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Commentary

Non-mesh, long-lasting insecticidal net use amongst nomadic communities in Garissa County, Northern Kenya

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Background

Malaria remains a major public health problem in Kenya despite the concerted control efforts. At the moment it is estimated that malaria accounts for 13-15% of all hospital in-patient admissions and 30% of all the patients seen at the outpatient clinics [1]. Annually in Kenya, there are an estimated 3.5 million cases diagnosed and 10,700 deaths from malaria, of which children constitute 67% [2]. The diseases remain the most common reason for presentation at local hospitals in Kenya [3]. Long lasting insecticide treated nets (LLINs) and indoor residual spray (IRS) remain the main tools for control of malaria [4] in several malaria endemic regions, Kenya included. Currently, LLINs are for use indoors and protect human populations during sleeping hours.

The Kenya Malaria Indicator Survey (KMIS) 2020, showed that overall malaria prevalence was at 6% by microscopy in children under the age of 5 years. Epidemiologically, the Northern parts of Kenya, are classified as semi-arid and seasonal malaria transmission zones [5] and in these areas malaria transmission is less than 1%. At the moment, LLINs are not distributed or IRS is not being conducted in these areas to control malaria. However, these regions occasionally experience malaria epidemics occasioned by extreme weather events such as El Nino and increased rainfall [5]. Malaria vector that are known to exist in these regions is *Anopheles arabiensis* and in 2022 the invasive malaria vector, *Anopheles stephensi* was detected in Marsabit and Turkana [6,7]. These two malaria vectors are known to bite outdoors and can pose serious challenge for malaria transmission when the conditions are suitable for disease transmission.

The population that inhabits the northern parts of Kenya are mainly nomadic communities and have been defined here as groups of people with no fixed home who move according to the seasons and in search of water, food, and pasture for their animals. Due to the climatic conditions in the northern parts of Kenya, the nomadic populations are known to sleep outdoors. Moreover, as a result of lack of exposure to malaria bites this population lacks functional immunity to malaria. Thus, the existence of the two malaria vectors will complicate the transmission of malaria in these regions.

The distribution of long-lasting insecticidal nets (LLINs) has long been a key malaria intervention, however, for nomadic populations who live and sleep outside, in harsh climates and areas with increasing reports of exophagic behavior of mosquitoes, traditional LLINs are often inadequate. The Division of National Malaria Program (DNMP) is currently not conducting mass net distribution of LLINs or continuous distribution through ante-natal (ANC) clinics in this region. However, because of the climatic conditions in these regions, the conventional LLINs might not be optimal for use. The MENTOR Initiative working with Ministry of Health (MoH), investigated the acceptability of non-mesh, long-lasting insecticidal nets amongst nomadic communities in Garissa County, Kenya using a prospective, longitudinal study design and cross-sectional household surveys. This commentary paper revisits the use of non-mesh LLINs amongst nomadic communities in the norther parts of Kenya.

Use of Non-mesh Long Lasting Insecticide Treated Nets

In our previous study in Garissa, northern part of Kenya, we found high acceptability to use of Dumuria nets amongst the nomadic communities. In order to increase LLINs acceptability and usage, malaria control programs need to consider specific needs and contexts of communities. Large-scale, blanket net distribution campaigns, which are currently the standard practice in most malaria endemic countries, do not cater for the specific and nuanced needs of the differing communities they often serve. Dumuria, the non-mesh LLIN offers a highly effective and desirable malaria prevention option to a typically hard to reach and underserved nomadic population at increased risk of malaria infection. At the moment, continuous distribution of LLINs through antenatal clinics mainly occurs in the lake endemic regions where malaria is endemic. In the Northern parts of the country, ANC distribution of LLINs is only occurring in Isiolo County.

In the East African region, dumuria net has previously been distributed to the nomadic population of South Sudan where extremely high levels of acceptability were found when compared to standard LLINs (unpublished observations, P. Guillet). Nomadic communities use of dumuria nets in Garissa County, northeastern Kenya worked as a good option for outdoor sleepers and harsh environments. With the eminent spread of this malaria vector, there will be a need to test other potential nets such as dumuria nets which are durable and context-specific tool to prevent malaria among traditionally hard-to-protect and highly vulnerable populations.

Previous studies looking at retention, utilization, and durability of this novel, non-mesh nets designed for outdoor use indicated that dumuria were highly acceptable, with high retention and utilization [8]. Based on the findings of these two studies and with a possible extensive spread of the invasive malaria vector *Anopheles stephensi* in the northern parts of the country, more studies need to be conducted in this region and the non-mesh dumuria nets be considered for possible distribution among the nomadic communities.

The northern parts of Kenya, house the Dadaab refugee camp, consequently the establishment of this invasive vector in this region will pose a serious challenge for malaria transmission. Other vector control tools would be amenable in this region to reduce the human vector contact. This calls for adopting integrated vector management (IVM) strategies to minimize breeding of this vector. These will include conducting indoor residual spray (IRS) more specifically in the dwellings in the refugee camps. Similarly, storage of water can provide breeding grounds for this vector which has been found to breed in various habitats. Thus, reducing breeding habitats for the vector by covering water storage tanks and or eliminating other potential breeding habitats will be critical in reducing the densities of the vector. Control of this vector using *Bacillus thurngiensis israelensis* (*Bti*) in water bodies, which are not used for domestic purposes is also recommended.

Invasion of Northern Parts of Kenya by *Anopheles stephensi*

In 2022, the invasive malaria vector *Anopheles stephensi* was detected in Marsabit, northern Kenya [6]. This vector is known to exhibit different feeding (outdoor, evening biting) and resting behaviors (animal shelters are common dwellings) rendering methods such as IRS less effective [9,10]. It also can adapt to various climatic conditions, unlike the non-invasive malaria vectors whose survival in cold temperatures in high altitude areas is restricted. The vector is known to significantly spread fast to new areas. Thus, the invasion by this mosquito could pose a significant threat to Kenya's efforts to control and elimination malaria.

In Africa, *Anopheles stephensi* was first detected in Djibouti City in 2012 [11]. It has now spread to Ethiopia, Sudan, and Somalia [12] and latest, Kenya [6]. *Anopheles stephensi* crepuscular biting and resting outside houses could translate to reduced efficacy of core vector control interventions, Insecticide treated nets (ITNs) and indoor residual spray (IRS). If *Anopheles stephensi* were to spread in North Eastern consequences would include: There is the risk that malaria from the urban & peri-urban will be exported to the rural remote areas. Additionally, this species has been found to be resistant to majority of the publicly available insecticides. Seasonal malaria transmission characteristic of the region means that the populations have not acquired immunity against malaria.

Conclusion

Use of LLINs is one of the strategies for malaria control in the country. This has reduced malaria prevalence and incidence in several parts of the country. Traditionally, the LLINs which are being distributed through mass net distribution and ANC are the mesh fabric nets and are mainly distributed in the malaria endemic regions. No distribution of LLINs occur in the norther parts of the country. These regions are inhabited by nomadic population who move from time to time in search of pasture for their animal. Because of the harsh climatic conditions in these regions these populations also sleep outdoors exposing them to risk of being bitten by malaria vectors. Thus, any malaria control tools for use in these regions should be context specific and meet the needs of this population. Moreover, the recent detection of the invasive malaria vector *Anopheles stephensi* in this region may result into upsurge of malaria cases. Thus, more studies need to be conducted in this region and the non-mesh dumuria nets be considered for possible distribution among the nomadic communities. Additionally, control of this vector will require an integrated approach using IRS and larval source management besides the distribution of the non-mesh LLINs.

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