion of being infected with rabies should be immediately destroyed and specimens be submitted for laboratory testing.
- ◆ There is no treatment for rabies once clinical signs appear.

Humans

- ◆ Post-exposure treatment for rabies should be available.
- ◆ Pre-exposure (i. e vaccination) and post-exposure treatment regimens for rabies in humans should be made available to all medical practitioners found in the rabies affected areas.

7.2.6 Destruction of animals

- ◆ All animals in direct contact with a rabies case, i.e animals that have had access to the same cage, pen or yard or which have been separated only by a single wire fence, within 14 days before the disease was detected, will be considered and treated as dangerous contact animals.
- ◆ Depending on vaccination status, antibody titre result and factors relating to the extent of exposure to the rabid animal, either further quarantine or destruction of the animal will need to be considered.
- ◆ The areas that the animals occupied will need to be cleaned and disinfected.
- ◆ Stray, unvaccinated dogs and cats should be destroyed if not claimed soon after capture.
- ◆ Stray dogs registered and vaccinated against rabies should be captured and held for about 24 hours for the owner to claim his/her animal, failing which, the animal would be destroyed.

- ◆ Unvaccinated dogs not under control in a vaccination zone should be destroyed.

7.2.7 Treatment of animal products

- ◆ Where a suspected or known rabid animal is found on a farm, attention should be given to the disposal of farm products from both suspect and contact animals.
- ◆ *Milk from affected or suspect cows should be disposed off as unsuitable for human or animal consumption.*

7.2.8 Disposal

- ◆ Dead and destroyed animals should be burnt or buried after the necessary diagnostic specimens have been taken.

7.2.9 Decontamination

- ◆ The infectivity of rabies virus is destroyed by most organic solvents, by oxidising agents, and by surface-active agents (quaternary ammonium compounds, soaps, and detergents).
- ◆ Oxidizing agents such as hypochlorite may be used for environmental decontamination.
- ◆ Quaternary ammonium compounds are also useful for personal disinfection.
- ◆ Should accidental exposure occur as when a person is bitten, saliva is splashed on the hands or face, or suspensions containing virus are spilled or splashed, first aid should be applied immediately
- ◆ If rabies is detected or suspected in an animal held or handled in a quarantine center, laboratory, or household, the areas contaminated by the rabid or suspect animal should be cleaned and disinfected with warm soapy water, an oxidising agent such as sodium hypochlorite or an acid or alkali after the animal has died or been destroyed.

- ◆ Vehicles used to transport dogs, cats and other animals to a detention center or to a laboratory should be periodically cleaned and sprayed with one of the disinfectants stated above.

7.2.10 Vaccination

Animals

- ◆ In a rabies outbreak area, dogs and cats should be ***vaccinated compulsorily***.
- ◆ Cats are particularly at risk if wildlife is infected because of their nocturnal hunting behavior.
- ◆ Vaccination of at-risk, valuable farm animals may also be a sensible precaution.
- ◆ *safe and effective inactivated vaccines* to protect animals against rabies are now available and attenuated parenteral vaccines need not be considered.
- ◆ Compulsory mass vaccination of dogs, cats may be carried out at designated vaccination centers or at the premises of owners.
- ◆ The identification of vaccinated animals by some suitable means (eg serially numbered dog tag or collar of colored rope inside plastic tubing and an effective recording system would be necessary).

Humans

- ◆ Pre-exposure, prophylactic immunization would be required for people with a high-risk of exposure to rabies:
 - Veterinarians and their assistants in clinics and at the diagnostic laboratory,
 - stray dog and cat catchers,
 - animal handlers at quarantine centers and laboratories and
 - wildlife control workers should all be considered at high-risk and be immunized.

- ◆ With the exception of those in the diagnostic laboratory and quarantine centers, where immunization should be carried out before an outbreak, all the others should only receive the required course of vaccinations at the onset of an outbreak.

Detection and management in wildlife

- ◆ rabies requires moderate to high densities of medium-sized carnivores, over large areas (*>5000 square km*) in order to persist.
- ◆ experience indicates that local rabies infections are adapted to be spread by only a small number of species.
- ◆ Although any mammal may be infected by any of these variants, only 1–5 species are involved in persistence and spread of a particular form.
- ◆ *In the tropics, rabies persists in dog populations.*
- ◆ Rabies spread chiefly by cats exists only in southern Africa.
- ◆ Prevention of spread of introduced rabies to susceptible wildlife may best be achieved by the *control and confinement of domestic animals* in the area.
- ◆ Prompt and effective measures to detect and eliminate any outbreak in wildlife are essential, to stop the disease at an initial focus before it becomes widespread.
- ◆ The following methods are used to control rabies in wildlife:
 - population reduction
 - trap–vaccinate–release (TVR)
 - oral vaccination
 - combinations of the above

Population reduction

- ◆ Where there has been demonstrated exposure of wildlife in an urban situation, and the focus outbreak has been detected early, it may be desirable to initiate wildlife reduction in the affected area concurrently with control measures in domestic animals.

- ◆ Where sampling demonstrates rabies presence in wildlife *in a discrete and controllable area*, actions should be undertaken to reduce the population density of involved species to below the threshold for rabies persistence in the area.
- ◆ Threshold densities for reservoir species are widely variable, and the rate of rabies movement through populations is not a species constant.
- ◆ The decision for stamping out will be much more difficult if the species affected are endangered native species such as red fox or red wolf in our context.
- ◆ Wildlife population reduction may not achieve disease control if the level of reduction is inadequate.

Trap–vaccinate–release (TVR)

- ◆ If wildlife reduction is unacceptable for some reasons or the outbreak is in an urban area where shooting and poisoning of target animals cannot be undertaken, TVR programs may be initiated.
- ◆ TVR may become also the only option where vaccine baits have not been developed for a species.

Oral vaccination

- ◆ When rabies in wildlife is accepted to be widespread and to have established a sylvatic cycle, serious consideration should be given to *large-scale wildlife vaccination programs based on baiting with accepted oral vaccines for the target species*.

7.3 Public awareness

- ◆ The roles and responsibilities of veterinary and medical practitioners and local government, wildlife and public health authorities in an outbreak area should be clearly defined and made known to all concerned.
- ◆ Veterinary and medical practitioners report all suspect cases of rabies and take appropriate post-exposure measures.

- ◆ Local government and public health authorities that may assist in rabies control measures during rabies outbreak should have to be properly briefed.
- ◆ The public should be kept informed on the public health aspects of rabies, the requirements related to the control and eradication campaign including the reporting of animal bite cases.