

## Review Article

# Epidemiology of malaria as it relates to utilization of insecticide treated nets among pregnant women and under five years children in South-South Nigeria

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## ABSTRACT

Pregnant mothers and children under five years are exposed to malaria infection. One of the WHO recommendations on prevention of malaria is the use of insecticide treated nets (ITNs). The use of ITNs is still low in Nigeria. Is to access challenges and improvement on use of ITNs among pregnant mothers and care givers of children under five in Bayelsa, Delta and Rivers state respectively. Review of articles related to use of ITNs among pregnant mothers and under five years children were adopted using The American Journal of Human Genetics among 28 studies. Malaria is responsible for 30% childhood and 11% maternal mortality despite the availability on use of ITNs. ITNs were 62.8% effective in reducing febrile episodes and 84.1% effective in reducing marked levels of malaria parasitemia. Mass distribution of bed-nets has increase ownership of ITNs resulting to 81.5% in Nigeria. Free ITNs has resulted in universal household ownership but the use of the nets is still very low in Nigeria. Malaria interventions are threatened by pyrethroids used in all ITNs. Irritation and suffocation are challenges to utilization of ITNs. In health promotion on use of ITNs, manufacturers' improvement on quality of ITNs is an epidemiological factor that could enhance the use among the vulnerable groups.

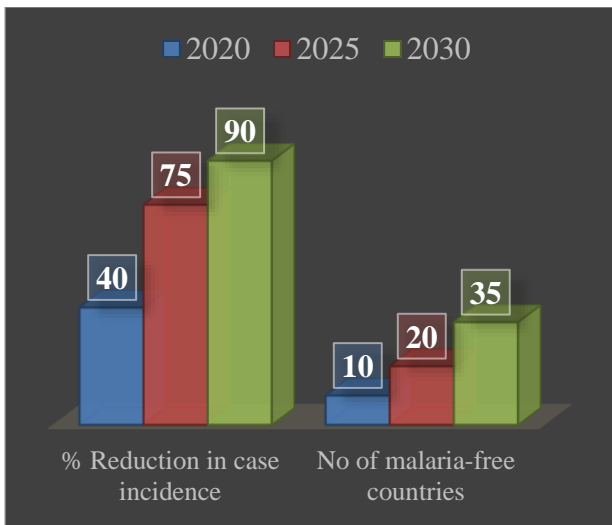
**Keywords:** Malaria epidemic, Global reports, ITNs, Mass distribution, Ownership, Utilization

## INTRODUCTION

The world success on malaria elimination has been reported to be slowed compared to initial progress.<sup>1</sup> There was no much difference of global malaria cases between 2010 to 2018 despite malaria intervention availability.<sup>2</sup> This is especially in Africa, and Nigeria in particular where it is a major public health problem.<sup>3,4</sup> Among the vulnerable population to malaria infection are pregnant women and children under 5-years. These are the subpopulation groups who are exposed to malaria related anemia that highly contributes to death if effective intervention is not taken.<sup>5</sup>

The 2016 report indicate that 99% of malaria cases in sub-Saharan Africa are caused by *Plasmodium falciparum*, *P. vivax* is the common parasite.<sup>6</sup> WHO recommends use of long-lasting ITNs (LLINs); intermittent preventive treatment in pregnancy (IPTp) with sulfadoxine-pyrimethamine (SP) and prompt diagnosis as well as effective treatment among pregnant women during antenatal care services.<sup>7</sup> Yet, malaria interventions are threatened by resistance of malaria vectors to pyrethroids used in all ITNs, which has been on the increase from between 2010 and 2016.<sup>8</sup> It is agreed that to achieve universal ITN coverage, affected countries with malaria infections need to subscribe to supportive

program to reach global malaria targets for 2020 and beyond (Figure 1).<sup>6</sup>



**Figure 1: Global malaria target for 2020-2030 relative to 2015.**

Adapted from ‘The E-2020 initiative of 21 malaria-eliminating countries: 2019 progress report’.<sup>8</sup>

There has been decline in malaria infection in Africa due to increase investment to eliminate malaria but sustaining it has been a difficult issue for indigenous malaria cases in African countries.<sup>9</sup> WHO recommend one ITN for every two people at risk of malaria; hence Nigeria has been involved in free mass distribution of LLINs to vulnerable populations.<sup>3</sup> The renewed target for roll back malaria (RBM) in Nigeria now includes to control malaria with targeted key performance indices including

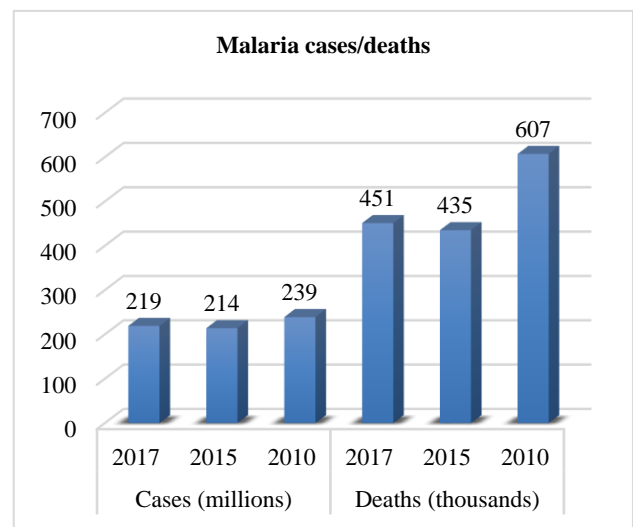
- 80.0% of children <5years and pregnant women to use ITN.<sup>10</sup>
- 74% of ownership of ITNs in households through mass distribution.<sup>11</sup>

Despite the evidence that the use of ITNs decreases malaria related mortality and morbidity, its use is still low as reported by the 2013 Demographic Health survey in Nigeria.<sup>4</sup> There is evidence that ITNs coverage or ownership seems to have achieved the RBM target. However, utilization is quite low and a far cry as most of the owners are not utilizing their nets due to various factors.<sup>12</sup> A study to identify factors that are meant to be eliminated for effective utilization of ITNs among pregnant mothers and care givers of under five years children in Bayelsa State, Delta State and Rivers State within South-South Nigeria will go a long way to influence stake holders in promoting the health of the vulnerable population against malaria infection.

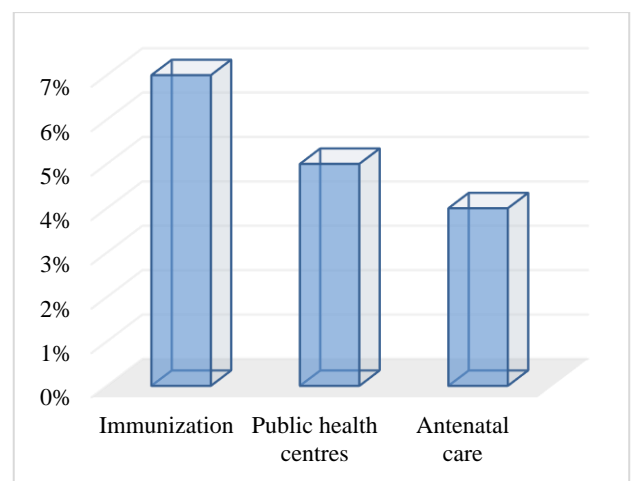
### GLOBAL MALARIA CASES AND MORTALITY

Global report on malaria in 2015 indicates that malaria infections were about 212 million cases and had caused

429,100 deaths. Majority of the affected populations are more of children and pregnant mothers.<sup>13</sup> In 2016, 91 countries experienced 216 million malaria cases, with 5 million cases higher than the previous year. The mortality rate due to malaria was recorded at 445, 000 deaths which was similar to figures reported in 2015.<sup>6</sup> These indices show that the global burden of malaria did not seem to be a continuous or consistent declining trend in the past decade. Indeed, the 2017 data appear worse than 2015 (Figure 2).<sup>5</sup> It is acknowledged that cases of malaria reduced globally between 2010 and 2018 from 71 to 57 cases per 1000 population at risk. That of 2014 to 2018 which was 57 cases 85% higher among 20 countries in Africa Region and India.<sup>7,8</sup>



**Figure 2: Numbers of malaria cases and deaths at baseline, 2015 vs. 2017.**



**Figure 3: Increase in ITN distribution by healthcare venue.**

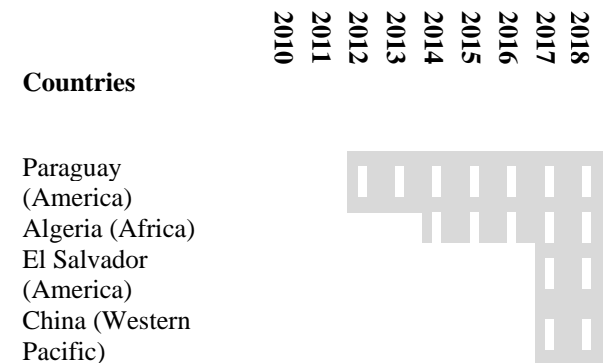
### Prevention of malaria with use of ITNs

WHO recommends use of LLINs, IPTp and SP as well as prompt diagnosis and effective treatment of malaria

infections as main stay among pregnant women during antenatal care services.<sup>7</sup> In 2016 intervention against malaria infection with the use of ITNs shows that 54% of people at risk of malaria in sub-Saharan Africa were sleeping under it. This ITNs utilization rate is not near the goal of universal access.<sup>6</sup> Between 2016 and 2018, 578 million ITNs were distributed by producers worldwide, out of which 50% went to Africa and India. The African countries include Côte d'Ivoire, Democratic Republic of Congo, Ethiopia, Ghana, Nigeria, Uganda and the United Republic of Tanzania. Globally, 80% of ITNs were distributed through mass distribution campaigns, 10% in antenatal care facilities and 6% as part of immunization programs (Figure 3).<sup>8</sup>

**Challenges in progress of malaria control as it concerns ITNs**

Lack of sustainable and predictable international and domestic funding, humanitarian crisis in malaria endemic territories, poor climate conditions, emergence of parasite resistance to antimalarial treatment and mosquito resistance to insecticides are noticed in some countries.<sup>6</sup> Malaria intervention are threatened by resistance of malaria vectors to pyrethroids used in all ITNs, which has been on the increase from between 2010 and 2016.<sup>8</sup> Irrespective of the slow progress in elimination of malaria, there is hope of progress and lessons to be learnt in countries. For instance, Algeria in Africa is among the few countries that have reported zero indigenous cases for a minimum of two consecutive years (Figure 4), and are certificated malaria free.<sup>5</sup>



**Figure 4: Countries that have achieved malaria-free status in ≥ 2 years.**

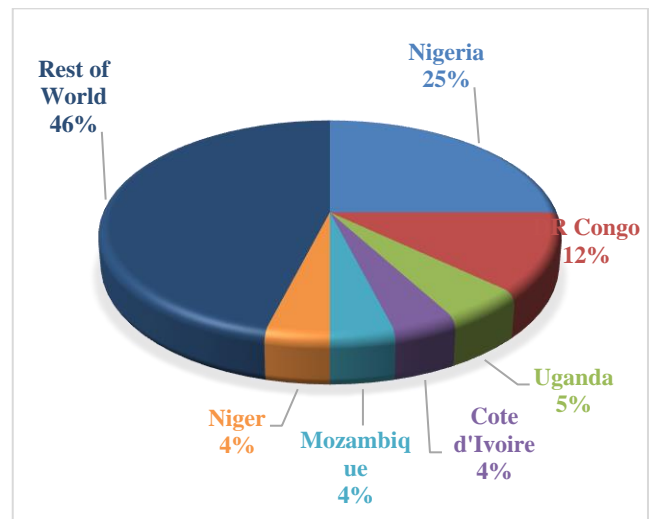
Adapted from ‘The E-2020 initiative of 21 malaria-eliminating countries: 2019 progress report’.

**AFRICA: SUB-SAHARAN MALARIA CASES AND MORTALITY**

So much can be said of malaria in Africa e.g. 15 countries in Sub-Saharan Africa responsible for about 80% of the world malaria infection.<sup>3</sup> Malaria has been identified for decades as a public health problem in Sub-Saharan Africa. It has caused a high rate of and death among women of child bearing age and children under one year old in Africa. One of the five highest deadly diseases in

Sub-Saharan Africa is malaria.<sup>14</sup> According to the WHO 2017, there were 216 million cases of malaria in the world and 445,000 deaths took place in 2016 of which 90% of the deaths occurred in Africa continent and 80% of the reported case is from Sub-Saharan Africa. All ages and sexes are affected by malaria, although low immunity level among pregnant mothers and under five years children has been an underlining factor responsible for high rates of death.<sup>15</sup> Plasmodium falciparum is the most highly rated parasite over P. vivax that causes malaria infection in Africa. In fact, WHO reported that

- In every 50 seconds, a child dies of malaria hence a constraint to socio-economic development.<sup>16</sup>
- Malaria is wide spread among 76 countries in Africa and Asia.<sup>8,17</sup>
- In the 2019 global malaria report, 19 countries in sub-Saharan Africa and India contributed 85% of the global burden. In other perspectives, Africa contributed 93% (Table 1); while Nigeria is one of 6-countries that accounted for 54% of all malaria cases (Figure 5).<sup>7</sup>



**Figure 5: Nigeria as most affected global cases.**

**Table 1: Global malaria cases according to WHO report of 2019.**

Year	Estimated cases (millions)	95% CI
<b>Estimates</b>		
2010	251	231 - 278
2017	231	211 - 259
2018	228	206 - 258
<b>Distribution of occurrence of malaria-2018 cases (%)</b>		
African region	93.0	
South-East Asia	3.4	
Eastern Mediterranean	2.1	
Rest of World	1.5	
<b>Total</b>	<b>100.0</b>	

### ***Policy on malaria prevention with the use of ITNs in Africa***

WHO in 1992 emphasize that ITNs is the best and reliable preventive strategy against malaria burden. Ghana as a signatory to the May 2006 Abuja Declaration. As part of the objective of the RBM, agenda was to raise ITNs ownership to 80% and utilization to 60% by 2010. Further target set for 2015 was to achieve 100% ownership and 80% usage.<sup>14</sup>

The WHO recommends utilization of ITNs as the main strategy towards control of malaria by all ages and sexes. Distribution of free ITNs should be the main intervention in national malaria control strategy in all Sub-African countries. WHO target of 85% coverage is a vital key performance index to distribution of ITNs supply. Adjunct to this recommendation is one ITN for every two people who are at risk of malaria.<sup>3</sup> The Abuja declaration in 2000 by African leaders for the provision of 60% of ITNs for African children by 2005 is yet to be achieved by Sub-Saharan countries, despite their effort to meet universal coverage.<sup>18</sup> Most countries are below the set target of protection coverage.<sup>16</sup>

### ***Constraints and achievements in Malaria Control with the use of ITNs in Africa***

Funding of malaria programs by donors has been scarce in Sub-Saharan African countries. Thus, making the fight against malaria a difficult task. Poor awareness or knowledge about malaria preventive measures, and misunderstanding between couples on use of ITNs is reported in previous investigations.<sup>19</sup> Factors identified as challenges for ownership ITNs include, but not limited to:<sup>16</sup>

- Awareness or knowledge: level of understanding on use of bed nets,
- Demographic factors: age, sexes, marital status, and occupation
- Access to healthcare: distance to nearest antenatal care,
- Affordances: access and cost including availability of transport as well as house-hold size

Studies from Africa reveal that ownership of bed nets cannot be interpreted as utilization of the ITNs. The latter makes it far from meeting the target of universal coverage. Utilization of ITNs has been reported to be as low as 9.6%. Reasons for non-utilization of ITNs in Africa are perceived un-comfortability and hotness created by ITNs, low understanding of malaria prevention. Inadequate separate sleeping rooms, poor quality of ITNs and inadequate ITNs to the house hold members.<sup>14</sup>

The issue of poor quality underpins failure rates. Re-emergence of malaria has been experienced in Senegal, Western Kenya, Gambia, Benin, Tanzania and Uganda where ITNs have been utilized. These situations warrants

the need to study the main challenge of resistance to ITNs of the mosquitoes that causes malaria.<sup>20</sup> In Sub-Saharan Africa, it is estimated that the population of users of ITNs have gone up from less than 2% in 2000 to 67% in 2015. Modification of nets into pyrethroid treated bed nets has help to reduce vector increase, number of infection rates in Anopheles populations leading to decline in malaria-associated cases and death rates in African countries.<sup>20</sup>

However, the study in Benin, Equatorial Guinea and Malawi have shown that distribution and utilization of new ITNs provide more advantages to reduce malaria burden despite pyrethroid ITNs resistance than use of old ITNs.<sup>21</sup> Therefore, it must be acknowledged that regardless of poor quality, ownership and utilization of the available ITNs is a *sine qua non*.

### ***NIGERIA: MALARIA CASES AND MORTALITY***

#### ***Epidemiology on utilization of ITNs among pregnant mothers and under five children in Nigeria***

Nigeria is among 11 countries that account for 70% in the world malaria deaths rate.<sup>22</sup> Malaria is a major public health problem in Nigeria and it is responsible for 30% childhood and 11% maternal mortality, despite the availability of effective interventions.<sup>4</sup> 100% of the Nigerian populations are at risk of malaria infection. Nationally, the malaria burden accounts for 60% of outpatient visits to health facilities.<sup>23</sup> Malaria infection is endemic in Nigeria, and everybody is at risk with a prevalence of 919 per 10,000 (9%) of population.<sup>10</sup> Nigeria leads other ten African countries with a high burden of malaria and accounted for 25% of total malaria cases (Figure 5), and 19% of malaria deaths worldwide in 2017.<sup>24</sup>

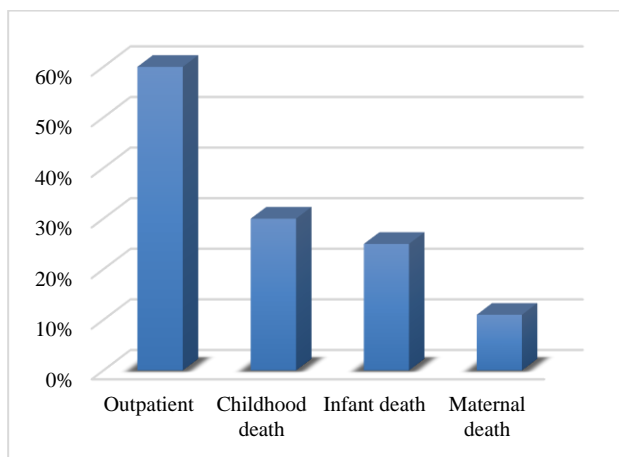
According to the statistics of the Nigerian National Malaria Control program, the burden of malaria includes 60% of outpatient visits to health facilities (Figure 6); and an estimated annual loss of 132 billion Naira in the form of treatment and prevention costs, and loss of man-hours, amongst other losses.<sup>25</sup> The geographic spread of the malaria burden is heterogeneous in the country, with the highest prevalence among children ages 6 to 59 months in the North Central, North East and North West regions, and the lowest prevalence in the South East region.<sup>23</sup>

#### ***Policy of malaria prevention on use of ITNs in Nigeria***

The Government of Nigeria, through the National Malaria Elimination Programme (NMEP) and in collaboration with partners, is scaling up malaria prevention and treatment interventions in line with the goals of the National Malaria Strategic Plan (NMSP) 2014-2020. NMEP employs a mixed-model approach for ITN distribution that includes free mass distribution campaigns and continuous distribution of ITNs to supplement the mass campaigns. Continuous distribution relies on several routine health service delivery channels:

immunization campaigns; antenatal care (ANC); the integrated maternal, newborn, and child health week; school-based distribution; community-based distribution; and, distribution through the commercial sector.<sup>23</sup> as previously indicated in the narrative (Figure 3), the majority of households receive free ITNs from different venues and through mass distribution campaigns.<sup>23</sup>

For instance, the Rivers State government of Nigeria has distributed more than two million nets, during the Immunization Plus days, and stand-alone campaigns, in its effort to meet the target of providing two ITNs per household in the State. Although, the usage of the nets is still very poor.<sup>25</sup> Another report indicates high proportion of households in two other states (87% in Bauchi and 72% in Cross River) had at least one ITN during mass distribution between 2010 and 2011.<sup>26</sup>



**Figure 6. Statistics of malaria burden in Nigeria.<sup>25</sup>**

### **Challenges in malaria control with the use of ITNs in Nigeria**

Despite the common occurrence of malaria during pregnancy, there was a limited knowledge and use of recommended anti-malarial intervention by women attending antenatal clinics. Many pregnant women who due to poverty and/or lack of education do not go for antenatal care and have no access to preventive malaria care. These categories of women may present when the disease is severe. Inconsistent and/or inappropriate use of bed-nets has been reported to be a challenge.<sup>4</sup> In Rivers State, it was discovered that a large proportion of the nets were not used over beds and mattresses, but as screens for windows and doors; probably to escape the discomfort from heat that is a common complaint amongst users of the net.<sup>25</sup>

Further, the more disadvantaged households were less likely to have a ITN,<sup>26</sup> and only one-third of those who owned bed-nets slept under the net during the night preceding the survey, thus, highlighting the alarming gap between net ownership and utilization. The most common reason, given for not using the nets was suffocation or hot

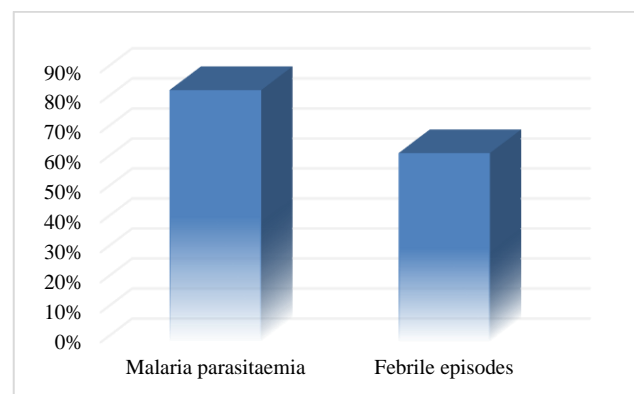
condition due to lack of proper air circulation in the net. This has largely been attributed to the hot tropical climate of the sub-Saharan African region and agrees with findings from other studies done in different African countries where low bed net utilization has been reported.<sup>27</sup>

### **Expectation of progress in malaria control with use of ITNs**

The efficacy and cost effectiveness of ITN in reducing malaria has led to free or highly subsidized ITN to pregnant women and under five children. Following the recommendation by the WHO, the ITNs distributed by the National Malaria Elimination Programme have been LLIN brands. Household ownership of at least one LLIN in Nigeria increased from 44% in 2010 to 69% in 2015. This was the result of routine and periodic mass distribution for rapid scale-up of LLINs in the communities.<sup>24</sup> ITNs coverage or ownership seems to have achieved the RBM target.

Reports have indicated that sleeping regularly under ITNs is the most effective way to prevent malaria among children and that ITN was 62.8% success in reducing febrile episodes, but more effective in reducing marked levels of malaria parasitaemia.<sup>10</sup>

However, utilization is quite low and a far cry as most of the owners are not utilizing their nets. Previous study report shows that patient experience of discomfort, heat, irritation and suffocation limits utilization, while affordances and quality are further barriers to utilization. It behooves on ITNs manufactures to improve the quality of nets, while healthcare workers and government agencies vigorously increase the campaign of creating more awareness on how best to use the ITNs among pregnant mothers.<sup>12</sup>



**Figure 7: Effectiveness of ITNs in reducing febrile episode vs mal parasitaemia.<sup>10</sup>**

## **DISCUSSION**

The objective of this epidemiological narrative review is to articulate what is known regarding challenges and

necessary improvement on use of ITNs among pregnant mothers and care givers of children. The main aim of developing strategies to prevent malaria infection is because of evidence of high rate of malaria cases and mortality in the world. Global malaria data released in 2019 indicate public health epidemiology that requires concerted and enhanced effort to improve the situation, especially in Nigeria that contributes a quarter of the world's burden. This is regardless of global report indicating that progress in controlling malaria infection has been stalled.<sup>28</sup>

Identified slow progress on malaria elimination is due to factors such as poor funding in investment of malaria control by many donor countries and agencies, emerging of resistance to malaria commodities such as pyrethroid ITNs by malaria vectors, poor attitude to effective utilization of insecticide nets by owners of bed nets, inadequate distribution of nets to vulnerable groups such as pregnant mothers and children under five years. World Health Organization best recommended strategy for prevention of malaria is adoption of use of LLINs, and two doses of SP for pregnant mothers and children under five years.

Universal coverage on use of ITNs has been low due to poor utilization by those who owns the nets encouraging increase of malaria infection. Poor use of ITNs increases incidences of malaria episode, maternal and fetal anemia, placental parasitemia, low birth weight and neonatal mortality. Therefore, various State government should contribute immensely for continuous distribution of ITNs at various household and rigorous health education on utilization to be the watch guide to health workers. This translates to potential health promotion strategy of monitoring pregnant mothers as well as care-givers to change their attitude in the use of LLINs. By further interpretation, antenatal clinics and immunization sites constitute one of the avenues for such health promotion vis-à-vis educational campaign.

## CONCLUSION

As a result of various factors that have been a hindrance to effective utilization of ITNs, WHO and regional leaders should sustain the policy of free distribution of nets to households. Perhaps, lessons need to also be learnt from countries like Algeria and Paraguay that have achieved malaria-free status. While manufacturers need to improve on the quality of their products, monitoring of utilization of the distributed nets is a sine qua non to progress towards malaria-free target.

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