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Original Research Article

Uptake of indoor residual spray as a malaria vector control strategy among the residents in Migori County, Kenya

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ABSTRACT

Background: Globally unexpected 219 million malaria cases occurred in 2021, with 90% of these cases happening in the WHO Africa region and unexpected 435,000 malaria transmissions worldwide, with children less than five years being the most-at-risk (61%) of malaria infections (World Malaria Report, 2021). In 2019, IRS coverage was 94.6%. This was reason enough to assess contributing factors leading to not reaching targeted 100% of the households mapped despite massive resources.
Methods: The study adopted analytical cross-sectional design. The study area was Migori County (Awendo, Uriri, Rongo, Suna East, Suna West and Nyatike sub counties) where IRS had been implemented in four sessions. The study period November 2021 to April 2022. The respondents sample size was determined using Cochran (1963) for a single population of 1,000 households. The respondents were randomly selected villages from purposively selected Migori County. Kenyatta University Ethics Review Committee and NACOSTI provided ethical clearance. Quantitative data analyzed using SPSS version 2.6 and thematically for qualitative data. A Chi-squared test used to compute statistically significant differences between independent variables at p value <0.05.
Results: Some 249 (90%) of the respondents confirmed their houses were IRS- covered while 32 (10%) of the houses were not sprayed because they were not informed in advance (p value <0.000).
Conclusions: Using the Chi-squared test of significance the spray operators` arrival time for IRS activities affected the respondents daily calendar of events significantly (p=0.013, <0.05) resulting into respondents' non-participation and unmet targets.

Keywords: Chemical, Eligible structures, Households, Household-heads, Indoor residual spray, Insecticide, Spray operators

INTRODUCTION

Globally unexpected 219 million malaria cases occurred in 2021, with 90% of these cases happening in the WHO Africa Region (AFR).[1] In the same period, there was unexpected 435,000 malaria transmissions worldwide, with children less than five years being the most-at-risk of malaria infections, representing approximately 61% of malaria infections globally. About 80% of global malaria transmission in 2022 was reported in 17 nations in the WHO Africa and India while seven of these nations represented 53% of malaria transmissions. Globally malaria caused 216 million clinical cases in 2022.[2] Malaria is among the major causes of morbidity and mortality in Kenya, representing 16.4% of outpatient attendances.[3] Malaria is a preventable and treatable disease caused by parasites transmitted to individuals through the bite of infected female *Anopheles* mosquitoes.

Indoor residual spraying (IRS) is applying an effective dose of insecticide on indoor surfaces of housing units

where malaria vectors (mosquitoes) are likely to rest after biting humans.[4] Indoor residual spray with insecticides is another ground-breaking approach to quickly reduce malaria transmission more than once every year, consistently reducing malaria incidence. Many malaria vectors are considered "*endophilic*"; the mosquito vectors rest inside houses after taking a blood meal. These mosquitoes are particularly susceptible to control through indoor residual spraying which involves coating the walls and other surfaces of a house with a residual insecticide. For several months, the insecticide kills mosquitoes and other insects that come in contact with these insecticide-coated surfaces. Although IRS does not directly prevent people from being bitten by mosquitoes, it kills mosquitoes after they have fed and when they come to rest on the sprayed surfaces thus preventing transmission of infection to other persons. To be effective, IRS must be applied to a very high proportion of households in an area (usually >80%).[5]

The incessant admonitions that overall ecological change will allow falciparum malaria fever to spread into northern circles, including Europe and parts of the United States, rely upon common transmission models driven fundamentally by temperature.[6] Indoor residual spraying is resource intense and time-sensitive that requires elaborate planning and exhaustive mechanism at the highest level, including determining the type of insecticide to use, when and where to implement the intervention and at what frequency a schedule of indoor residual spray activities and itemized budget. In any event, 14,000 under five years children are hospitalized every year with malaria disease, and there are 34,000 deaths among under 5 years.[7] Therefore, IRS combined with other malaria prevention strategies guarantee a safety-net for malaria prevention among adults, pregnant women and children.[8]

In Kenya, there were an estimated 3.5 million new clinical cases and 10,700 deaths annually, with those living in Western Kenya being especially at a higher risk of malaria.[9] A 5.1% mortality rate has been reported among patients admitted with severe malaria largely due to *Plasmodium falciparum* which accounts for 80-90% of cases in Kenya although *P. malariae*, *P. ovale*, and *P. vivax* also exist in the country. The vector species in Kenya are members of the *Anopheles gambiae* complex and *A. funestus* and the transmission patterns of the disease in Kenya are influenced by rainfall, vector species, intensity of biting, and altitude with stable malaria occurring in most parts of Coast, Nyanza, and Western regions including Migori County.[10] The main objective of the study was to investigate the uptake of IRS as a malaria vector control strategy among the residents in Migori County, Kenya.

METHODS

An analytical cross-sectional study design with mixed quantitative and qualitative methods was used in this study, carried out between November 2021 and April 2022. Quantitative data were collected from 281 self-administered, semi-structured questionnaires while qualitative data came from the key informant interviewees and from the focus group discussions each comprising 8-12 participants.

The study was carried out in 6 of 8 sub-counties of the Migori County, Kenya that were purposively selected because IRS activities had been conducted there for 4 sessions between 2018 and 2021 prior to this study. The study participants were consenting adult residents of the Migori County who had lived there for at least 12 months prior to the study commencement. The sample size for recruited participants of the study was determined as previously done, for a single population of 1,000 households.[11] The 281 participants were randomly selected from the 1,083 households in the villages mapped in the study area.

Quantitative data were analyzed using SPSS software version 2.6, while qualitative data were analyzed thematically. The Chi-squired test was used to compute statistically significant differences between independent variables and their relationship with the uptake of IRS at the confidence level of 95% (p value <0.05). The Kenyatta University ethics review committee and NACOSTI provided ethical clearance and permit respectively and the authors had no conflict of interest to declare in this study.

RESULTS

A total of 281 villages from 1083 mapped, each village a household head that had lived in the study site for a minimum of one year were sampled and targeted for interview. The data analyzed realized a response rate of 278 (98.9%), valid responses. Demonstrated that any rate above 80% (r=0.8), is considered credible enough for generalization and making conclusions about a population.[17]

Table 1: Comparative analysis of arrival time by SOs for IRS during last the session and uptake of IRS activities.

Category	(n=278)	
	Frequency	Percentage
Arrived late for IRS	239	85
Arrived in time for IRS	39	15

The type of households housing structure was significant in that iron sheets "mabati" were not eligible for insecticide spray. Mud wall (soil) smeared had 47 (53%) and 11 (4%) iron sheet "mabati" material a sign of the communities' low-income level therefore some residents were reluctant to expose their household items as seen in Figure 1.[18]

Referral and linkages to health facilities during a health intervention touching on human life of the residents with some risks was aimed at sensitizing the residents. Advocacy and social mobilization was carried out in case of allergies and chemical reaction following IRS. The results showed that 212 (76%) were informed of referral health facilities while 24% were not, Figure 2. The level of information given the perception and safety of respondents during IRS activities and thereafter (Figure 2).

Table 2: Migori coverage of IRS in the year 2019.

Sub County	Structures found	Structures sprayed	Spray coverage
Rongo	330,651	311,975	94%
Awendo	330,086	298,598	90%
Nyatike	442,859	422,690	95%
Suna East	331,862	319,304	96%
Suna West	227,393	210,095	92%
Uriri	339,979	328,566	97%
Migori County	2,002,830	1,891,228	94.6%

According to Table 2, 85% of residents reported that spray operators arrived late for the exercise and complained about the time management because they had other daily engagement, personal values in life, therefore late arrival contributed to the 10% refusals.

About 249 (90%) p value =0.000 of the residents interviewed confirmed their houses were IRS covered while 32 (10%) houses were not sprayed reason they were not informed in time.

In 2019 of the targeted 2,002,830 structures mapped about 1,689,228 was sprayed with Indoor residual spray reporting 84%.

Table 3: Comparative analysis of arrival time by SOs for IRS during last the session and uptake of IRS activities.

Category	(n=278)	
	Frequency	Percentage
Arrived late for IRS activities	239	85
Arrived in time for IRS activities	39	15

The study results showed 239 (85%) of spray operators (SOs) arrived late for the IRS activities, while only 39 (15%) of residents reported that spray operators arrived in time.

Figure 1 shows that more than half 53% of residents' houses were made from soil (mud) the local available material, followed by cement plastered houses at 23%, bricks stone houses 20% the least being mabati 'iron sheets' which were not illegible for IRS intervention.

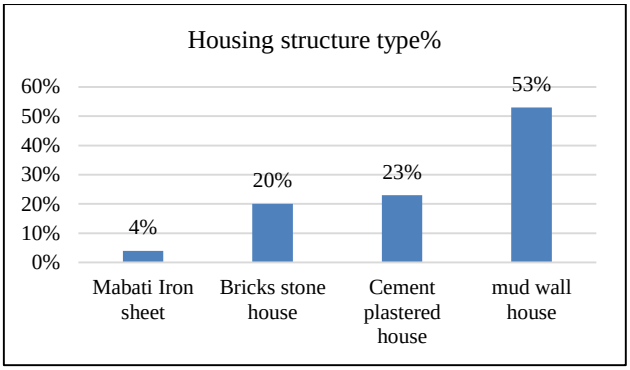

Figure 1: Type of residents house structure for IRS eligibility criteria.

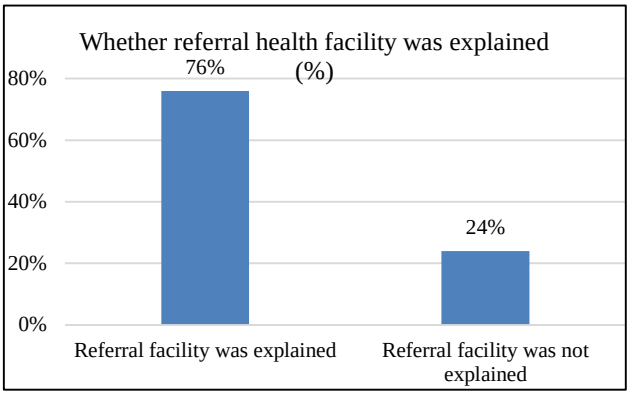

Figure 2: Whether a referral to health facility was explained to the respondents.

Figure 2 shows that 76% of the referral facilities were explained to the residents during indoor residual spray while 24% reported that they were not explained.

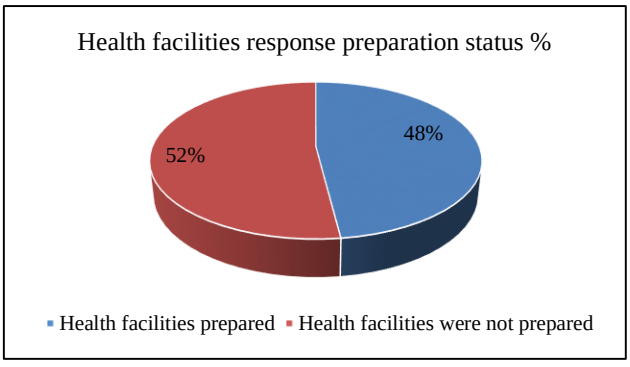

Figure 3: Health facility preparedness to handle emergencies during IRS.

The above Figure 3 shows that 52% of the health facilities were prepared to handle any emergencies from the field during IRS while 48% were not.

DISCUSSION

This study sought to investigate the factors associated with uptake of indoor residual spray among the residents

of Migori County, Kenya.[19] indicated that health facilities, care providers got trained and stocked with essential commodities to respond to any emergencies during indoor residual spray (IRS). This concurred with this study that showed health workers were adequately prepared to respond to any emergencies during IRS.[20] Indoor residual spraying: an operational manual for indoor residual spraying (IRS) for malaria transmission control and elimination. 2nd edition, details the timing of IRS however this study found out that spray operators (SOs) never followed the guidelines, this led to residents closing their houses and going away before SOs arrived. The study suggested use of non-strong scent/smell chemical and that does not stain the walls.[20] The study stated that scent and staining walls couldn't be compared to the benefits of malaria vector control as a prevention leading to reduction in malaria cases globally. Further, findings revealed that spray operators should be accompanied by village elders to assist navigate spray sites. Conversely, ccommunity members; the gatekeepers involvement specifically; clan elders, CHVs, opinion leaders and chiefs/assistant chiefs is key to program success. A study conducted in northern Uganda on effectiveness of chemicals used in IRS, this study confirms its effectiveness in IRS.[21]

The study confirms that IRS structures should be confirmed by IEC mobilizers prior to spray to avoid missing from the PMI Vector link electronic system.[22] Further applying broad-spectrum chemicals that target other insects like bedbugs apart from mosquitoes. Engage seasonal workers from among the residents for ownership and accessibility as was done during COVID-19 pandemic. According to the Malaria Indicator Survey, 2020 report, less than half 49% of general population owns at least one ITN in a year, this opens the door for integration of other strategies like IRS to ensure the population is protected against malaria infection. Despite SOs informing residents of the guidelines and procedures pre-IRS and post IRS some residents still suffered chemical reaction by entering the house before actual time.

Alternative treatments for indoor residual spraying for malaria control in a village pyrethroid and DDT-resistant vector in the Gambia explains that the current type of chemical used in Africa Kenya inclusive has long lasting efficacy in control of mosquitoes.[23] The same was confirmed by residents in the study that chemical lasted between six to nine months just before the next IRS cycle.[24] A study of clinical features in pregnancy are the same with this study on the benefits of IRS for malaria prevention among pregnant women of Migori County.[25] Monitoring health for the sustainable development goals (SDGs) as a priority in Africa, Kenya, Migori inclusive counts some of the contributions resulting from IRS in the last five years where malaria prevalence reduced from 38% to 33% during the study period.[26,27] Guidelines for treatment of malaria stated clearly use of first line for uncomplicated malaria and second line for complicated malaria practiced in Kenya.[28] Action and investment to defeat malaria in Africa, Kenya has benefited through global fund and Presidential Malaria initiative (USAID) funding IRS in the last five seasons contribution to reduction in malaria burden.[29] Universal health coverage (UHC) agenda, global report places Kenya in a strategic position to drive and localize in the Counties Migori inclusive, through community, stakeholders involvement, this was confirmed in this study the stakeholders importance. Recommendations for achieving Universal Health Coverage through greater networking and allocating adequate resources to control Malaria, HIV, TB and non-communicable conditions (NCDs) emerging and re-emerging diseases due to climatic change.

There are few limitations. The neighbouring Sub-Counties population of Kuria East and Kuria West were excluded from participating in the study because they were not covered in the previous indoor residual spray sessions due to low malaria prevalence rates. Secondly according to study objective of assessing the uptake of IRS among the residents of Migori County covered specifically the six malaria endemic Lake region therefore excluded sub counties that doesn't fall under this category. It's also clear that including Kuria East and West would mean changing the study topic/focus to comparison instead of assessment of uptake of IRS.

CONCLUSION

Uptake of indoor residual spray (IRS) was influenced by diverse operational and contextual factors as demonstrated in socio demographic, socio cultural and socio-economic situations; residents received health promotion messages packaged towards behaviour change communication. The strategies of improving housing structures was important too. Residents economic and health benefits was key in reduction of out-of-pocket expenditure, hospital visits, time wastage, absence from school among children and anemia in pregnancy caused by malaria infection as the main factors addressed by IRS among the residents. Emphasis on residents' level of knowledge, attitude and perception especially household heads on IRS, transformation led to generally higher uptake of IRS. Manufacturers to conduct further research to modify chemical smell and residue that could last upto nine months but doesn't stain the walls. Involve local community in seasonal workers recruitment and selection. Use insecticide with less smell, reduce amount of water used in mixing chemicals and observe community annual seasonal calendar. Test of significance, chi-square the arrival of spray operators was significant at ($p=0.013$, <0.05), therefore the spray operators arrival time for IRS activities affected residents daily calendar leading to closed doors and unmet target.

Recommendations

The stakeholders; National government, County government, and development partners should engage the

local residents through social behaviour change communication with key messages to support IRS activities as a beneficial intervention for malaria vector control. Key malaria stakeholders should come up with clear policy guidelines on annual IRS activity calendar suitable for the residents. The County government being a devolved system should allocate resources to improve primary health care infrastructure at the community level for long term improved access to IRS activities. The department of health services to cultivate political goodwill to enhance uptake of health initiatives by the residents, this will lead to improved knowledge and attitude, therefore reduce high expectation and donor dependency by the residents. The health systems coordination and supervision should be structured to ensure spray operators timely departure for field work.

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REFERENCES

1. WHO. Action and Investment to defeat Malaria (AIM) for a malaria-free world. World Malaria Report (2016-2030). 2022.
2. Hay. The population at risk of transmission containing close to 50 percent of the world's population, WHO 2020.
3. KHIS. Migori County malaria prevalence in the last five years, 2022
4. The NMCP Report. Kenya National Malaria Policy Framework 2020 - 2024.
5. Tukei BB, Beke A, Lamadrid-Figueroa H. Assessing the effect of indoor residual spraying (IRS) on malaria morbidity in Northern Uganda: a before and after study. Malar J. 2017;16:1-9.
6. White NJ, Pukrittayakamee S, Hien TT. WHO: Global technical strategy for malaria 2016-2030. 2021. Available from: https://www.who.int/publications/i/item/9789240031357. Accessed on 12 June 2023.
7. Mashauri FM, Manjurano A, Kinung'hi S, Martine J, Lyimo E, Kishamawe C, et al. Indoor residual spraying with micro-encapsulated pirimiphos-methyl (Actellic® 300CS) against malaria vectors in the Lake Victoria basin, Tanzania. PloS One. 2017;12(5):e0176982.
8. Tangena JA, Adiamoh M, D'Alessandro U, Jarju L, Jawara M, Jeffries D, et al. Alternative treatments for indoor residual spraying for malaria control in a village with pyrethroid-and DDT-resistant vectors in the Gambia. PLoS One. 2013;8(9):e74351.
9. White NJ, Pukrittayakamee S, Hien TT. WHO: Global technical strategy for malaria 2016-2030. 2021. Available from: https://www.who.int/publications/i/item/9789240031357. Accessed on 12 June 2023.
10. Mashauri FM, Manjurano A, Kinung'hi S, Martine J, Lyimo E, Kishamawe C, et al. Indoor residual spraying with micro-encapsulated pirimiphos-methyl (Actellic® 300CS) against malaria vectors in the Lake Victoria basin, Tanzania. PloS One. 2017;12(5):e0176982.
11. WHO. Recommendations for achieving universal coverage with long-lasting insecticidal nets in malaria control. Geneva 2022. Available from: https://www.afro.who.int/publications/who-recommendations-achieving-universal-coverage-long-lasting-insecticidal-nets. Accessed on 12 June 2023.
12. The National Malaria Strategy Report. Kenya National Malaria Policy Framework 2020-2024.
13. Okumu FO, Chipwaza B, Madumla EP, Mbeyela E, Lingamba G, Moore J, et al. Implications of bio-efficacy and persistence of insecticides when indoor residual spraying and long-lasting insecticide nets are combined for malaria prevention. Malar J. 2020:378.
14. WHO. Recommendations for achieving universal coverage with long-lasting insecticidal nets in malaria control. Geneva 2022. Available from: https://www.afro.who.int/publications/who-recommendations-achieving-universal-coverage-long-lasting-insecticidal-nets. Accessed on 12 June 2023.
15. The NMCP Report. Kenya National Malaria Policy Framework 2020-2024.
16. The NMCP Report. Kenya National Malaria Programme Report. 2019.
17. The NMCP Report. Kenya National Malaria Policy Framework 2022.
18. Orodho JA. Techniques of writing research proposals and reports in education and social sciences. Nairobi: Masola Publishers. 2004.
19. Tukei BB, Beke A, Lamadrid-Figueroa H. Assessing the effect of indoor residual spraying (IRS) on malaria morbidity in Northern Uganda: a before and after study. Malar J. 2017;16:1-9.
20. Rockville. Monitoring & Evaluation Reference Group. Mortality Task Force of Roll Back Malaria. Guidance for Evaluating the Impact of National Malaria Control Programs in Highly Endemic Countries.
21. Tukei BB, Beke A, Lamadrid-Figueroa H. Assessing the effect of indoor residual spraying

(IRS) on malaria morbidity in Northern Uganda: a before and after study. Malar J. 2017;16:1-9.
22. Tukei BB, Beke A, Lamadrid-Figueroa H. Assessing the effect of indoor residual spraying (IRS) on malaria morbidity in Northern Uganda: a before and after study. Malar J. 2017;16:1-9.
23. WHO. Indoor residual spraying: an operational manual for indoor residual spraying (IRS) for malaria transmission control and elimination. 2nd edn. Geneva: World Health Organization; 2021.
24. Tangena JA, Adiamoh M, D'Alessandro U, Jarju L, Jawara M, Jeffries D, et al. Alternative treatments for indoor residual spraying for malaria control in a village with pyrethroid-and DDT-resistant vectors in the Gambia. PLoS One. 2013;8(9):e74351.
25. WHO. The population at risk of transmission containing close to 50 percent of the world's population. 2020.
26. Wickramasuriya GA. Clinical features of malaria in pregnancy. Malaria and ankylostomiasis in the pregnant woman. Oxford University Press; 1937:5-90.
27. WHO. World health statistics: monitoring health for the SDGs sustainable development goals 2019, World Health Organization. Available from: https://www.who.int/publications/i/item/9789241565707. Accessed on 12 June 2023.
28. World Health Organization. Guidelines for the treatment of malaria. World Health Organization; 2015.
29. Wickramasuriya GA. Clinical features of malaria in pregnancy. Malaria and ankylostomiasis in the pregnant woman. Oxford University Press; 1937:5-90.
30. WHO. Global technical strategy for malaria 2016-2030. Geneva: World Health Organization; 2020:30
31. The NMCP Report. Kenya National Malaria Policy Framework 2020.

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