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Review Article

Dengue Virus in Africa; What to Know About the Virus?

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Abstract: Dengue virus (DENV) is an RNA virus of the family Flaviviridae and genus Flavivirus with 4 serotypes capable of causing disease in humans. DENV is prevalent both in tropical and subtropical regions with a high possibility of spreading to close regions. The infection is transmitted to humans by Aedes aegypti and Aedes albopictus mosquitoes in urban areas during epidemics in Africa. Outbreaks of DENV 1-3 serotypes have been frequently reported over the course of the years in many Africa countries. Endemicity within the community is by vertical transmission from an infected female Aedes mosquito to her offspring. Diagnostic capacities are limited in the form of rapid test, point of care testing, and ELISA assay locally while PCR, plague reduction neutralization and micro-neutralization assays are some complicated methods. A multifaceted and integrated strategy is expedient to battle dengue fever outbreak in Africa, including highly enhanced diagnostics, improved surveillance and reporting, prognostic modeling, entomological surveys, vector control interventions, and education and public awareness campaigns. As we can't estimate the exact amount of the virus we have in Africa, we advocate for key action points highlighted by the Accra Expert Conference to be established in all Africa countries in the fight against DENV.

Keywords: Dengue virus, Dengue fever, DENV, Serotypes, Africa.

1. Introduction

Dengue fever is one of the several significant arboviral diseases in the world. The causative pathogen of dengue fever is Dengue virus (DENV), an RNA virus which is prevalent in 128 countries with an estimated 390 million people infected annually. This disease is inflicted by four congenitally associated but antigenically unique viruses named DENVs 1-4 of the family Flaviviridae and genus Flavivirus, each of these viruses can cause varying illnesses of mild fever to deadly cases like dengue shock syndrome and dengue hemorrhagic fever (DHF) (Bhatt et al., 2013),(Guo et al., 2017). With Africa region being one of the greatly affected continents, reports of Dengue virus has been revealed in particular populations and local travelers from over 25 African countries (Diallo et al., 2022). Presently, Dengue virus has inflicted over 100 nations in the world (Guo et al., 2017). Over 20 African nations have reported laboratory confirmed prevalent cases of Dengue virus, with a cumulative of 22 Africa countries reporting an erratic cases of Dengue outbreaks (Simo et al., 2019). This virus is a persistent and neglected contagious illness of public health interest, causing the greatest concern of arbovirus diseases, with an annual total of 10,000 and 1 million mortality and symptomatic infection respectively from more than 125 countries (Gainor et al., 2022).

Dengue fever is endemic in tropical and subtropical areas with high potential of circulating to nearby regions, causing an important effect on human lives and economies over the years. These global trends together with increased temperatures as a result of climate alteration have intensified worries that DENV will skyrocket in already prevalent regions as a result of increased multiplication, survival, replication and biting rates (Messina et al., 2019). Out of the 390 million individuals affected with dengue fever annually, only 96 million results in clinical representations leading to 500,000 hospitalized cases and 25,000 mortality yearly (Bhatt et al., 2013). Infection of dengue virus in humans is facilitated via the bite by an infected Aedes mosquitoes, which manifest asymptomatically in over 50% cases, and also in an influenza-like manner with fever, headache, and rash (Mwanyika et al., 2021). Dengue fever is part of the most significant arising mosquito vector infections globally with a lengthy record of human disease in tropical and sub-tropical regions. Ae. aegypti is said to be the major vector of Dengue virus worldwide, while Ae. Albopictus is considered as the major vector in some regions where local species are endemic (Caron et al., 2013). Since 1960, Dengue virus outbreak has been recorded in several African countries with all the four serotypes spreading across Africa. Serotype 2 of the dengue virus has been documented as the most common in Africa (Jaenisch et al., 2014). In this paper, we succinctly highlight the burden, key information to know about DENV, and recommendations in addressing its burden in Africa.

2. Dengue Vectors in the Community

The DENV virus is transmitted by Aedes aegypti and Aedes albopictus mosquitoes to humans in urban areas in Africa during epidemics. The mosquitoes are mostly found breeding in human-associated water storage containers such as jars, barrels, canisters, cement tanks, discarded containers, and other such items (D. Diallo et al., 2012). Although the Aedes mosquitoes primarily feed on humans, they have also been found feeding on other animals. Aedes aegypti is mostly active indoors during the day, but it can also transmit viruses outdoors. On the other hand, Ae. albopictus is an opportunistic feeder and is more active outdoors (Sintayehu et al., 2020). The suitability of climate for Ae. aegypti, which is associated with dengue incidence, is expected to increase in the future due to factors such as temperature and precipitation (Diouf et al., 2021). DENV has been found in several African countries, and Ae. aegypti has been found infected with all DENV serotypes in the field. In Senegal, Ae. aegypti was the only potential vector identified in all subsequent urban epidemics and sporadic dengue cases. In Tanzania, Ae. aegypti was associated with DENV in an entomological survey conducted during a dengue outbreak. Similarly, in Nigeria, DENV was detected in Ae. aegypti collected during entomological studies (Mwanyika et al., 2021), (Mboera et al., 2016).

2.1. Burden

Before the 2000s, DENV-2 was the most commonly reported serotype in Africa and caused several epidemics in East Africa and sylvatic outbreaks with sporadic human cases in West Africa. DENV-3 appeared only in Mozambique in 1985 and in Somalia in 1993, while DENV-1 outbreaks were observed in Sudan in 1984, Comoros in 1993, Nigeria in 1960 and Senegal in 1979 (Amarasinghe, 2011). However, in recent decades, the number and frequency of dengue epidemics in Africa have increased dramatically. DENV-2 and 3 are the main serotypes implicated in the epidemics on the African continent, although the circulation of the other two serotypes has been documented. In East Africa, DENV-2 has remained very active in countries affected over the last century but has also emerged in several other countries including Ethiopia in 2013, Tanzania in 2014 and Mozambique in 2014-2015. Outbreaks of DENV-2 and 3 were reported In several West African countries such as Mali, Senegal, Mauritania and Burkina Faso as well as Gabon and Angola in Central African countries (Otu et al., 2019), (Diallo et al., 2022).

Outbreaks of DENV-3 were reported in 2009-2018 in Tanzania, Zanzibar, Comoros, Benin, Cape Verde, Gabon and Senegal, while epidemics of DENV-1 were detected in Angola, Kenya, Senegal and Somalia in 2011-2018. The increasing number and frequency of dengue epidemics in Africa highlight the need for effective surveillance and control measures to prevent and manage outbreaks of the disease (Caron et al., 2013), (Diallo et al., 2022).

2.2. Transmission

Transmission of the virus is vertically from an infected female mosquito to her offspring through the eggs. This is one of the ways in which dengue virus is thought to be maintained in nature during periods when environmental conditions are unfavorable for mosquito survival and transmission (Ferreira-de-Lima & Lima-Camara, 2018). Studies have detected dengue virus in male mosquitoes of several species, indicating that these mosquitoes may also contribute to virus maintenance in nature. Additionally, the detection of dengue virus in adult mosquitoes that were collected as juveniles suggests that vertical transmission may be occurring (Mboera et al., 2016).

One study in Tanzania found that most of the dengue virus-positive pools from Aedes aegypti mosquitoes collected during a 2014 outbreak were from mosquitoes that were collected as juveniles, further supporting the idea of vertical transmission. Another study in Côte d'Ivoire detected dengue virus in a pool of emerging adult mosquitoes that were collected as larvae, indicating that the virus was likely transmitted vertically (Kone et al., 2018). Overall, these findings suggest that vertical transmission may be an important mechanism for the maintenance of dengue virus in mosquito populations, particularly during periods when environmental conditions are unfavorable for transmission (D. Diallo et al., 2022).

2.3. Diagnosis

In summary, diagnostic capacities for dengue virus in Africa are insufficient, but there are reliable serological assays that require only modest technological know-how and investment. Many rapid tests are available with satisfactory sensitivity and specificity, and the application of point-of-care testing, enzyme linked immunosorbent assay based serological diagnosing methods could aid accurate diagnosis and potentially raise awareness of the disease locally. More sophisticated diagnostic methods such as polymerase chain reaction for dengue virus RNA, plaque reduction neutralization and micro-neutralization assays, are also accessible and could be integrated into government and regional reference laboratories with appropriate capacity building (Jaenisch et al., 2014), (Onyedibe, 2018).

2.4. Recommendations For Future Approaches

A comprehensive approach to dengue control in Africa would require addressing the root causes of the disease, which include poor urban planning, inadequate water and sanitation infrastructure, and ineffective waste management (Bhatt et al., 2013). Identifying and mapping the distribution of vector mosquitoes such as Ae. Aegypti and Ae. Albopictus in Africa would be crucial to predict and prevent potential outbreaks of dengue. This can be achieved through entomological surveys and mapping of breeding sites, as well as monitoring the spread of the vectors using innovative tools such as remote sensing and geographic information systems (GIS). Understanding the ecological and environmental drivers of vector distribution and abundance can also inform targeted vector control interventions such as larval source reduction, adulticide spraying, and community engagement to eliminate breeding sites (Mweya et al., 2013).

In addition to surveillance and research efforts, it is important to strengthen public health interventions for dengue in Africa. This includes effective vector control measures, such as the use of insecticide-treated bed nets, indoor residual spraying, and environmental management to reduce breeding sites for mosquitoes (World Health Organization, 2014). It also involves enhancing public awareness and education about the disease and its prevention, particularly in areas of high dengue transmission risk. Furthermore, strengthening healthcare systems in Africa is crucial for improving dengue management. This includes increasing access to appropriate medical care and improving clinical diagnosis and case management of dengue fever. Capacity building for healthcare providers on dengue diagnosis and management should also be a priority (Jaenisch et al., 2014). Finally, international collaboration and partnerships can play a significant role in addressing the challenges of dengue in Africa. This includes supporting research and surveillance efforts, providing technical assistance and capacity building, and facilitating access to vaccines and other medical interventions. A coordinated effort involving multiple stakeholders, including governments, non-governmental organizations, academia, and industry, is necessary to address the complex challenges of dengue in Africa. Education and public awareness campaigns can improve community participation in vector control and reduce the risk of dengue transmission (Greif et al., 2011), (Anders & Hay, 2012).

3. Conclusions

Dengue virus is prevalent in African countries but we don’t know how much the exact burden is because Dengue virus surveillance is not what a true surveillance of infectious disease is in after Africa. The summary of the key action point highlighted by the Accra Expert Conference to dengue virus includes; making dengue diagnostic tools more widely available in healthcare in Africa, collecting representative data across Africa to uncover the true occurrence of dengue and to more clearly define its transmission in the region. Established networks such as African laboratory networks, the Pasteur International network, the INDEPTH network and others should work together to produce these required types of data. This improved information is expedient in informing policymakers to take the necessary steps to control the dengue vector and provide health services (Greif et al., 2011).

A multidisciplinary and integrated approach is necessary to combat dengue in Africa, including improved diagnostics, surveillance and reporting, predictive modeling, entomological surveys, vector control interventions, and education and public awareness campaigns. These efforts can contribute to reducing the burden of dengue in Africa and enhancing the overall health and well-being of the population. Implementation of a graded laboratory diagnostic system across Africa would facilitate the definitive diagnosis of dengue infection, provide quality assurance and quality control, and support locally relevant scientific research. It is important to evaluate these diagnostic tests in patients with annual falciparum index, taking into account the high background endemicity of malaria and various concomitantly circulating flaviviruses.

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Not Applicable

Conflict Of Interest

The authors declare no conflict of interest, financial or otherwise.

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Author Contributions

All authors planned and wrote the paper. We have read and approved the paper.

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