A review of West Nile Virus and its Potential Vector (*Culex pipiens*) in North Africa

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Abstract: West Nile Virus (WNV) can cause neurological disease and death in people. *Culex pipiens* is the suspected vector in the transmission of WNV. The objective of this study is to review the history of transmission foci in order to help the implementation of an effective and permanent human surveillance in North Africa. West Nile fever first appeared in Algeria in 1994 and was responsible for 20 cases, including 8 deaths. In 1997, a second epidemic was reported in Tunisia, with 173 cases, including 8 deaths. In Morocco, an epizootic was reported in 1996 with 42 equidae. North of Cairo was the first place where WNV was isolated in Egypt in 1950. The re-emergence of WNV cases in the following years confirms an enzootic circulation of the virus in North Africa. West Nile virus has and will remain a formidable clinical and public health problem hence the necessity of prevention against this disease.

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1. Introduction:

The West Nile Virus (WNV) was isolated for the first time in 1937 in Uganda and it was introduced in 1950 in Egypt. Since its introduction, it has a major public health problem especially in recent years. It is considered the most invasive virus in the world. It appears in humans and animals and causes serious epidemic of infectious diseases.

Infection with West Nile virus (WNV) is a typical example of the emerging and re-emerging disease. The WNV, which had long been confined to sub-Saharan Africa, Asia and the Middle East, where it was endemic, now has an ever-widening circulation. It is present on all continents, with epidemic outbreaks increasingly close together. These epidemic peaks can affect both humans and animals, with significant public health and economic consequences. The generalization of WNV infection throughout the world is favored by the multiplicity of the viral reservoir, consisting of several avian species, including migratory birds, and the abundant presence of the viral vector. The ornithophilic mosquito of the genus *Culex*, the main vector of WNV, is widely distributed throughout the world (Hubalek and hlouzka, 1999). Clinically, WNV infection can be manifested in a wide range of clinical settings, the most serious of which is neurological involvement such as meningitis or meningoencephalitis, which can be life-threatening.

West Nile fever first appeared in Algeria in 1994 and was responsible for 20 cases, including 8 deaths (Le Guenno et al., 1996). In 1997, a second epidemic was reported in the region in Tunisia, with 173 cases, including 8 deaths (Triki et al., 2001). In Morocco, an epizootic was reported in 1996 with 42 equidae (El Harrack et al., 1997). As a result, the virus has repeatedly spread in Morocco (2003, 2008 and 2010) and in Tunisia (2003, 2008 and 2011) suggesting an enzootic circulation of the virus (Schuffenecker et al., 2005; Garbouj et al., 2003; Figuerola et al., 2009; Ben Hassine et al., 2011). West Nile virus will remain a major public health problem in the future.

The aim of this study is to review the history of WNV in North Africa and to identify the transmission foci in order to implement an effective and permanent human surveillance.

2. West Nile Virus history in North Africa (Figure 1):

In Tunisia, several outbreaks of virus transmission appeared in 1997, 2003, 2007, 2010, 2011 and 2012 (Triki et al., 2001; Hachfi et al., 2010; Riabi et al., 2014; Bouatef et al., 2012). Other studies have shown high transmission among humans, equines and birds (Riabi et al., 2014; Bahri et al., 2011; Ben Hassine et al., 2014; Hammouda et al., 2015). Mapping studies have shown that the regions that have high-risk infections in equines are Jendouba, Nabeul, Sousse, Monastir, Sfax, Mednine and Djerba (Bargaoui et al., 2015).

In Algeria, if clinically, WNV has not been described in humans despite the isolation of the virus from the vector in 1968, its circulation has already been suspected since 1968 by sero neutralization carried out on

9 Human sera of which two were positive for an arbovirus (Unidentified West Nile virus). Since 1973, in several southern regions and intermediates between the South and the North, human serological surveys have clearly demonstrated the circulation of West Nile fever virus (Korba et al., 2016).

In Morocco, Both WNV transmission epidemics were recorded in 1996 and 2003. The result of the first epidemic was 94 cases among equines including two deaths and just one case among humans (Tber et al., 1996). The second appeared in Kenitra province between September and October 2003. It was limited geographically and temporarily probably because of climatic and vector conditions unable to provide a major virus transmission. The virus has repeatedly spread in Morocco 2003, 2008 and 2010 (El Rhaffouli et al., 2012).

Cairo was the first home where WNV was isolated in Egypt in 1950 (Taylor et al., 1956). Several authors showed the existence of many outbreaks between 1951 and 1954 (Taylor et al, 1956; Southam et al., 1954). Fourteen years later, WNV infections were detected in Alexandria in 1968 (Mohammed et al., 1970). In 1989, the sero prevalence study showed 3% infections of Nile Delta children by WNV (Corwin et al., 1992). Recently, unpublished data showed a large dispersion of this virus in Egypt. It should be noted that before 1998, the only evidence of natural infection in birds was the isolation of WNV from a pigeon (Work et al., 1955).

In Libya, no published reports concerning WNV human or equine infections were reported but a permanent human surveillance is implemented in this country showing the existence of active loci.

3. Potential mosquito vector of WNV: *Culex pipiens* (Figure 1):

Culex pipiens is known to be a vector of several diseases, notably arbovirus. It was also considered the main responsible for the outbreak of WNV that hit the United States in 2002 (Palmisano et al., 2005). In fact, WNV has been isolated from *Culex pipiens* several times in the United States (Andreadis et al., 2001; Reisen et al., 2004), Romania (Savage et al., 1996), Israel (Samina et al., 1986), Bulgaria and the Czech Republic (Hubalek and hlouzka, 1999). Its vectorial competence for this disease has been demonstrated experimentally in several regions of the world (Tohm and Turell, 2001; Goddard et al., 2002; Hubalek and hlouzka, 1999; Tiawsirisup et al., 2005; Turell et al., 2001). In addition to demonstrated its vectorial ability to transmit the virus, varied trophic preferences, abundance and long activity, infected females of this species are capable of transmitting the virus to their offspring (Farajouallahi et al., 2003; Murgue et al., 2001), which makes this mosquito the first suspect of the maintenance and transmission of enzootic West Nile virus.

Culex pipiens is the suspected vector in the transmission of WNV and the most responded mosquitoes in the Maghreb. Its role in the transmission of West Nile epidemics that have affected Tunisia, Algeria, and Morocco is strongly suspected. Its high density that coincides in time and space with the date of case detection makes it the most likely vector. Natural and artificial infections studies on collected populations of *Culex pipiens* from Tunisia (Wasfi et al., 2016), Algeria (Korba et al., 2016), and Morocco (Amraoui et al., 2012) showed that they are efficient experimental and natural vectors to transmit WNV.

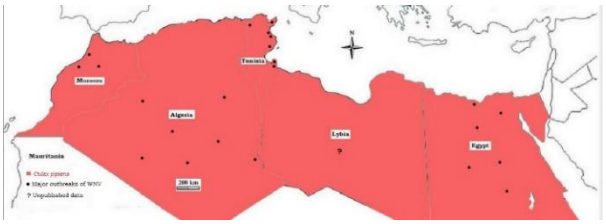

Figure 1. A North Africa map of West Nile Virus and its potential vector (Taylor et al., 1956; Mohammed et al., 1970; Corwin et al., 1992; Tber et al., 1996; Brunhes et al., 2000; El Rhaffouli et al., 2012; Bargaoui et al., 2015; Korba et al., 2016; Wasfi et al., 2016)

4. Conclusion:

There is currently no effective treatment for West Nile fever. The fight against West Nile virus infections must therefore be based on other means of prevention, which involve the education of exposed persons (measures to reduce mosquito breeding sites, to protect against exposure to adult mosquitoes by wearing protective clothing and the use of insecticides) as well as active surveillance at several levels of the West Nile virus transmission cycle: birds, Equines and humans (even mosquitoes).

Conflicts of Interest:

Authors declared no conflicts of interest.

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