

## Review of rabies situation and control in the North African Region with a focus on Tunisia

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### Summary

Rabies is a major zoonosis that affects the central nervous system of warm-blooded mammals. The disease is present worldwide, except for some islands. Africa and Asia record over 95% of the fatal cases of rabies worldwide, and therefore the greatest risk to human life from rabies occurs in these regions. Mass vaccination of dogs is the most appropriate way to control and eliminate the disease at the animal source, in order to interrupt the infectious cycle of the disease from animals to humans. Rabies is endemic in the North African Region, and countries should be encouraged to develop programmes for eliminating human rabies through the implementation of sustained campaigns to immunise dogs and by providing post-exposure

prophylaxis (PEP) to people who have been exposed to suspected rabid dogs. In Tunisia, the national strategy against rabies was started in 1981 and it has been upgraded since. Following the launch of the annual vaccination programme in 1993, there was a significant improvement in the health status for rabies in Tunisia, with a decrease in the number of cases in animals and humans. Since 2011, an increase in cases of rabies in dogs and humans has been observed, due to lower vaccination coverage, mismanagement of waste and an increase in the stray dog population. The political will at international, regional and national levels is the cornerstone of the strategy to eliminate the disease. In the framework of the regional approach in the Maghreb, additional efforts and political willingness are necessary at the national level to better control and eventually eliminate rabies.

### **Keywords**

Control programme – Rabies – Stray dog – Vaccination – Zoonosis.

### **Introduction**

Rabies is a major zoonosis that affects the central nervous system of warm-blooded mammals; it is caused by viruses belonging to the *Lyssavirus* genus within the family Rhabdoviridae (1, 2). The disease is present worldwide, except for some islands. Although some countries have developed effective control programmes able to eliminate the disease in animals, rabies remains endemic in many animal species, including wildlife, in many countries (1, 3). Rabies kills about 60,000 people annually, mainly in African and Asian countries (4). It is estimated that more than 95% of human cases are caused by the bites of dogs infected with rabies (5). Currently, more than 80% of rabies deaths occur in rural areas where access to health services, including post-exposure prophylaxis (PEP), is limited or non-existent (4, 6). Africa and Asia record over 95% of the fatal cases of rabies worldwide, and therefore the greatest risk to human life from rabies occurs in these regions (7). Mass vaccination of dogs is the most appropriate way to fight and eliminate the disease at the animal source, in order to interrupt the infectious cycle of the disease from other species to humans. It is estimated that the vaccination of at least

70% of the dogs in infected countries could eliminate rabies in dogs and, as a consequence, the number of human cases could be rapidly reduced to zero (5).

The mass vaccination of dogs is also considered the most economical method to protect human beings from rabies. Each year, approximately 9 to 12 million people throughout the world are given prophylactic treatment following a bite from an animal potentially infected with rabies, at a total cost of about US\$ 2.1 billion (8).

The World Organisation for Animal Health (OIE), in collaboration with other international organisations, is heavily committed to the fight against rabies by emphasising that veterinarians and National Veterinary Services have a primary responsibility in applying their knowledge and skills to help control this zoonosis. To this end, rabies is also one of the topics identified as a priority by the OIE, the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO), in the framework of the joint 'One Health' approach that aims to address health risks at the human–animal–ecosystem interfaces (7).

The objective of this paper is to review the rabies situation and the control measures in place in the North African Region, with a major focus on Tunisia. This region represents a continued threat for introduction of the disease into Western European countries that are currently free of rabies. Rabies is endemic in North Africa and, in particular, the northern part is considered a high-risk zone where the disease represents a serious public health problem.

## **Overview of rabies in North Africa**

The Maghreb Region, which includes Mauritania, Morocco, Algeria, Tunisia and Libya, covers about 4 million km<sup>2</sup>. This territory is inhabited by nearly 90 million people, and 45% of the population lives in rural areas. About 70 million large animals are present in this zone – which is a significant resource for poor rural populations and also for the domestic economy – while the canine population in Morocco, Algeria, Tunisia and Libya is estimated to be around 4–5 million (1.5–

2 million in Morocco; 1.1–1.5 million in Algeria; 600–800,000 in Tunisia; 1–1.5 million in Libya). The dynamics of the canine population shows a high turnover rate and is characterised by a young dog population (many are aged two to three years), with the percentage of dogs less than one year of age ranging from 18 to 30%. The proportion of males is 60–70% and more than 90% of dogs are accessible for vaccination (9, 10). The dog density (number of dogs per householder) is on average 1.3 in urban areas and 1.9 in rural areas (9, 10).

From 2005 to 2013, a total of 389 laboratory confirmed human cases of rabies were notified by Algeria, Morocco and Tunisia through the OIE World Animal Health Information System (WAHIS), confirming that this disease remains a serious threat to the health of people (Fig. 1).

Insert Fig. 1

One project (the RABMEDCONTROL project 2007–2008) reported that about 90% of human cases in the North African Region were due to dog bites and that more than 85% occurred in people that did not receive PEP (7). The majority (>50%) of human cases in North Africa occur in young people aged between 0 and 19 years (9, 10).

The information available from Libya is scarce because of the unstable political situation. In 2008, three human rabies cases caused by dog bites were reported, and from 2009 to 2011 a total of 30 suspected human cases were registered (9).

The percentage of rabies events in animals, by species, in the North African Region in 2012 is shown in Fig. 2, based on the data submitted through WAHIS. Among animal species, ruminants and equids are the main victims of the disease, while dogs are the main reservoirs and transmitters of rabies in North Africa, and especially in the rural areas (11). Some of the North African countries (Morocco, Tunisia and Algeria) have developed programmes for eliminating human rabies through the implementation of sustained mass vaccination campaigns to immunise dogs and, in parallel, by

providing PEP to people who have been exposed to suspected rabid dogs. In addition to this, initiatives are also in place to control the stray dog population, to support surveillance and diagnostic testing capacity in the laboratories and to organise interdepartmental commissions (among the units of different ministries involved in the fight against rabies) to facilitate the implementation and coordination of the necessary actions (9). A phylogenetic analysis of rabies isolates suggested that there was no exchange of rabies virus between North Africa and the Sahel region, and that limited spread of the disease occurs among the countries in the North African Region (12).

Insert Fig. 2

## **Epidemiological review of rabies in Tunisia**

Tunisia is the smallest country in the North African Region; it shares borders with Algeria to the west and Libya to the southeast, and also abuts the Mediterranean Sea. The country covers an area of about 160,000 km<sup>2</sup> and has a Mediterranean coastline of 1,300 km. It comprises 24 Governorates and the population is estimated at around 11 million, with more than 65% living in urban areas (13).

Rabies is endemic in Tunisia, and the northern zones are the most severely affected. It is a notifiable disease in humans and other species, and surveillance networks for humans and animals are in place. It has been estimated that the dog population is about 1 million and the dog density is 1.3 dogs per dwelling in urban areas and 2.1 dogs per dwelling in the rural zones (9, 10).

A total of 8,747 cases of animal rabies were reported in Tunisia from 1983 to 2013, of which 38% (3,350) occurred in dogs. The number of laboratory confirmed rabies cases in humans, dogs and other animals notified in Tunisia over three decades is shown in Fig. 3. In the context of the epidemiology of rabies, the graph shows that the increase in human cases followed a surge of rabies in animals. In 1992, a major increase in rabies outbreaks was recorded, with 581 cases in animals and 25 human deaths. The figure clearly shows that the implementation (since 1993) of an annual mass vaccination

campaign for dogs significantly improved the rabies status in Tunisia. A decrease in rabies cases was registered annually. The situation has deteriorated since 2011, however, with an alarming increase in rabies cases in animals (360 cases) and in humans (7 cases). Figures as high as these had not been recorded for almost 20 years previously.

Insert Fig. 3

Since the start of the annual vaccination programme in 1993, approximately 420,000 dogs have been vaccinated yearly by official veterinarians and private veterinarians authorised by the Competent Authority; this represents about 45% of the estimated dog population in Tunisia. The percentage of dogs vaccinated and the number of rabies cases in dogs from 1983 to 2013 in Tunisia is indicated in Fig. 4. The graph indicates that the level of vaccination coverage has decreased since 2011 (around 382,000 dogs have been vaccinated annually in 2011 and later years), and a significant and continuing increase in rabies cases in dogs has been observed in parallel. Additional factors have played a role in the recent increase in canine rabies cases in Tunisia, such as the mismanagement of waste in some areas and the increase in the stray dog population in recent years.

Insert Fig. 4

## **Rabies control strategy implemented in Tunisia**

The national control strategy for rabies in Tunisia was started in 1981, when the first national control programme was adopted by the competent authorities. Since then, the strategy has been improved, first by implementing peri-focal vaccination from 1987 to 1992 – which involves the application of vaccination 10 km around the outbreak – and second, starting in 1992, by conducting an annual vaccination campaign in dogs on a yearly basis and for a period of two months (14, 15). Three different ministries are involved in designing and applying the control programme: the Departments of Agriculture, Health and the Interior. The pillars of the programme are the epidemiological surveillance, education and communication campaigns, as well as control of the stray dog population through

killing and sterilisation campaigns in collaboration with associations and non-governmental organisations. In addition, the programme includes a free mass vaccination campaign and free medical care for people exposed to the disease. A recent investigation conducted in Tunisia, which used a questionnaire to evaluate the annual vaccination campaign, analysed the reasons why the remaining population of dogs was not vaccinated. The results of this survey are reported in Table I.

Insert Table I

These results highlight the fact that more than 50% of the dogs that are not usually vaccinated during the annual vaccination campaign could be vaccinated if adequate and appropriate communication and awareness campaigns were conducted (15, 16).

In Tunisia, the overall annual costs for PEP are on average about US\$ 1.7 million. In 2009, a total of 32,531 people received treatment after being bitten by suspected rabid dogs, while in 2012 about 36,000 people received treatment (9). In addition, the financial impact of rabies was estimated for three countries (Algeria, Morocco and Tunisia): the prevention of human rabies was calculated to cost US\$ 13.5 million (PEP: \$90/person) annually, while the total cost of animal rabies was estimated to be US\$ 3.6 million with equal breakdown costs (US\$ 1.2 million) among livestock mortality, mass vaccination and reduction of the dog population.

### **Awareness, communication and education campaigns are part of the rabies control strategy**

Given that several ministries are in charge of different aspects of the programme to control rabies, communication among these stakeholders is a key factor in success. Communication with the general public, and especially with children, who are most likely to be affected by the disease, is also a main issue. In line with the recommendations of the OIE Global Conference on Rabies Control held in Seoul, Republic of Korea (September 2011) and the first meeting convened by the OIE Sub-Regional Representation for North Africa on rabies control in North Africa in Tunis, Tunisia (June 2014)

(17), a seminar dedicated to communication about rabies was held in Tunis, Tunisia (November 2015) (18). This seminar was attended by representatives from five North African countries (Algeria, Libya, Mauritania, Morocco and Tunisia). The participants represented various organisations involved in the fight against zoonoses, and especially rabies. In addition to the focal points of the Animal Health Communication Network (RECOMSA in French: RÉseau régional de COMmunication en Santé Animale) of the Mediterranean Animal Health Network (REMESA in French: RÉseau MÉditerranéen de Santé Animale), several ministries were represented: the Ministry of Agriculture, Ministry of Health, the Ministry of the Interior (in charge of the control of stray dogs) and the Ministry of Education, because children are the most frequent victims of dog bites, and therefore rabies. Several representatives of the Pasteur Institute also participated in this event. Communication experts from the OIE, WHO and a communication agency, as well as a sociologist, explained the basic principles of communication needed to send consistent messages and develop an effective national awareness campaign. Lively and constructive working-group sessions contributed to an exchange of views and improvement in the cohesion among the various players in the fight against rabies. This seminar demonstrated the very active collaboration on risk communication between the OIE and WHO. Moreover, it provided participants with a wide range of methodological tools that they can use to design risk communication strategies for their own countries, such as the Communication Handbook for Veterinary Services, jointly developed by the OIE and WHO (19).

Rabies vaccines (80,000 doses) were delivered through the OIE regional vaccine bank in Tunisia at the end of 2015, with the support of the European Union. This delivery was the first step towards the implementation of a national vaccination campaign, launched at the end of January 2016 by the Tunisian authorities, and provided the opportunity to organise the National Rabies Awareness Day, which was attended in particular by field-based veterinarians and technicians, journalists and media representatives.

In line with the outcomes of the Global Conference ‘Global elimination of dog-mediated human rabies – The time is now!’, which was held on 10–11 December 2015 in Geneva (Switzerland) (20), it is estimated that vaccinating 70% of dogs in zones where rabies is present can dramatically reduce human cases. In this context, the OIE regional vaccine bank mechanism is able to enhance the implementation of vaccination campaigns against rabies.

## Conclusion

Rabies is a disease that is fully preventable and the elimination of canine rabies is a realistic objective. In the Maghreb region, the epidemiology of rabies is well known, with dogs being the reservoir and vector of the disease to other animals and to humans in North Africa. In addition, the majority of dogs present in this territory are accessible to the vaccination programme. National control programmes in the North African area should play a predominant role, in line with programmes that should be elaborated and implemented at regional level. These can be effective in controlling and ultimately eliminating the disease, because there is limited exchange of rabies viruses among countries in the Maghreb (12).

The financial impact of rabies in North Africa is significant, and PEP is extremely expensive and overused in relation to the number of confirmed cases of canine rabies. Therefore, mass vaccination of dogs is the best and most economical way to control and eliminate the disease because the cost of the dog mass vaccination campaign is <10% of the overall PEP cost.

In the framework of a regional strategic approach in the Maghreb, additional efforts and political willingness are necessary at the national level to improve the control of the disease. Several shortcomings in the current national control programmes for rabies in the region may be highlighted, including:

- a shortage of financial and human resources;
- insufficient communication and awareness campaigns;

- inadequate coordination among the departments involved that belong to different ministries;
- insufficient vaccination coverage to break the infectious transmission cycle;
- underreporting of cases or suspected cases;
- insufficient participation by dog owners;
- inadequate stray dog population management;
- mismanagement of household waste.

The OIE Sub-Regional Representation for North Africa plays an important role in assisting countries in the Maghreb region to coordinate activities among their Chief Veterinary Officers by sharing experiences, information and data on rabies. In addition, the OIE Reference Centres should encourage the development of harmonised animal disease surveillance activities, in line with international standards. The REMESA is also a major platform for coordinating and managing actions against priority diseases such as rabies in collaboration with the national laboratories based in North African countries.

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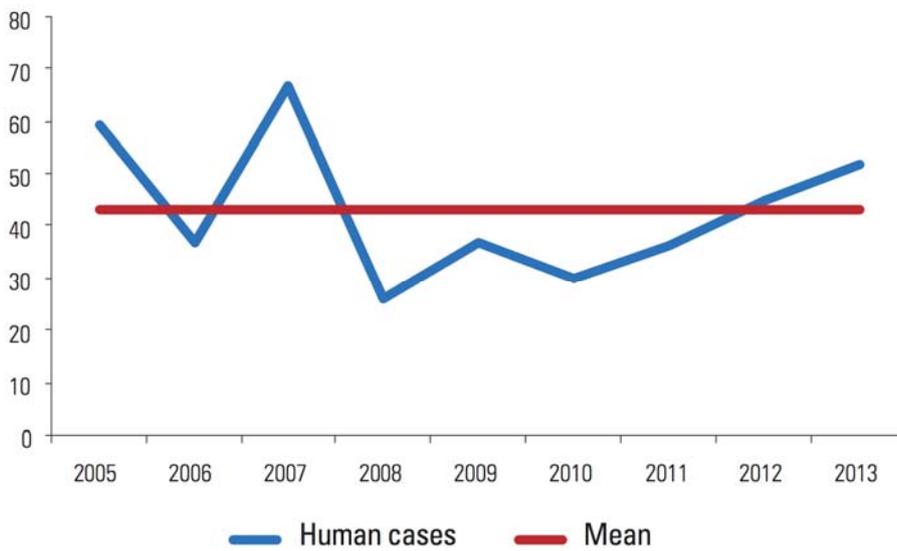
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**Table I****Reasons for not vaccinating dogs during the annual campaign**

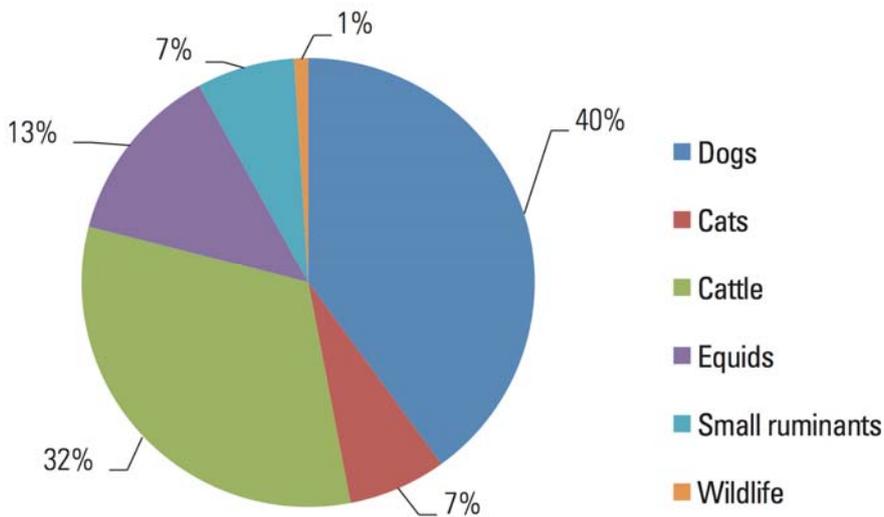
*Source:* General Directorate of Veterinary Services, Ministry of Agriculture, Tunisia

Reasons	Percentage
Purchased after the vaccination campaign	8
The owner ignored the period of vaccination	25
The owner was not informed of the date of the period of vaccination	22
Other: Refused vaccination/dog not approachable/zone is not reachable by the vaccination programme	45



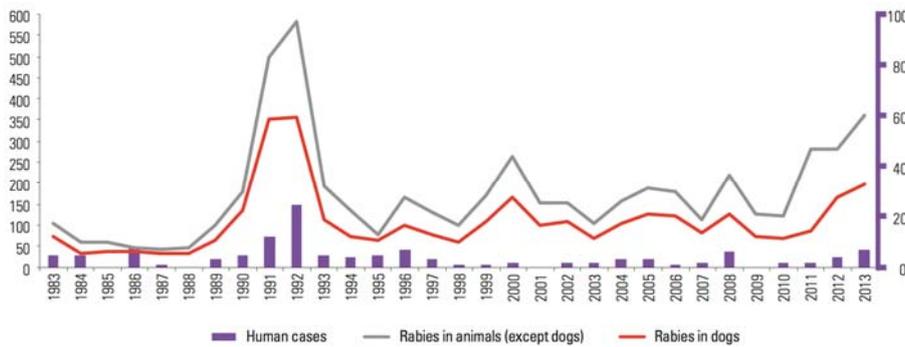
**Fig. 1**  
**Total number of human rabies cases in Algeria, Morocco and Tunisia between 2005 and 2013**

Source: OIE WAHIS-WAHID



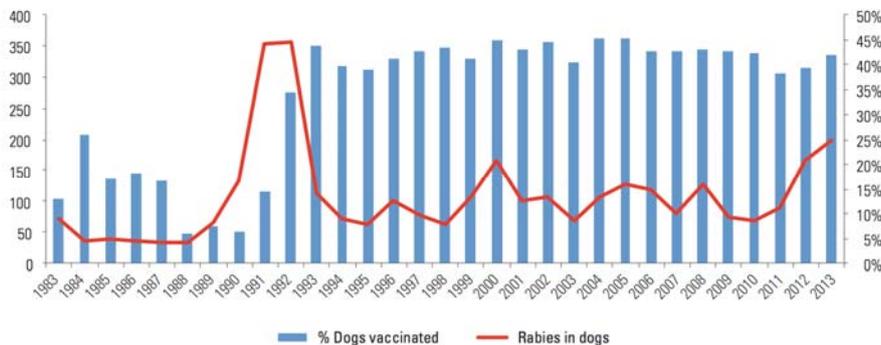
**Fig. 2**  
**Percentage of rabies cases in animals by species in the North African Region in 2012**

Source: OIE WAHIS-WAHID



**Fig. 3**  
**Number of rabies cases reported in animals and humans between 1983 and 2013 in Tunisia**

Source: General Directorate of Veterinary Services, Ministry of Agriculture, Tunisia



**Fig. 4**  
**Percentage of dogs vaccinated and number of rabies cases in dogs from 1983 to 2013 in Tunisia**

Source: General Directorate of Veterinary Services, Ministry of Agriculture, Tunisia