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Short Communication

Anopheles stephensi Emergence and Malaria Control Challenges in Ethiopia

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Introduction

This Policy Brief examines the emergency of *Anopheles stephensi's* and challenges facing malaria control in Ethiopia based on a narrative review and synthesis of evidences.

In areas where it was previously under control, malaria appears to be rising right now. The emergence of *Anopheles stephensi* in Africa and the impact of the COVID-19 pandemic on preventive and control initiatives are the main causes of this issue. About 10% of all diseases in Africa are caused by malaria. According to the Ethiopian FMoH, the country is heavily infected with malaria, and the current positivity rate is 26%. Because most African *Anopheles* mosquitoes, including *A. gambiae*, breed in rural settings, malaria is typically thought of as a disease of the countryside. However, metropolitan areas of Ethiopia (Diredawa, Oromia, Somali and Afar), Djibouti, Sudan, and Somalia have been shown to harbor *A. stephensi*. As a result, malaria risk in urban Ethiopia will be increased. Due to *A. stephensi's* intimate relationship with artificial habitats, over 126 million people living in cities around Africa may be at danger of contracting malaria. Attempts to advance global health in Africa including Ethiopia are seriously in danger by the spread of this invasive vector. It effectively spreads *Plasmodium falciparum* and *vivax* malaria. Currently, A significant threat to malaria prevention and control in Ethiopia is the spread of *A. stephensi* as a result of zoophilic (desire for animals), exophagic (eating outdoors), and exophilic (resting outdoors) preferences. In Ethiopia, malaria is the main cause of outpatient visits (10 - 40%) and hospital admissions (13 - 26%), placing an immense strain on healthcare resources. Because it decreases the labor force available to grow and harvest food and cash crops, malaria also plays a role in the vicious cycle of poverty in the country. This narrative summary seeks to summarize the issues associated with malaria control in Ethiopia as well as the introduction of *A. stephensi*, with the goal of making recommendations for upcoming research and decision-makers.

Methods

A narrative review was conducted on original articles, reviews, reports, fact sheets, and publications on the prevalence of malaria now and in the future, the expansion of *A. stephensi*, the difficulties associated with treating malaria, and the difficulties associated with malaria control. Examiner looked at very recent papers and took into account original articles, systematic reviews, meta-analyses, other reviews, the grey literatures, press releases, and reports.

Findings

The findings were presented under the following three thematic areas.

Current and prospective prevalence of malaria

The WHO indicated that progress in lowering the global burden of malaria has halted in recent years, particularly in sub-Saharan Africa (high burden nations). Over 96% of the annual worldwide morbidity and mortality from malaria occur in Africa. In Africa, malaria still caused harm to small children and pregnant women. The combined prevalence of malaria among adults in Ethiopia (13.61%) was found to be greater than that of the general population and nearly equal to that of pregnant women. Seven months earlier, the Bench-Sheko Zone's Health Department in Southwest Ethiopia reported that out of 82,000 suspected cases of malaria, 45,000 people had been positively identified as having the illness. According to this data, the zonal prevalence of malaria is currently greater than 50%. A study done in Northwest Ethiopia found that 29% febrile diseases are considerably caused by malaria. Land use changes have accelerated globally during the last few decades. The spatial and temporal distribution of vector-borne diseases, including malaria, is significantly impacted by changes in ecology and the environment. Housing conditions, altitude, climate, and environmental changes brought on by the building of infrastructure, dams, and agricultural projects are significant drivers of malaria risk and transmission in Ethiopia. Despite the fact that malaria occurs in areas between 1600 and 2000 meters above sea level (masl), certain investigations have identified malaria in locations higher than 2000 masl. An estimated 32% of households in villages with irrigation micro-dams in northern Ethiopia had malaria, compared to 19% in areas without micro-dams. The negative effects are much more obvious in lowland and midland environments, where the country has recently thought about extending its large-scale irrigated agriculture. In addition, rising temperatures in Ethiopia's highlands, notably in Addis Ababa, are making the region more favorable to malaria, which is anticipated to result in a rise in the disease's prevalence. A study done in northern Ethiopia suggests that by 2050, climate change may cause the area suitable for malaria transmission to increase by 94 to 114%. Up to 130 million Ethiopians could be at risk of malaria by 2070, which could cause considerable economic losses. Furthermore, the emergence of novel vectors like *A. stephensi* increases the possibility of increased *P. falciparum* and *vivax* transmission throughout Africa, particularly Ethiopia. Since the initial *A. stephensi* identification in 2012, the number of malaria cases in Djibouti has increased thirty-fold. Therefore, in Ethiopia, the annual incidence of falciparum malaria may increase by 50% in the absence of novel interventions.

Challenges in controlling malaria

African malarial mosquitoes have an affinity for biting people while they are sleeping inside their dwellings. But in the early evening, *A. stephensi* can bite. Bed nets don't provide the same level of protection when people are out seeking for food because they aren't truly in bed. This vector also prefers to consume its blood meal outside. If it bites inside, it gets out of there swiftly to escape being sprayed with insecticide. *A. stephensi* is resistant to several insecticide classes in Ethiopia, most notably pyrethroids, the sole class that the WHO recommends using in nets. In the Amazon, India, Africa, and Asia regions, histidine rich protein-2 (HRP2) antigen-deficient isolates have been found. As a result, RDT-based malaria diagnosis is losing accuracy over time. Additionally, malaria transmission can extend a very long time due to the fact that this vector frequently nests in artificial water storage locations (plastic tanks, cisterns, barrels, abandoned tyres and plastic containers). Due of an unreliable water supply, many people practice water conservation. This issue is more urgent in urban and periurban areas where there is high population density, ongoing demand for water storage, limited access to healthcare, and insufficient vector control. It is not surprising that *A. stephensi* and *A. aegypti*, a key dengue vector in metropolitan Africa, usually cohabit. Additionally, solid waste management is typically an issue in these areas, which raises the possibility of these vectors thriving there. These show that certain regions are vulnerable to malaria epidemics. Although *A. stephensi* is typically an urban vector, when habitats like streams and irrigation ditches are plentiful, it may extend its biological range into more rural areas. Finally, it is said that *A. stephensi* is a three to meet-the drug resistance, the diagnostic resistance, and the exceedingly potent vector. These circumstances made it more challenging to fight the disease and provided a new barrier to stop malaria spread. The four doses of the Mosquirix® (RTS, S) vaccine only reduce infant malaria mortality by 30%. Accepting this limitation, a sizable domestic or foreign budget or sum of money is required to carry out a malaria vaccination programme in Africa. Additionally, adults are not eligible for the malaria vaccine. These concerns and the emergence of insecticide-resistant malaria vectors draw attention to the current system's reliance on chemotherapy.

Difficulties in treating malaria

The development of resistance among regularly used antimalarial drugs is a serious problem. It has been discovered that many African nations, including Eritrea, Rwanda, and Uganda, have parasites that are resistant to artemisinin. The partner agents utilized in ACTs are likely to develop a partial artemisinin resistance. Resistance to artemisinin and the co-agents used in ACT regimens can lead to high rates of treatment failure. Parasites that are multi-drug resistant are present across Ethiopia's malarious regions. Chloroquine-resistant vivax malaria has been reported in Ethiopia as well. The emergence of drug-resistant parasites, particularly falciparum, makes it challenging to put malaria containment measures in place.

There are various reasons why antimalarial drugs are currently resistant. Some of these consist of the medicine dosage, treatment compliance, and poor treatment adherence. Ineffective dosing, a poor pharmacokinetic profile, and counterfeit antimalarials that expose parasites to insufficient drug all contribute to the development of resistance. In Ethiopia, self-treatment is typical. So, as a result of market price inflation that has happened both locally and globally, patients are forced to buy and take half of the antiplasmodial medicine dosage. Numerous re-infections are usual since malaria transmission continues for a very long time after the arrival of *A. stephensi*. Therefore, the current antimalarial medications may become less and less effective due to the development of resistant parasites as a result of the parasites being exposed to the drugs frequently due to recurrent therapy and treating huge numbers of malaria afflicted patients.

Policy recommendations

For the protection of native mosquitoes, keep using bed nets and indoor sprays because they are still out there. ACTs remain the best treatment for uncomplicated *falciparum* malaria. But there is currently no one tool that can completely address the malaria problem. However, no single method can now solve the malaria problem (no single method can now solve the malaria problem fully). Innovative new methods are necessary. These include novel techniques for controlling vectors (such as new insecticides), improved diagnostics, and stronger drugs, among others. It was shown that indoor residual spraying with Fludora® Fusion (a combination of deltamethrin and clothianidin) caused high and protracted mortality in carbamate- and pyrethroid-resistant malaria vectors, primarily because of the clothianidin component. The new Interceptor G2 nets greatly surpassed pyrethroid-only nets at preventing malaria because they have been treated with a pyrethroid as well as a separate chemical class called chlorfenapyr that hasn't before been used for vector control. It is also advised to use attractive targeted sugar bait (ATSB), an outdoor bait station that draws mosquitoes and kills them. Endectocides like ivermectin, which humans can consume to have an impact on mosquitoes that bite them indoors, outdoors, daytime, and night-time, represent another new frontier. Two further innovative approaches that show promise are the genetic engineering of mosquitoes and the use of radiation to sterilize insects. To prevent mosquitoes from laying their eggs in urban locations, remove standing water, tightly seal water containers with polystyrene beads, and use larvicides in storage containers. Through local and national public media, such as television and radio, community mobilization and awareness-raising efforts should be carried out to increase and improve efforts to prevent, control, and treat malaria. In order to increase the capacity of surveillance (vector and drug resistance monitoring), diagnostic, protective, and curative systems of malaria, as well as to demonstrate solidarity with international organizations concerned with malaria containment and elimination, the nation should mobilize its resources and involve stakeholders (environment, education, local councils, trade and industry, agriculture, housing, and finance sectors). For better waste management and a decrease in mosquito breeding, environmental management and sanitation organizations may be especially crucial. On the other hand, the ministries of education can assist localities in identifying and managing the risk factors linked to the vectors through community- and school-based instructional initiatives. Attempts to suppress one would also control the others since *A. stephensi* breeds where mosquitoes that transmit dengue, chikungunya, and yellow fever also do. Preventive chemotherapies like mass drug administration (MDA), seasonal malaria chemoprevention (SMC), intermittent preventive treatment of malaria in pregnancy (IPTp), and intermittent preventive treatment of malaria in school-aged children (IPTsc) can be used to supplement regular malaria control efforts. Transmission of malaria might be lowered by early diagnosis and treatment of infections. To treat malaria infections with resistance, ongoing research in discovery of novel antiplasmodial drugs is necessary. Medicinal herbs are useful resources in the search for new antimalarials. Traditional Ethiopian insecticides, insect repellents, and antimalarials must still be translated or integrated into modern medicine. The WHO suggested enhancing and more effectively managing the use of diagnostics and therapies in order to alleviate drug pressure through preventive approaches. Additionally, it is advised that clinical efficacy studies be used to keep track of the antimalarials currently on the market in order to make quick judgments on treatment plans [1].

Bibliography

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