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Investigation of the frequency of rabies in EMRO countries: A review study

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Abstract

Objective: Rabies is a dangerous zoonotic infectious disease. Dog bites cause 99% of all human deaths from rabies. In Europe and North America, however, with the successful control of rabies in dogs, the wild cycle of rabies is the major and dominant cycle of disease. According to the WHO classification, the Eastern Mediterranean Regional Office (EMRO) countries are divided into population health laws, health system performance, and health spending levels. This review aimed to evaluate the epidemiology of rabies in the EMRO countries in these three categories.

Methods: In this study, using some search engines (PubMed, Scopus, and Google Scholar) were searched about the frequency of rabies in EMRO countries without considering the time and related content.

Results: In some parts of the world, including most countries in the region, EMRO, rabies is endemic and a serious problem for human and animal health.

Conclusions: According to the global strategic plan to end human deaths from rabies by 2030, all the countries in the EMRO region and the international organizations such as WHO, OIE, etc., must take the necessary measures to control this disease. Regional and global cooperation, and comprehensive and effective policies, are required to solve this issue.

Keywords: rabies; surveillance; epidemiology.

Introduction

Rabies is a dangerous zoonotic infectious disease. Dog bites cause 99% of all human deaths from rabies. The rabies causal agent is a neurotropic virus of the *Rhabdoviridae* family and the *Lyssavirus* genus [1]. The virus is specifically present in the saliva of infected mammals, and a bite transmits it. After the virus enters the host's central nervous system, 100% lethal progressive encephalomyelitis develops [1].

Rabies remains in both urban and wild epidemiological cycles in the wild. Dogs play an important role in the urban cycle of rabies [1]. The urban cycle is prevalent in most developing countries in Asia, Africa, Central, and South America, with many stray and unvaccinated dogs. Less industrialized countries, especially those with large populations of stray dogs, are at greater risk for dog rabies. In Europe and North America, however, with the successful control of rabies in dogs, the wildest cycle of rabies is the major and dominant cycle of disease [2]. In some parts of the world, including India, rabies' urban and wild cycle has developed simultaneously. In addition to creating more risks, it also complicates the epidemiological face of the virus. Dog rabies has been eliminated in Western Europe, Canada, the United States, Japan, and some Latin American countries. Australia and many Pacific countries have always been free of dog rabies. According to a 2012 world health organization (WHO) report, rabies in dogs threatens the lives of 3.3 million people in Africa and Asia. Of course, pets can also transmit rabies to humans, but they are less important [1].

In North America and Europe, the wild cycle of rabies is the major cycle of the disease. This type of transmission cycle involves one or more wild carnivorous species. In Europe, for example, the red fox (*Vulpes vulpes*) is the main reservoir of the disease. In some parts of Asia, the raccoon dog (*Nyctereutes procyonoides*) is considered a rabbit repository. The entry of raccoon dogs into Eastern European countries indicates the survival of the infection cycle. According to the European rabies bulletin, in the United States, which includes the northern, central, and southern parts of the Americas, bat species are the other reservoirs of the rabies virus. However, different cycles of infection may occur simultaneously in a geographical area. For example, there are different cycles of rabies infection in Raccoon, Skunk (white-tailed weasel), red fox, gray fox, and polar fox in the United States at the same time. Also, rabies from wild-life (wild cycle) is transmitted sporadically to cattle and humans [1].

In recent years, extensive studies have been conducted on the molecular epidemiology of the rabies virus. The results of these studies have been able to determine the pattern of disease transmission. According to figures released by the WHO in 2018, an estimated 60,000 people die each year from rabies worldwide [1]. Since the disease is more common in poor areas, it is thought that many cases are not reported; therefore, there are no accurate statistics on the number of cases. Although all age groups are susceptible to rabies, it is more common in children 5-15. Worldwide, annual rabies causes 3.7 million years of lost life (DALYs) as well as \$ 8.6 billion in economic losses [3].

In 2017, on world rabies day, the WHO and other organizations such as OIE, GARC, and FAO, came up with an ambitious plan to end the human death caused by rabies transmitted by

dogs by 2030. The animal control and rabies control program principles in humans are possible in coordination with other organs [4]. Of course, in many countries, for years, rabies control programs in the wild have been able to control rabies in their country.

Eastern Mediterranean Regional Office (EMRO) is one of the regional offices of WHO, which includes 22 countries: Afghanistan, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine, and Oman. Pakistan, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, the United Arab Emirates, and Yemen have about 645 million people. According to the WHO classification, EMRO countries are divided into population health laws, health system performance, and health spending levels. This study aimed to evaluate the epidemiology of rabies in the EMRO countries in these three categories.

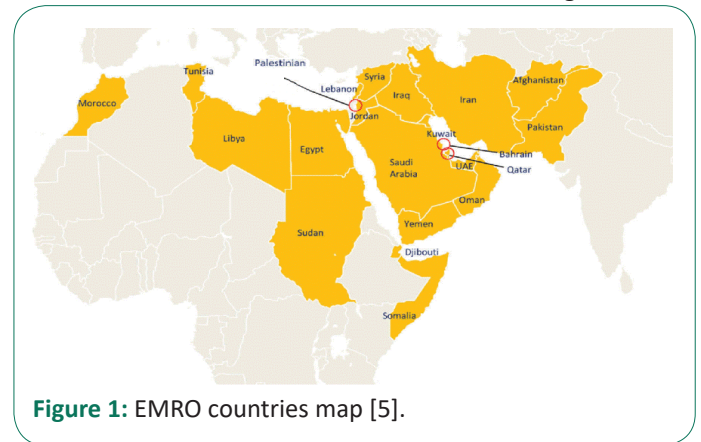


Figure 1: EMRO countries map [5].

Study method

In this study, using Google, PubMed, and Google Scholar search engines and online information sources, epidemiological data on human and animal rabies in EMRO countries extracted from more than 60 articles were identified from January 2000 to December 2020. In this study, we removed about ten articles before screening because of duplicate records (n=8), identification as ineligible by automation tools (n=1), and other reasons (n=1). Over 50 papers were screened, and all remain reports were eligible included in the review.

Results

First group: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates

Following the WHO report (2018), Bahrain, Kuwait, Qatar, and the United Arab Emirates are rabies-free [1]. Studies describe rabies dispersal in other countries in this group as follow:

Oman: Oman is a country in the eastern part of the Arabian Peninsula. There is little information about this country. It seems this country is rabies-free since 1990. The first case of human rabies in Oman was reported in the same year, a boy who was bitten by a fox. Unlike other countries, rabies is a sylvatic disease, and the dog is not a reservoir of the disease; because in this country, for religious reasons, dogs are not kept as pets, and people do not have close contact with dogs [6]. In this country, some animal species such as cattle, camel, sheep, and goats are the main victim of rabies disease. Sylvatic rabies is endemic in this country, and eight human victims reported since 1990 [7]. According to studies conducted in 2014, the fox was the main

reservoir of the disease in this country [8]. During the study period, only one case of human rabies was reported, involving a middle-aged woman bitten by a fox in 2003 [6].

Saudi Arabia: This country is located in the Arabian Peninsula. Rabies is endemic in animals in this country. A growing number of animal rabies cases have been reported in Saudi Arabia. There are few published reports on the current rabies situation

in the nation. No human rabies had been reported in the country for more than ten years; in 2016, the first human rabies case was reported in the country was a 60-year-old man with a dog's claw on his face who was on a trip to Morocco. In addition, from 2007 to 2009, more than 11,000 animal bites were reported, half of them were dog bites. In the following ranks were cats, camels, and rodents [9].

Table 1: Human rabies mortality rate in the first group countries from 2010 to 2017, according to the official WHO statistics.

Country	Reported number of human rabies deaths							
	2017	2016	2015	2014	2013	2012	2011	2010
Bahrain	0	0	0	0	0	0	0	0
Kuwait	0	0	0	NDA*	0	0	0	0
Oman	NDA	NDA	NDA	NDA	NDA	NDA	NDA	0
Qatar	0	0	0	NDA	NDA	0	0	0
Saudi Arabia	1	2	3	NDA	NDA	0	NDA	NDA
UAE	No data	No data	No data	No data	No data	No data	No data	No data

* No data available (NDA)

Second Group: Egypt, Iran, Iraq, Jordan, Lebanon, Libya, Morocco, Palestinian, Syria and Tunisia

Egypt: North Africa is one of the endemic areas of rabies; however, there is little information about the occurrence of the disease in these areas [10]. The number of reported deaths from human rabies in Egypt between 2000 and 2007 was 0.1 per 100,000 population, and limited data are available. The rabies virus has been confirmed in this area for a long time [11]. However, records of the disease disappeared by the 18th century, and Only a few reliable sources were available [11].

At the beginning of the 20th century, the rabies Institute in Egypt was established to diagnose the disease [12]. According to the WHO, in the late 1990s, the average number of rabies deaths was reported to be 30-40 persons per year, and in 2000, was about 35 persons per year [12]. The main reservoirs reported in 2000 were dogs, but cats, ruminants, horses and donkeys, rodents, and mangoes were also considered the main reservoirs of the disease [11]. From 2000 to 2010, the condition was stable, with 80 cases of rabies reported each year [13]. Improving and controlling rabies in Egypt requires serious management of the dogs' population, which should do by vaccinating dogs, collecting, and sterilizing stray dogs. From now, approaches are being implemented to control dog populations [14].

Iran: Iran is a country located in the Middle East that runs from the south to the Sea of Oman and the Persian Gulf and north to the Caspian Sea. In this country, rabies is endemic in both wild and domestic animals [1]. The main carrier of the disease is the dog, although the main reservoir of the disease has not yet been fully identified.

Different species can host the disease in Iran, including dogs, foxes, jackals, and livestock such as cattle and sheep [15]. Rabies is the most important wildlife disease in Iran and is found throughout the Central Desert. The highest rate of rabies observed in Iran is in the northern, eastern, and southern regions [13].

In 2011, 297 animal rabies cases were reported; most of them were cattle, such as cows. In addition, between two and six people die from rabies in Iran every year [15].

Like most Asian countries and the Middle East, animal bites are on the rise in Iran, with over 200,000 cases per year. Preventive treatment measures are administered to all biting animals because of the unclear safety of the biting animal and a lack of training. Of these statics, dogs bite about 81%, and 89% of dog bites are bitten by stray dogs.

In 31 provinces of the country, more than 730 centers have been established where Post-Exposure Prophylaxis (PEP) is done. In these centers, preventive measures are performed free of charge before and after the onset of rabies. According to officials at the Ministry of Health and Medical Education, about 130-120,000 people are treated for rabies free of charge each year due to animal bites. According to the Pasteur Institute of Iran, 5 to 11 people die every year from rabies in Iran [14,16].

Because the disease has spread across the country, attention must be taken when implementing control and prevention measures in all regions. The country has spent 80% of its health budget on increasing PEP demand, which is why vaccination of stray dogs in this country is carried out under the supervision of its veterinary organization [17]. However, as of 2014, just 45% of 900,000 stray dogs had been vaccinated, which leaves many strays unvaccinated [16].

Iraq: Ancient texts and artifacts show that rabies has a long history in Iraq. These texts refer to the disease caused by dog bites and the rules for the domestication of dogs. Rabies disease has been endemic in the region since ancient times. In Iraq's two largest neighboring countries, Iran and Turkey, rabies has been reported in dogs and wildlife, and dogs are an important carrier for human-to-human transmission of the disease. The annual rate of human rabies infection in these two neighbors is almost the same. However, there is no accurate information on Iraq. Because in Iraq, there is no laboratory to diagnose

rabies. In Iraq, vaccination of dogs against rabies is mandatory, but there is insufficient information on the population of stray dogs. Scattered reports indicate rabies in wildlife, especially in eastern areas. However, the prevalence of rabies in wildlife, the role of wildlife in the transmission, and the protection of the rabies virus to humans and animals are not well known.

All Iraqi provinces are at risk of rabies. In addition, hospitals and health centers report human rabies through symptoms because no laboratory can routinely diagnose rabies. According to a 2013 study by Horton et al., The number of human rabies cases in Iraq over ten years from 2001 to 2010 was 186, with 63% of children under 15 and 37% of people over 15. Of this population, 83% lived in rural areas, and the rest in urban areas. The main patients were male (89%), and the rest were female. Several studies have shown that rabies is more prevalent in rural areas than in urban areas. In contrast, only 29% of the population lives in rural areas. The number of human rabies cases in Baghdad city from 2001 to 2002 averaged two per year, and the number of infected people between 2009 and 2010 reached an average of six persons per year [18].

Jordan: Jordan is a country located in West Asia. Human rabies is rarely reported in this country. Jordan, in cooperation with Israel, controls the disease by baiting. People of this country are aware of the dangers of rabies, therefore, vaccinating their pets. Rabies has a low risk in this country. Rabies' main reservoir in Jordan is dogs and jackals. In 2015, animal rabies cases were reported, but no human rabies cases were reported [14, 19].

Lebanon: Lebanon is a country in West Asia where rabies is endemic. There are 7,369 cases of animal bites in the country between 2005 and 2016, with an average of 614 bites per year [20]. The reported cases were dog bites (91%), and 53% of the bites were domestic dogs. Between 2013 and 2017, two human rabies cases were reported, both of them had Syrian nationality [20]. In this country, people exposed to rabies, such as veterinarians, do not take the rabies vaccine seriously, and vaccination of domestic dogs is rarely done. Even in field research, the rabies vaccine is not given. It is not available in most veterinary clinics [20]. The number of animal bites in Lebanon is increasing every year, which is worrying. One of the reasons for the increase in animal welfare in this country is the war-torn refugees who came to this country after 2011. The increase in waste disposal in the country has also increased the population of stray dogs [20].

Libya: Libya is a country located in North Africa. Little is known about the prevalence of rabies in the country, although few studies have shown that rabies is endemic. Rabies is found in various animal species, including dogs, bats, and other mammals [21]. This country declared itself free of rabies, but rabies is endemic in all neighboring countries [22].

Morocco: Morocco is a country located in northwestern Africa. The country has a long coastline with the Atlantic Ocean that extends from the north to Gibraltar and the Mediterranean Sea. Morocco is bordered by Algeria to the east, the Atlantic Ocean to the west, and Mauritania to the south. Historically, Rabies has no starting point in this country [23]. Morocco has strict rules for controlling rabies in animals that are updated every nine years. The government began controlling rabies in about 1911, coinciding with the first human and dog vaccination by the Tangier Institute of Pasteur in northern Morocco. Later, human and animal vaccination was routinely performed, with no

change in the number of rabies cases [23].

Morocco is a country with a variety of animal species. Herbivores, such as cows and sheep, are the primary victims of rabies in Morocco. Due to their economic value, special attention has been paid to their infection and the diagnosis of rabies in these organisms. The diagnosis of rabies in herbivores has risen from 12% in 1951 to 79% in 2015 [23, 24]. Dogs are the leading cause of rabies, whether human or animal. In 1951, 8,254 dogs were diagnosed with rabies, accounting for 51% of all animal diagnoses. Over time, with the advent of prevention and control programs, the number has risen to 18 percent in 2015, indicating the veterinary organization's specific attention for diagnosing rabies because of its economic value in living organisms [23, 24]. From 1951 to 2015, about 800 cats with rabies were reported to be responsible for 5 percent of all rabies animals reported cases [23]. Rats are also known as transmitters in some cases, but after 1980, they have been classified as other transmitters of rabies in the WHO reports. This organization does not consider an epidemiological role for rats [25]. Morocco is home to 30 species of bats that have not reported any rabies or human transmission since 2015 [26, 27]. According to 2006-2015 statistics, Morocco had 21 cases of human rabies per year. From 1923 to 2014, more than 1,046 deaths and 838,660 cases of PEP were reported [23, 28].

In this country, in the ratio of each human, there is an average of 6.14 dogs in rural areas and 34.33 dogs in urban areas, compared to the 2005 and 2014 statistics. The Moroccan government has no plans to control the population of dogs, which are the main cause of rabies in humans [23]. Between 1986 and 1990, the WHO implemented the first national rabies control plans (NRCP), which marked the beginning of the global battle against rabies. Different NRCPs caused the number of rabies cases in dogs to decrease from 82% in 1982 to 18% in 2015 [23]. Rabies is a common disease among rural people in Morocco, with 80% reported rural and 20% urban. One of the reasons for the increase in human rabies in Morocco is the high price of vaccines for the poor and the unavailability of vaccines for rural people [23, 29].

An average of 391 animal and 22 human cases each year are reported from this country, and rabies still is a serious problem in this country [30].

Palestine: It is located between the Mediterranean Sea and the Jordan River. Little is known about this country, as the last case of human rabies was reported in 1995 [11]. However, rabies is endemic in the country. In this country, dogs are the main reservoir of the virus [31].

Syria: Syria is a country in southwest Asia along the eastern shores of the Mediterranean Sea. Little information is available about this country. However, rabies is endemic in the country and has a higher rate than its neighboring country, Lebanon. This country reported 24 cases of human rabies between 1997 and 2002 [32]. The population of stray dogs and the lack of regular programs and vaccination periods by the veterinary organization in the country seem to have contributed to the outbreak [14].

Tunisia: Tunisia is a country located in North Africa. In 2011, most of the country's population was 66.3 percent urban, and the rest were rural [33]. Rabies is endemic in the country, with the Northern provinces more affected by the disease. The genus *Lyssavirus* in this country has genotype Africa 1 [10]. The ra-

abies diagnostic system performs relatively well for both humans and animals, except for bat species [34]. Rabies' main reservoir is in Tunisia is the dog, and according to the 2011 Dog Vaccination Report, 48% [10]. In 2011, 64 cases of rabies were reported in dogs, and in 2012, 167, and 199 in 2013. According to OIE, one human case was reported in 2011, 3 in 2012, and 6 in 2013. Rabies has been seen in the country in other species, especially

in cattle, and many victims are killed annually. In 2011, 34 cases in cattle were reported [34]. Human cases of rabies are sometimes laboratory-confirmed but most often diagnosed clinically. In this country, PEP is performed by the government in 360 clinics and is free, and on average, 40,000 PEP is conducted annually in this country [34].

Table 2: Human rabies mortality rate in the second group countries from 2010 to 2017 according to the official WHO statistics.

Country	Reported number of human rabies deaths							
	2017	2016	2015	2014	2013	2012	2011	2010
Egypt	NDA*	NDA	NDA	NDA	32	21	34	43
Iran	12	1	7	4	5	6	8	4
Iraq	9	NDA	6	12	8	11	NDA	NDA
Palestine	NDA	NDA	NDA	NDA	0	0	0	0
Jordan	5	1	0	NDA	NDA	NDA	0	0
Lebanon	1	0	2	NDA	NDA	NDA	NDA	NDA
Libya	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA
Morocco	15	17	19	20	24	6	5	14
Syria	7	4	3	0	7	5	2	1
Tunisia	1	4	6	3	6	3	NDA	NDA

* No data available (NDA)

Third group: Afghanistan, Pakistan, Yemen, Sudan, Djibouti and Somalia

Afghanistan: The main rabies reservoirs in Afghanistan are foxes and jackals, although dogs should be considered the main source of human bites. Rabies in Afghanistan kills hundreds of people a year because there is no vaccination or public health control over the dog population. From March to April 2001, rabid dogs in Kabul attacked about 180 people, and the WHO estimated four human cases a day in the capital. In 1999, a common epidemic occurred in Afghanistan in the provinces of Kabul and Ghazni, and in recent cases, the vaccine has not been available to the public after human exposure. In 2013, Sandrine Duron and colleagues, in a study, reported that rabies is one of the dangers that travelers may face when traveling abroad. In the summer of 2012, a rabid dead dog was found in an international military transport camp in Afghanistan, and the study followed, showing that between 2008 and 2012, there were 144 cases and five deaths as a result. Only eight neighboring countries around Afghanistan do not have rabies, and for example, 9 cases of human rabies have been estimated per million people in Karachi and Pakistan [35].

Pakistan: Pakistan is a South Asian country with a 64% rural population. There are 14.7 dogs per person in this country [36]. In 2010, more than 97,000 cases of dog bites were reported by health and medical units in this country [37]. According to the WHO, vaccination of stray dogs is not widespread in the country; However, In Lahore and Karachi, vaccination of stray dogs has been reported to be slightly successful in controlling rabies [38]. In this country, 2,000 to 5,000 deaths are reported annually due to rabies in humans, which is a worrying statistic compared to other countries. Despite the WHO's emphasis on the non-use of brain tissue vaccines, Pakistan still uses these vac-

cines, so it is challenging to control rabies in this country [37].

Yemen: Yemen is a low-income country with severe inequality and is one of the least developed countries in the world. In this country, dog rabies is endemic [39]. Studies demonstrated that up to 7,000 people are at risk for the disease each year in Yemen. The number of people bitten by rabid dogs has increased intensely since 1990, mainly due to the increasing population of dogs throughout Yemen's cities and villages, which has seriously affected people's lives in these areas. There are more than one million dogs in Yemen, of which only 10 to 20 percent are pets, and the rest are stray dogs that feed on food scraps and cause the disease to spread among the people and the other animals. In addition, no official action has been taken to control and prevent rabies in Yemen [39]. Rabies is a significant disease in Yemen, but information on the number of human rabies cases is limited due to its inefficient monitoring of the condition. Yemen's Ministry of Health has reported about 30 cases of human rabies in the country annually. However, recent estimates suggest that about 220 people are infected by rabies each year. A 2013 study in Yemen found that dogs were the main source of rabies in Yemen as 92% of cases reported and that the main victims of dog bites were children. In addition, 74.3% were stray dogs, and 55.7% were domestic. This high rate is attributed to their contact with stray dogs or whether the disease is endemic in the country [39].

Sudan: Sudan is a country located in northeastern Africa and southern Egypt. Rabies is endemic in this country [40]. So far, little research has been done on rabies in this country. Deaths from the disease occur routinely in the country. According to 2010 to 2014 statistics, an average of 84 dog bites and five human rabies cases have been reported annually. The highest number of human rabies cases was in 2010, with 13 cases [41].

In this country, the fluorescent antibody test (FAT) method is used to diagnose rabies, which is the standard method for diagnosing rabies. According to a 2002 study, dogs were the leading cause of illness in the country. Goats and donkeys are important carriers of rabies due to their direct contact with dogs [40].

Djibouti: It is a country located in East Africa. It is home to a variety of dogs, bats, and other mammals. Not much is known about rabies in this country. However, rabies is endemic. According to a study by Rupprecht et al., the population of stray dogs in 2017 was 24,659 [42].

Somalia: Somalia is a country located in East Africa. It is home to a variety of dog and bat species and other mammals. Little is known about this country. The number of stray dogs in the country is reported to be low, with the average number of stray dogs being ten from 2010 to 2014 and the number of reported dog bites reported from 2010 to 2014, averaging 3 to 4 per year. The number of reported human rabies cases in 2012 was six [41]. Another source states that the population of dogs about humans in Somalia is 31.2, which, of course, is a high number [42].

Table 3: Human rabies mortality rate in third group countries from 2010 to 2017 according to the official WHO statistics.

Country	Reported number of human rabies deaths							
	2017	2016	2015	2014	2013	2012	2011	2010
Afghanistan	NDA*	NDA	NDA	NDA	NDA	NDA	NDA	NDA
Djibouti	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA
Pakistan	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA
Somalia	1	2	3	NDA	NDA	NDA	NDA	NDA
Sudan	1	1	0	1	2	2	5	13
Yemen	NDA	NDA	NDA	NDA	48	NDA	NDA	NDA

* No data available (NDA)

Discussion

The obtained data in this study showed that rabies, despite the various surveillance measures of the countries in the region and related local and global organizations, is still a serious problem for human and animal health and requires the use of more convenient and effective solutions.

Despite extensive research over the past 100 years, rabies remains a worldwide health threat [43]. Although some rabies-free countries and islands such as Japan, New Zealand, Greece, Portugal, Chile, and Barbados, rabies are widespread throughout the world [43-45]. Even with ongoing efforts at medical intervention, rabies has one of the highest mortality rates among human infections [46]. This matter is mainly due to large global rabies reservoirs in domestic and wild animals [47,48]. Rabies is estimated to cause tens of thousands of deaths worldwide each year, with Asia and Africa accounting for more than 90% of all rabies deaths and India reporting only about 30,000 deaths each year [49]. Since rabies reporting systems are not established well, especially in most EMRO countries, these numbers may be underestimated, and this estimation certainly requires more careful research.

The disease is endemic in most EMRO countries [1], and since dogs are one of the main reservoirs of the infection in these countries [25], with the increase in the number of these animals in them, the number of rabid bites is increasing [50]. The growing trend of the stray dog population, the increasing number of animal bites, and the spread of rabies in many areas remind us of the need to pay more attention to disease control and research in its various aspects.

In this review, according to studies and observations from 2000 to 2019, the situation of rabies, in general, has improved due to education and raising the level of awareness and public health. In recent years, the mortality rate of rabies has de-

creased in various countries due to the control programs of the country and WHO [1,25,37], including free PEP program, as well as the existence of diagnostic centers in the countries such as the Pasteur Institute of Iran and the provision of necessary training by these centers [16,23].

Studies confirmed that rabies is worse in countries that, for various reasons, do not observe public health and do not monitor health and public awareness, such as the third group countries, Afghanistan, Pakistan, Syria, and Libya.

Rabies has always been one of the great importance in public and economic health worldwide, as a classic zoonotic disease. An estimated 10 million people worldwide receive post-exposure therapy, which costs a financial burden of more than \$one billion a year [49]. Recent updates on rabies status in EMRO countries indicate that the disease is being controlled in countries that have a control program for the disease and are vaccinated regularly, such as Iran, Jordan, Morocco, and Tunisia [12,17,28,34] and in the case of Rabies Free countries this disease has been eliminated [1, 25].

In countries where PEP is available to the public and free of charges, such as Iran and Tunisia [17, 34], the human mortality rate is lower than in other countries. Of course, it should be noted that there must be sufficient training to deal with the animal bite and act upon it. However, in countries where vaccines are not free of charge, such as Morocco, the death rate is higher [23].

In contrast, some countries do not have a specific plan to control or eliminate the disease, such as the third group, Lebanon, Syria, Iraq, Palestine, Libya, and Egypt. The statistics have not changed or have increased in Egypt, Sudan, and Yemen, but there is no statics in Libya and Palestine, which is very worrying.

In addition, Oman and Saudi Arabia of the first group, Iraq,

Libya, Palestine, and Syria of the second group, and all the third group countries need further study in this field.

Conclusion

Rabies is a major and global concern to which all governments, particularly those in Asia, should pay close attention. Lack of facilities, insufficient monitoring, and training are among the reasons for the difficulty of controlling this disease in most countries of EMRO.

Different methods to control this disease are vaccination of stray dogs and pets, PEP, and efficient training. In the first step, all the country and international organizations such as WHO, OIE, etc., must take the necessary measures to control this disease. Regional and global cooperation, as well as comprehensive and effective policies, are required to solve this problem.

Finally, the WHO should receive an annual update on the rabies situation in the EMRO countries. Based on the annual and periodic reports, countries need to be relocated at levels one, two, or three. In order to be a motivation for level two and three countries.

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