

Review of FMD situation in North Africa

Introduction

North Africa is located in a critical geographical position at a cross-road between sub-Saharan African countries, the Middle East and the European continent. This cross-road is essentially the Mediterranean basin which can be considered nowadays as a strategic political and economic corridor. It is also therefore recognised the centrality of the Mediterranean area in the framework of the development scenarios of international trade, especially in light of the changes in global economic relations and political conditions in the countries of south-eastern Mediterranean, which inevitably would lead to a review of the objectives, policy instruments and way of interactions between the countries bordering the Mediterranean basin including those relating to ensure a sustainable livestock production systems. In North Africa, a few kilometers away from Europe, there are animal diseases that if re-introduced in Europe (e.g. Foot and mouth disease) or introduced (e.g. Peste des petits ruminants), could have devastating effects on the animal population and linked generated sector's economy. In the Mediterranean basin, a platform for collaboration in the field of veterinary public health called REMESA (Réseau Méditerranéen de Santé Animale) has been operating; it encompasses the collaboration of 15 Mediterranean countries: eight belonging to the Middle East and North Africa (Morocco, Algeria, Tunisia, Libya, Mauritania, Egypt, Lebanon and Jordan) and seven in the south of Europe (Italy, France, Spain, Portugal, Malta Cyprus and Greece). The REMESA network is governed by a Joint Permanent Committee (JPC), made up of the Chief Veterinary Officers of the 15 adhering countries, by representatives from OIE and FAO, as well as representatives of regional and international organizations, namely European Union (EU) and Maghreb African Union (UMA). The Secretariat of the network is assured by the OIE and FAO Sub-Regional offices based in Tunisia. The main objective of the network is to improve the prevention and control against the major transboundary animal diseases and zoonoses through the strengthening of the national and regional resources and capacities. This is achieved through systematic exchange of experiences between countries and regular capacity building activities to promote the harmonization of animal diseases surveillance and reinforce the capacities of Laboratories and Veterinary Services for diseases that are considered as a priority for the countries (e.g. Foot and mouth disease, Peste des petits ruminants, Rift Valley Fever, Rabies).

REMESA extensively discussed the reoccurrence of FMD (serotype O) in Tunisia, Algeria and Morocco in 2014-2015 - after about 15 years of absence - by creating the major significant sanitary event in the North African region in the recent times. The detection of a new FMD serotype (A) in Algeria in 2017 demonstrates that this disease continues to be present in the region and imperil the livestock sector of North Africa. The objective of this article is to review the FMD situation within the epidemiological context of the entire North Africa region.

Animal movements in North Africa and recent incursions of FMD in the region

In North Africa, the livestock population is estimated to be about 7 million large ruminants and 75 million small ruminants (>12% of the small ruminant population of Africa). In this region, the movements of animals – especially at the borders – are frequent, regular and conducted mainly informally. Figure 1 illustrates the main patterns of the animal movements occurring in North Africa region since centuries for social, economic and religious purposes as well as the pathways of the recent incursions of different FMD strains in North Africa based on the samples analysed by OIE reference laboratories. The Figure highlights the fact that the zone ranging from Libya to Morocco – known to have high degree of borders porosity – could be considered as a unique epidemiological unit since these countries share a common risk factor, such as the animal movements without an effective traceability system in place. The figure highlights as the corridor from Middle East to North Africa (via Egypt and Libya) was in the recent years permeable to the introductions of FMD strains in 2009, 2010 and 2013 coming from Western Asia continent. Although in the Middle East there are countries that mainly import animals, it should not be neglected the

degree of connectivity of the animal's movement occurring between Middle East and North Africa (via Egypt and/or via Libya). Further introductions have occurred from East African countries. This pattern of incursions - at least in part - overlaps with the high concentration of animal movements entering into Egypt and Libya from Ethiopia, Chad, Niger and Sudan.

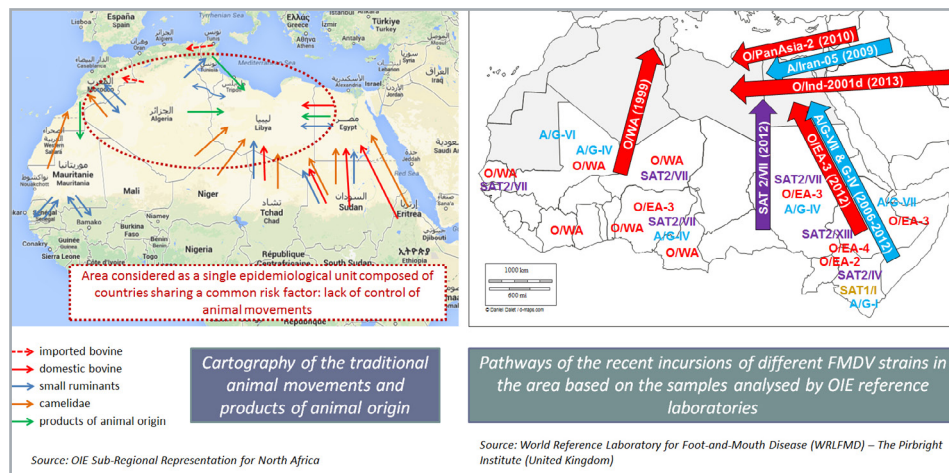


Figure 1. Main patterns of the animal movements/products in North Africa region and past incursions of different FMD strain

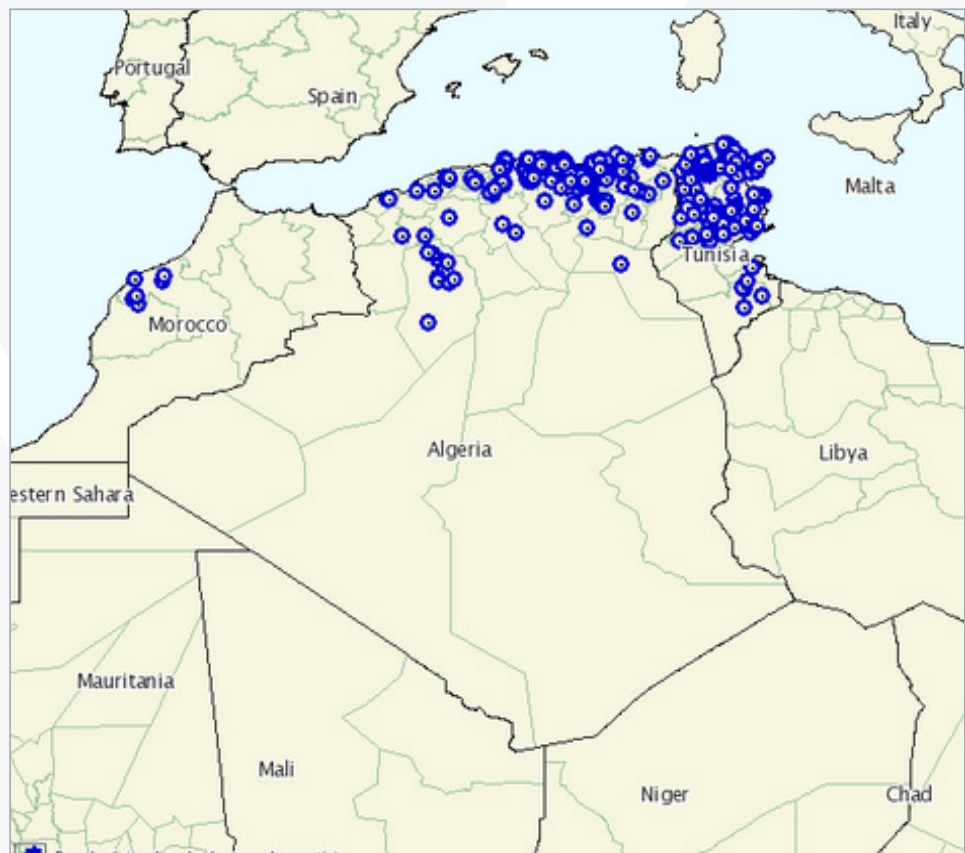
2014-2015: FMD epidemic in Tunisia, Algeria and Morocco

Based on the OIE immediate notifications, foot and mouth disease reoccurred in Tunisia (April 2014), Algeria (July 2014 and March 2015) and Morocco (October 2015) creating the major significant sanitary event in the North African region in the recent times. While recognising the presence of the disease in the neighboring countries such as Mauritania, Libya and Egypt (endemic vs intermittent reoccurrences), this disease was absent in these three countries in the period ranging from 1999 to 2014. The foot and mouth disease viruses - isolated from the outbreaks occurred in Tunisia, Algeria and Morocco (during the period 2014-2015) - were classified within serotype O, and the phylogenetic analysis on VPI coding sequences revealed that these viruses belong to the Ind-2001 lineage within the Middle East-South Asia (ME-SA) toptotype. The O/ME-SA/Ind-2001 lineage was initially identified in the Indian subcontinent in 2001 and subsequently became the predominant lineage in the region. Escape of this lineage from the Indian subcontinent has occurred sporadically, up to 2013, when viruses from outbreaks in Libya (September to November 2013) and Saudi Arabia (August to November 2013) were found to belong to the O/ME-SA/Ind-2001 lineage and phylogenetic analyses showed these viruses are most closely related to viruses from India, Nepal and Bhutan collected in 2013. These laboratory results provided evidence that a new FMD virus was introduced into Libya and that FMD outbreaks in Libya and Saudi Arabia have arisen through separate introduction of this virus in these two countries (Knowles et al, *Transboundary and Emerging Diseases* 2016, Valdazo-Gonzalez et al., 2014). To corroborate these results, there was an epidemiological investigation carried out by the Libyan Veterinary Services soon after the discovery of the new FMD serotype in their territory. This led to the conclusion that Libya used to import goats from the Middle East by plane and noting that goats were first imported from the Indian continent to Middle East and then (after only 24 hours stopping in Middle East) loaded in the plane to be exported to Libya. Figure 2 illustrates the potential pathway of the introduction of FMD strain O/ME-SA/Ind-2001 in North Africa via Libya in 2013. Owing to the long-standing interrelated animal movements - in particular between Libya, Tunisia, Algeria and Morocco - this exotic lineage of FMD introduced in Libya in 2013 spread, in turn, first to Tunisia (total outbreaks in 2014=142) then to Algeria (total outbreaks in 2014= 419 and a total outbreaks in 2015=12) and finally reached Morocco (total outbreaks in 2015=6) (Figure 3).

Figure 2.
Potential pathway of FMD virus introduction in North Africa



Figure 3.
FMD outbreaks notified to the OIE by Tunisia, Algeria and Morocco during the 2014-2015 epidemic



Based on the phylogenetic analysis carried out on both VPI and full genome sequences of the viral isolates obtained from Tunisia, Algeria and Morocco, the following major indications were reflected for the FMD epidemic occurred in 2014-2015 (Pezzoni et al., 2016):

- A unique introduction of the FMDV O/Ind-2001 lineage occurred in North Africa, in Libya in 2013, as suggested by evidence that all Libyan isolates share a common ancestor (estimated to be originated in July 2013);
- There was a single introduction from Libya into the Little Maghreb (Tunisia, Algeria and Morocco). In fact, all the Maghreb isolates were shown to derive from a unique putative common ancestor, estimated to be present since beginning of 2014;
- In Tunisia, the virus evolved in three main clusters, probably consistent with animal movements in the country;
- Two different introductions from Tunisia to Algeria have likely occurred, in 2014 and 2015 respectively; in fact, Algerian isolates from 2014 and those from 2015 cluster in different branches, together with different Tunisian isolates;
- The Moroccan isolate derived from viruses of the 2015 Algerian outbreaks, with which it shares a common ancestor.

However, major challenges were encountered to control the disease in North Africa:

- Difficulties to control animal movements;
- Difficulties in having immediate availability of appropriate vaccine;
- Absence - between countries - of an appropriate regional FMD vaccination strategy and other control measures (e.g. harmonised surveillance plans, stamping-out policy);
- Political instability occurring in Libya and the unknown animal health sanitary situation present in Libya. The latest available information on FMD is dated back to 2013. Tunisia established – for security reasons – a military zone at the border with Libya and animals coming from Libya and entering this restricted area are confiscated and – when serologically positive for FMD – are slaughtered. In 2016, about 6.000 animals coming from Libya were confiscated by Tunisia and 20% of them tested positive for FMD at the 3ABC ELISA test.

As mentioned, the control measures applied by the three countries (Algeria, Tunisia and Morocco) to face the incursion of the FMD strain O/ME-SA/Ind-2001 were different among the countries. However, the vaccination – although applied differently (see Table I) – was the main control measure that reduced the virus circulation of FMD strain O/ME-SA/Ind-2001 and the related clinical disease manifestation, mainly in cattle population.

Table I. Vaccination strategies against FMD in the Maghreb region

Country	Species	Serotypes
Algeria	Bovine	O - A (up to 2014)
	Bovine	O (2015-2016)
	Small ruminants	O- A (from the next campaign)
Marocco	Bovine	O (re-started again in 2014)
	Bovine	O-A (from 2017)
Tunisia	Bovine	A – O - SAT2
	Small ruminants	O - SAT2

2017: FMD in Algeria

In March 2017, Algeria notified to the OIE a new outbreak of FMD due to new strain in the country (serotype A) which caused clinical disease in cattle. Based on the information available through the OIE World Animal Health Information System (WAHIS), a total of 4 outbreaks due to FMD serotype A were reported in the North part of the country. The samples were submitted to the OIE reference laboratory of Brescia (IZSLER, Italy) for confirmation and for identification of the virus genetic lineage through sequences analysis. Phylogenetic analysis based on VP1 coding gene showed that the FMD virus serotype A detected in Algeria belongs to the A/Africa topotype, lineage G-IV which is endemic in sub-Saharan countries and the most closely related viruses are type A isolates from Nigeria 2015). The FMD World Reference Laboratory at The Pirbright Institute is going to perform vaccine matching tests in order to generate in-vitro information about the appropriate vaccine strain to be potentially used.

2017: FMD in Tunisia

On 27 April 2017, Tunisia confirmed the detection of an outbreak of FMD due to serotype A in Northern part of the country. In the affected farm, 17 cases were detected out of 22 susceptible animals and the clinical signs observed on the animals were fever, lameness, stomatitis, ulcers of all ages and salivation. In that farm, four bovines of unknown origin and bearing foreign identification marks were introduced and lately, illegal cross-border animal movements were registered. Five vaccination campaigns have been applied since 2014 and the last vaccination campaign was finalized in November 2016. A trivalent vaccine is available for cattle including the serotypes A, O and SAT2. From April to May 2017 a total of 2 outbreaks were reported by Tunisia (Figure 4).

Figure 4.
Outbreaks due to Serotype A
in Tunisia



The Table 2 shows the FMD serotypes that circulated in the Maghreb Region since the 1960s.

Table 2. History of FMD in the North Africa Region

Country	Year	FMD serotype
Algeria	1966 - 1990 - 1999	O
	1977	A
	2014-2015	O
	2017	A
Libya	1959 - 1960 - 1962 - 1967 - 1968 - 1972 - 1981 - 1982 - 1983 - 1988 - 1989 - 1994	O
	1979 - 2009	A
	2003	SAT2
	2009/2013	A-O-SAT2
Mauritania	1975 - 1976	SAT2
	1997	A
	2000	O
	2006	SAT2
Marocco	1991 - 1992 - 1999	O
	1977 - 1983	A
	2015	O
Tunisia	1965 - 1967 - 1969	C
	1970 - 1975 - 1989 - 1990 - 1994 - 1999	O
	1979 - 1982	A
	2014	O

International initiatives undertaken to support North African countries since the 2014-2015 FMD epidemic

During the 2014-2015 FMD epidemic, the EU, the European Commission for the Control of Foot-and-mouth disease (EuFMD) and OIE FMD Reference Laboratories [Brescia (Italy), Pirbright (UK) and ANSES (France)], provided support to the affected countries in the framework of regional cooperation and under the context of REMESA. The following initiatives were acted:

- procurement/donation of FMD trivalent vaccines [EU donated 1 million doses to Tunisia (on 21 August 2014) and 100.000 doses to Algeria (on 19 August 2014)];
- delivery of FMD diagnostic kits;
- genetic and antigenic characterisation of FMD virus isolates;
- designing and implementation of surveillance (harmonised survey) and field vaccine trials (vaccine effectiveness...);
- expertise during the technical workshops organised under the framework of REMESA;
- e-learning training through webinars;
- elaborating the document outlining the main elements to implement a regional FMD vaccination strategy for North African countries (be ready by the end of the first semester 2017);
- resolution was endorsed by REMESA to establish a FMD regional vaccine/antigens bank for North Africa;
- state of play of animal identification and traceability in North African countries by establishing a regional working group with the objective of elaborating a common regional strategy on animal identification and traceability.

However, in the absence of effective surveillance system and vaccination plans, North Africa remains constantly at risk of FMD incursions from Middle East and Sub Sahara with the high risk of becoming permanently endemic. The current political instability in Libya - causing also a significant lack of animal health sanitary information – represents one of the major challenges for the North African region in preventing and controlling animal diseases, including FMD.

In addition, the risk of introducing FMD into Europe from North Africa is not negligible and can be amplified if FMD becomes endemic in North African region. In this context, it should not be neglected the negative effects of the political instability in some countries adjoining the Mediterranean basin since the veterinary public health challenges cannot be isolated from matters related to political insecurity.

Therefore, in light of the reoccurrence of the serotype A of FMD in Algeria in 2017, it is imperative to continue to support the North African countries to control the disease and, in turn, the North African countries should speed up the implementation of the control measures and activities such as risk-based surveillance, harmonised vaccination strategy (also based on the risk) as well as to make significant progress on animal identification. In particular, it is fundamental to better:

- a) control traditional animal movements;
- b) implement investigation procedures in case of outbreak (trace back and forward); design surveillance activities;
- c) monitor the efficacy of the vaccination campaigns. Finally, it worth recalling that vaccination is an essential tool to control the FMD where it is endemic. The implementation of the OIE regional vaccine bank to allow quick and secure access to high quality vaccine is crucial. Appropriate vaccination programmes and post-vaccination surveillance are also vital to control and eradicate FMD.

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