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Nurses' Characteristics Associated with Good Knowledge, Attitude, and Practices (KAP) of the Malaria Vaccine in Bungoma County, Kenya

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Abstract

The study examined nurse characteristics associated with Knowledge, Attitudes, and Practices (KAP) regarding malaria vaccination in Bungoma County, Kenya. Malaria remains a major health burden in Kenya, with 3.4 million cases and 12,000 deaths in 2021. Bungoma County, a malaria-endemic area, implemented the RTS S1 malaria vaccine, but dropout rates for subsequent doses are high. The fourth dose dropout, particularly in Bungoma and Siaya, poses a significant challenge to vaccine adherence. A cross-sectional descriptive study comprising mixed research methods; comprising key informant interviews was conducted among nurses in Bungoma County. A stratified random sampling was used to select 63 health facilities providing malaria vaccine. Data collection involved structured questionnaires, observation checklist, and key informant interview guide. Hawthorne effect was minimized by rapport building or familiarizing the participants by spending a whole morning at the facility CWC and assuring sampled participants of anonymity, this made the participants calm and can provide immunization services without fear of being judged. Data was analyzed through descriptive and inferential statistics to determine associations between nurse demographics and KAP scores. The study found good KAP was significantly associated with characteristics such as age, years of experience, education level, and prior malaria vaccine training. Nurses aged over 35, with higher education, and those trained in malaria vaccine administration had a higher likelihood of exhibiting good knowledge and positive attitudes. The study concludes that implementing targeted training programs and mentorship initiatives for less experienced and younger nursing staff is essential for strengthening vaccine implementation effectiveness. Enhanced continuous education programs in Bungoma County would likely improve malaria vaccine practices and outcomes. Additionally, the findings indicate that structured support systems and ongoing professional development are crucial elements in maintaining high standards of vaccine delivery. The study recommends that mandatory comprehensive training programs should be established, incorporating both theoretical knowledge and hands-on practical skills development. These programs should be regularly updated to reflect current best practices and emerging challenges in vaccine delivery. Furthermore, the implementation of structured on-site mentorship programs, combined with continuous supervision, should be prioritized to ensure consistent application of proper vaccination protocols. Regular refresher courses should be offered to maintain and update healthcare workers' knowledge and skills, while a peer support system should be established to facilitate knowledge sharing and professional development.

Keywords: *Malaria, Malaria vaccination, Vaccine dropout, Knowledge, attitude, and practices, Immunization coverage*

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1.0 Introduction

Malaria remains a leading cause of morbidity and mortality in Kenya, particularly in endemic regions like Bungoma County. Due to altitude, rainfall patterns, and temperature, about 75 percent of the Kenyan population is at risk for malaria. In 2023, Malaria accounted for at least 15 percent of outpatient consultations nationally and 58 percent of outpatient consultations in the eight-malaria lake endemic region. Nurses are instrumental in administering vaccines, and understanding how their characteristics influence knowledge, attitudes, and practices (KAP) towards malaria vaccination can help improve vaccine uptake (WHO 2020). Malaria vaccination is a preventive strategy aimed at reducing malaria incidence and deaths of children < 5 years from the deadly malaria disease. Malaria vaccine classification, the malaria cycle in human beings starts at the point of receiving a mosquito bite from an infected female anopheles during a blood meal (UNICEF 2020). The current malaria vaccine targets either of the three phases outlined. RTS, S/AS01 mosquirix malaria vaccine is the first to undergo phase 3 clinical trial and it was piloted within the existing expanded immunization program in Ghana, Kenya, and Malawi (Natnael et al 2022).

1.1 Problem statement

Kenya's entire 53 million population is at risk for malaria. Malaria is a major burden in the country, with 3.4 million cases and 12,000 deaths in 2021. Malaria vaccine RTS S1 has been deployed as an intervention in Western Kenya. Bungoma is the 3rd County in the lake endemic region with a high burden of malaria. Bungoma County is among the countries that implemented the malaria vaccine through the existing Kenya expanded program of immunization (KEPI). The dropout rate on the subsequent doses has been high based on KHIS 2 data from the health facility's monthly immunization reports. Between January and July 2023, vaccine coverage for malaria doses varied across counties, with some counties surpassing 100% coverage, like Busia at 124% for the first dose and Vihiga at 123%, suggesting potential cross-county utilization or record inaccuracies. Coverage generally declined across subsequent doses, with the lowest for the fourth dose, where Kenya averaged 4%, and Bungoma and Siaya showed low uptake at 7% and 16%, respectively. Drop-out rates between doses were high, particularly from the third to the fourth dose, where Kenya's rate reached 61%, with counties like Bungoma and Busia experiencing even higher rates at 68% and 72%. In Bungoma sub-counties, the drop-out rate was especially high, with Kanduyi and Sirisia reporting 91% and 92% drop-out rates at the fourth dose, indicating significant challenges in vaccine adherence through all doses. This challenge is cross-cutting among the peer countries implementing the malaria vaccine, especially the malaria vaccine 4th dose dropout is high. Being a new vaccine with a slight deviation from the other routine vaccine schedule, with the 4th dose scheduled at 24 months of life, there are grey areas that are not clearly understood on the factors that could be causing the high dropout in the malaria vaccine.

1.2 Objective

To determine nurse's characteristics associated with good knowledge, attitude, and practices in Bungoma County.

2.0 Literature review

A study using photo voice by Powelson et al. (2021), focused on determinants of immunization dropout targeting children below 2 years of age in Zambezi province. The research study design was community participatory, the results established 4 main bottlenecks leading to vaccine

dropout. First was the societal norms and lack of social network support which leaves the immunization tasks to mothers. Secondly, the perception of non-satisfactory immunization services provided at the health facilities. Thirdly there were concerns on the side effects as a cause of vaccine hesitancy. Fourthly it was identified that caregivers hesitate to seek immunization due to lack of trust with the health providers. This study recommended as follows; to overcome immunization barriers there is a need to strengthen health systems, this entails strengthening logistics systems to address the vaccine stockouts and capacity building of health workers and strengthen communication skills. A study in Cameroon by Suh et al (2023) found more than seventy-eight respondents were aware of the existence of asymptomatic malaria, 83% defined it correctly, while about 75% knew how asymptomatic malaria was diagnosed, 70% prescribe artemisinin combined therapy correctly and 51.1% knew about asymptomatic malaria transmission. The health workers significantly related their knowledge of the presence and transmission of asymptomatic malaria. Those health workers who had been long in service were likely to have a high knowledge of transmission ($p < 0.05$). Two-thirds of the respondents, which is 67% knew about Artemisia afra tea, of this 53.7% noted the tea worked in treating asymptomatic malaria, and 79% were interested in prescribing it if it was authorized by the authorities. The study found that there was a moderate level of knowledge of asymptomatic malaria among health workers.

Dybsand et al (2019) concluded that participant responses suggest poor attitudes, low knowledge, and non-satisfactory performance cross-cut in all programs, it was more conspicuous among nursing students on immunization. Martino et al (2020) found that low coverage among all health workers categories was observed for flu immunization. Saitoh et al (2022) concluded nurses demonstrated higher reluctance linked with personal opinions, and social or peer factors than pediatricians with a significant p-value $p < 0.001$. Nurses had higher odds than pediatricians of suggesting children receive more vaccine injections than necessary with a p-value of $p< 0.01$. Swarnkar et al (2016) found that an overall good practice score of above 75% in the following areas assessed: while immunizing children with minor diseases, disposal of reconstituted vaccines after 4 hours lapse period, bio hazard waste handling process, not vaccinating child for BCG without a scar. They observed poor practice with a score of less than 50% for failure to effectively communicate with the caregivers on key immunization messages. Utilization of the counter foil for tracking children was very low. It was observed that nurse developed their competence in knowledge and practices with the advancement of academic qualification but a negative correlation between past training and length of service with both knowledge and practice of immunization.

3.0 Methodology

The study applied a descriptive cross-sectional survey comprising mixed research methods; comprising key informant interviews that used quantitative methods of data collection to gather information from the study population in Bungoma County. The study participants were nurses working at child welfare clinics providing routine immunization services in the sampled health facilities in Kanduyi, Bumula, and Sirisia Sub Counties in Bungoma County and Immunization program focal persons/EPI Logistician one at County and one at each of the three Sub Counties who met the following criteria; A County or Sub County expanded program of immunization focal point, must be in charge of either Bumula, Sirisia and Kanduyi, Consented to participate in the study and been in the role for at least 2months. The study adopted a multistage sampling

technique, purposive sampling was used to select Bungoma County. Using a list of health facilities available from Kenya Health Information Systems 2 there are 116 health facilities in the 3 sub-counties counties. A stratified random sampling was used to select 63 health facilities providing malaria vaccine. A total of 71 nurses from 63 health facilities participated in the study, selected via stratified random sampling.

Data collection utilized a structured questionnaire administered to participants after obtaining their informed written consent. The questionnaire gathered information on participants' socio-demographic characteristics, knowledge, attitudes, and practices regarding the malaria vaccine. Additionally, an observation checklist was employed to assess nurses' practices while they were unaware of being observed, helping minimize the Hawthorne effect. To further reduce the Hawthorne effect, researchers built rapport with participants by spending entire mornings at the Child Welfare Clinic (CWC) and ensuring participant anonymity. This approach helped participants remain calm and provide immunization services without feeling judged. The observation checklist specifically focused on nurses' adherence to standard operating procedures during malaria vaccine administration at the CWC. Key Informant Interviews (KIIs) were conducted with immunization program managers at both county and sub-county levels to gather critical information about malaria vaccine implementation. Statistical analysis was performed using the R program, incorporating both descriptive and inferential methods. Chi-square tests and logistic regression were used to identify associations between variables. Results were considered statistically significant at the 5% level ($p < 0.05$). For continuous variables, measures of central tendency and dispersion were calculated, including median, interquartile range, mean, and standard deviation. Logistic regression analysis determined odds ratios with 95% confidence intervals between independent and dependent variables. The findings were presented using tables, figures, and graphs.

4.0 Results and findings

The results and findings were presented in sections.

4.1 Socio-Demographic Characteristics of Nurses

The findings showed that 47 (66.2%) were aged between 18-35 years, 15 (21.1%) were between 36-45 years, and 9 (12.7%) were 46-60 years. Slightly less than three quarters 51 (71.8%) were female and 56 (78.9%) had diplomas as the highest level of education during the study period. Additionally, most 54 (76.1%) of respondents had worked at the facility for less than 5 years with 15 (21.1%) of respondents having worked between 6-10 years. Most of respondents 41 (57.7%) had worked at MCH department providing immunization services for less than 5 years with 28(39.4%) and 2 (2.8%) having worked between 6-10 years and more than 10 years respectively as shown in Table 1.

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Table 1: Socio-demographic characteristics of the respondents of Nurses

Characteristics		Frequency	Percent
Age group	18-35 years	47	66.2%
	36-45 years	15	21.1%
	46-60 years	9	12.7%
Gender	Male	20	28.2%
	Female	51	71.8%
Level of education	Certificate	5	7.0%
	Diploma	56	78.9%
	Bachelors' degree	9	12.7%
	Masters' degree	1	1.4%
Duration working at the facility	<5 years	54	76.1%
	6-10 years	15	21.1%
	11-20 years	2	2.8%
Duration at MCH	<5 years	41	57.7%
	6-10 years	28	39.4%
	11-20 years	2	2.8%

During the study period, the key informants mentioned that they regularly carry out mentorship programs to equip the nurses with knowledge on the Malaria vaccine.

"I conduct mentorship and support supervision visits to sub-county health facilities every quarter. These visits are scheduled in advance and typically last 2-3 days per facility. During these sessions, I focus on reviewing malaria vaccine administration practices, addressing any challenges faced by the nurses, and providing updates on the latest guidelines. I also use this time to assess the nurses' knowledge and attitudes towards the malaria vaccine, which helps tailor training and support efforts." (KII 1)

4.2 Socio-Demographic Factors Associated Knowledge Towards Malaria Vaccine

The satisfactory level of knowledge on malaria vaccine was higher 21(87.5%) among respondents aged 35 years and above with 35(74.5%) of respondents aged 35 years and below having satisfactory knowledge. Further, males (17 (85.0%)), respondents with working experience of more than 5 years (15(88.2%)) and more than 5 years at the MCH department (26(86.7%)) as well with a degree or higher (9(90.0%)) and 48(90.6%) of respondents with prior training on malaria vaccine had a satisfactory level of knowledge on malaria vaccine (Table 2).

Table 2, shows odds ratios (OR) on the likelihood of having satisfactory knowledge compared to a reference group for each variable. For instance, individuals over 35 years have higher odds for

satisfactory knowledge with an OR of 1.2 (95% CI: 0.24-6.29), but the p-value of 0.807 indicates no significant difference. Similarly, gender and working experience show higher ORs of 1.8 (95% CI: 0.36-8.74) and 1.2 (95% CI: 0.15-9.56), respectively, with p-values of 0.487 and 0.865, indicating no significant differences in knowledge levels based on these factors. The duration at MCH and education level yielded similar results, with ORs of 1.3 (95% CI: 0.23-6.88) and 2.9 (95% CI: 0.26-33.21) and corresponding p-values of 0.798 and 0.387, showing no significant impact. Notably, those who received training on malaria vaccine administration exhibited a much higher OR of 10.2 (95% CI: 2.43-42.64) and a significant p-value of 0.002, indicating that training significantly improved the likelihood of having satisfactory knowledge as indicated in Table 2.

Table 2: Socio-Demographic Factors associated with higher Knowledge on the Malaria Vaccine

Variables		Level of knowledge		OR (95%CI)	p-value
		Satisfactory	Unsatisfactory		
Age	≤ 35 years	35(74.5%)	12(25.5%)	Ref	
	>35 years	21(87.5%)	3(12.5%)	1.2(0.24-6.29)	0.807
Gender	Male	17 (85.0%)	3 (15.0%)	Ref	
	Female	39 (76.5%)	12 (23.5%)	1.8(0.36-8.74)	0.487
Working experience	≤ 5 years	41(75.9%)	13(24.1%)	Ref	
	> 5 years	15(88.2%)	2(11.8%)	1.2 (0.15-9.56)	0.865
Duration at MCH	≤ 5 years	30(73.2%)	11(26.8%)	Ref	
	> 5 years	26(86.7%)	4(13.3%)	1.3(0.23-6.88)	0.798
Level of education	≤ Diploma	47(77.0%)	14(23.0%)	Ref	
	Degree	9(90.0%)	1(10.0%)	2.9(0.26-33.21)	0.387
Training on malaria vaccine administration	Yes	48(90.6%)	5(9.4%)	10.2(2.43-42.64)	0.002
	No	8(44.4%)	10(55.6%)	Ref	

During the study, there were several knowledge gaps among nursing staff. These gaps, while not unexpected given the relative newness of the vaccine, have significant implications for the success of immunization efforts.

This was supported by key informants who narrated that

"……Yeah, I have noticed that few nurses lack a comprehensive understanding of the malaria vaccine's mechanism of action. They often struggle to explain to parents how the vaccine works differently from other childhood vaccines. Additionally, there's confusion about the vaccine schedule and why four doses are necessary, which makes it challenging for them to emphasize the importance of completing the full course." (KII 2)

4.3 Socio-Demographic Factors associated with Positive Attitude Towards Malaria Vaccine

In Table 3, most respondents aged 35 years and below 38(80.9%) had a positive attitude towards the malaria vaccine, similarly, 15(75.0%), and 9(90.0%) of male nurses with degree (BSc/Masters) had a positive attitude towards malaria vaccine. Additionally, respondents with working experience of 5 years and below 43(79.6%) and working at the MCH department for 5 years and below 33(80.5%) had positive attitudes towards malaria vaccine. Most of the respondents with training on malaria vaccine administration 40(75.5%) had a positive attitude towards malaria vaccine. Further analysis with the aid of a chi-square test was carried out to establish the association between respondent's attitudes towards malaria vaccine.

Table 3 shows that age, over 35 years was associated with lower odds (OR: 0.37, 95% CI: 0.10-1.28) of a positive attitude compared to younger age, although this was not significant (p=0.115). Males showed slightly lower odds OR: 0.77, (95% CI: 0.21,2.86) compared to females, with a p-value of 0.695 indicating no significant difference. Similarly, individuals with a degree had higher odds of a positive attitude (OR: 2.9, 95% CI: 0.30-29.15) compared to those with a diploma, but this finding it was not significant (p=0.351). Workers with more than 5 years of experience had lower odds (OR: 0.44, 95% CI: 0.10-1.86), those at MCH for over 5 years showed a slight decrease in positive attitudes (OR: 0.76, 95% CI: 0.20-2.90), neither statistically significant (p=0.262 and p=0.691, respectively). Lastly, while training on malaria vaccine administration suggested higher odds (OR: 2.16, 95% CI: 0.53-8.72) for positive attitude, the p-value of 0.280 indicates that this result was not statistically significant (Table 3).

Table 3: Socio-Demographic Factors associated with positive Attitude Towards Malaria Vaccine

Variables		Level of Attitude		OR (95%CI	p-value
		Positive	Negative		
Age	≤ 35 years	38(80.9%)	9(19.1%)	Ref	
	>35 years	15(62.5%)	9(37.5%)	0.37(0.10-1.28)	0.115
Gender	Female	38(74.5%)	13(25.5%)	Ref	
	Male	15(75.0%)	5(25.0%)	0.77(0.21-2.86)	0.695
Level of education	≤ Diploma	44(72.1%)	17(27.9%)	Ref	
	Degree	9(90.0%)	1(10.0%)	2.9(0.30-29.15)	0.351
Working experience	≤ 5 years	43(79.6%)	11(20.4%)	Ref	
	> 5 years	10(58.8%)	7(41.2%)	0.44(0.10-1.86)	0.262
Duration at MCH	≤ 5 years	33(80.5%)	8(19.5%)	Ref	
	> 5 years	20(66.7%)	10(33.3%)	0.76(0.20-2.90)	0.691
Training on malaria vaccine administration	Yes	40(75.5%)	13(24.5%)	Ref	
	No	13(72.2%)	5(27.8%)	2.16(0.53-8.72)	0.280

Another Key Informant had a concern about nurses' attitude towards malaria vaccine, as it was narrated that

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"…… A concerning attitude I have observed is complacency, especially in areas where malaria is less prevalent. Some nurses don't perceive malaria as a significant threat, leading to a lackadaisical approach in advocating for the vaccine. I have also noted that some nurses feel overwhelmed by the addition of another vaccine to an already busy immunization schedule, resulting in a less positive attitude towards its administration." (KII 3)

4.4 Practices Towards Malaria Vaccine

All nurses 71 (100%) reconstituted the (Adjuvant AS01 liquid (green ring) with the Antigen RTS, S lyophilized (red ring) malaria vaccine as per SOP, administered malaria vaccine on the left deltoid intramuscular of the child, recorded malaria vaccine administered on the MCH booklet clearly wrote the next visit date appointment, informed the caregiver of the next malaria vaccine appointment date, recorded on the malaria vaccine CWC register and other relevant registers immediately, and disposed of the used sharps on the safety box. Additionally, 69 (97.2%), 68 (95.8%), and 66 (93.0%) mentioned the immunization clinic has malaria vaccine job aids displayed on the walls or desk job aid for ease of reference by the nurse, had the temperature Log chart updated (Previous date temperature was recorded), and provided information to the caregiver on the importance of completing the four doses respectively as indicated in table 4.

Table 4: Nurses Practices Towards Administration of the Malaria Vaccine

Characteristics		Frequency	Percent
The temperature Log chart is available and updated (Previous date temp is recorded)	No	3	4.2%
	Yes	68	95.8%
The Nurse reconstitutes the (Adjuvant AS01 liquid (green ring) with the Antigen RTS,S lyophilized (red ring) the malaria vaccine as per SOP	Yes	71	100.0%
The Nurse, provides information to the caregiver on the importance of completing the four doses	No	5	7.0%
	Yes	66	93.0%
The Nurse administers malaria vaccine on the left deltoid intramuscular of the child	Yes	71	100.0%
The Nurse records malaria vaccine administered on the MCH booklet clearly writes the next visit date appointment	Yes	71	100.0%
The Nurse informs the caregiver of the next malaria vaccine appointment date	Yes	71	100.0%
The health provider records on the malaria vaccine on CWC register and other relevant registers immediately	Yes	71	100.0%
The health provider informs the caregiver to wait for 15 minutes before leaving to observe for AEFI	No	16	22.5%
	Yes	55	77.5%
The health worker disposes the used sharps on the safety box	Yes	71	100.0%
There is an up-to-date immunization dairy book at MCH	No	20	28.2%
	Yes	51	71.8%
There is a current record line list of children who have missed malaria vaccine appointments up to last month	No	17	23.9%
	Yes	54	76.1%
The Immunization Clinic has Malaria vaccine Job Aids displayed on the walls or desk job aid for ease of reference by the nurse	No	2	2.8%
	Yes	69	97.2%

During the study, nurses performed excellently in recording and storage of vaccines, however, there were some gaps noted like a lack of an up-to-date immunization diary book at MCH among others. Key informants additionally identified other challenges. One of the Key Informant narrated that

"One major practice gap is inadequate patient education. Many nurses don't spend sufficient time explaining the importance of completing all four doses, which contributes to poor follow-up. We've also noticed inconsistencies in record-keeping, particularly in tracking which children are due for subsequent doses, leading to missed opportunities for vaccination." (KII 2).

"A critical practice gap is the lack of proper communication about potential side effects. Nurses often fail to adequately prepare parents for common reactions, which can lead to vaccine hesitancy for future doses. Additionally, we've observed that some nurses don't integrate malaria vaccine counseling with other routine health services, missing chances to reinforce the importance of adherence to the vaccine schedule." (KII 4).

4.5 Summary of the Findings

The study revealed high knowledge levels among nurses regarding malaria vaccine protocols, with 98.6% demonstrating awareness of key aspects including the two-dose RTS, S formulation, proper cold chain storage (2-8°C), and vial disposal requirements. The same percentage (98.6%) understood adverse events following immunization (AEFI) reporting protocols within the required 7-day window to sub-county health authorities. These findings align with previous research by Dimala et al. (2018) showing 92% awareness of proper vaccine storage, and Muchiri et al. (2020) reporting 89% awareness of AEFI reporting among Kenyan healthcare workers. The high familiarity with reconstitution processes (98.6%) corresponds with Otieno et al. (2022) findings of 85% reconstitution knowledge in Kenya. However, as demonstrated by Badu et al. (2019) in Ghana, where 80% adherence to cold chain practices was observed despite high knowledge levels, understanding doesn't always translate to consistent practice implementation. This high level of awareness across multiple aspects of vaccine management suggests that training programs have been effective in conveying essential information to healthcare workers. The consistent high percentages across different knowledge domains indicate a comprehensive understanding of vaccine protocols, though the gap between knowledge and practice highlighted by comparative studies suggests the need for practical reinforcement. The strong theoretical foundation demonstrated by nurses in this study provides a solid basis for improving practical implementation, though continued monitoring and support may be necessary to ensure knowledge translates effectively into practice.

Regarding attitudes and support systems, 76.1% of nurses expressed confidence in the defaulter tracing system's effectiveness, surpassing Mtenga et al.'s (2019) findings of 62% in Tanzania. However, significant challenges emerged, with 62% of nurses requesting additional vaccine training, similar to Ojakaa et al.'s (2020) finding that 68% of Kenyan healthcare workers desired more training on new vaccines. Communication barriers with illiterate caregivers affected 53.5% of nurses, a challenge also documented by Nankabirwa et al. (2018) in Uganda. Additionally, 69% reported insufficient on-site mentorship, aligning with Muchiri et al.'s (2019) findings where 72% of Kenyan healthcare workers reported similar mentorship gaps. These findings reveal a complex interplay between confidence in existing systems and recognition of areas needing improvement. The relatively high confidence in defaulter tracing suggests some success in implementing tracking systems, yet the substantial proportion requesting additional training indicates awareness of

knowledge gaps and a desire for professional development. The challenges with caregiver communication and mentorship support highlight areas where systemic improvements could enhance vaccine delivery effectiveness. The consistency of these findings with other regional studies suggests these are common challenges in vaccine program implementation across East Africa, pointing to the need for coordinated regional approaches to address these issues.

In terms of practical implementation, the study found 100% adherence to key vaccination protocols, including proper reconstitution, left deltoid administration, and documentation procedures, surpassing Muchiri et al.'s (2020) finding of 95% anatomical site compliance and Nankabirwa et al.'s (2018) 98% documentation adherence rate. The perfect compliance rate for vaccination recording exceeded Badu et al.'s (2022) findings of 89% in Ghana. While all nurses demonstrated proper sharps disposal practices, comparing favorably to Ojakaa et al.'s (2017) 96% compliance rate in Kenya, some discrepancies between reported and actual practices were noted. This was similar to Dimala et al.'s (2020) findings in Cameroon, where actual protocol adherence (85%) differed from self-reported rates, emphasizing the need for continuous supervision and observational assessments to maintain high practice standards. The exemplary adherence to technical protocols demonstrates strong practical competency among nursing staff, though the noted discrepancies between reported and observed practices suggest room for improvement in consistency. The high compliance rates across multiple practical domains indicate successful integration of malaria vaccine protocols into existing immunization systems, possibly reflecting the effectiveness of current training and supervision methods. However, the differences between self-reported and observed practices highlight the importance of maintaining robust monitoring systems to ensure consistent high-quality implementation. The comparison with regional studies suggests that while the study area shows strong performance in many aspects, continued attention to practical implementation details remains crucial for maintaining these high standards.

5.0 Conclusion

The study concludes that healthcare worker characteristics including older age, higher education levels, and specialized training in malaria vaccine administration were associated with better knowledge outcomes. Despite generally positive attitudes towards the vaccine among nurses, significant challenges emerged around training adequacy and caregiver communication. While nurses demonstrated strong adherence to technical aspects of vaccine administration including reconstitution, injection technique, and safety protocols, notable gaps existed in patient education and documentation practices.

Though formally trained nurses showed greater competency in vaccine counseling, persistent challenges around schedule completion and side effect communication highlighted the need for enhanced training programs and improved communication strategies. The findings emphasize that strengthening healthcare worker capacity through targeted education and mentorship could improve overall vaccine service delivery and uptake.

6.0 Recommendations

The study recommends that comprehensive, mandatory training programs encompassing both theoretical knowledge and practical skills should be implemented for all healthcare workers administering the malaria vaccine. In addition, it is recommended that these training programs specifically address communication strategies with illiterate caregivers and effective workload management approaches. Besides, the study recommends that on-site mentorship and regular skills

assessments should be established to build and maintain staff confidence in vaccine administration. Moreover, continuous supervision systems and platforms for sharing best practices should be developed to ensure consistent high-quality vaccine coverage across facilities. Furthermore, regular refresher courses should be instituted alongside a structured peer support system to enhance vaccine delivery competencies. Also, the study advocates for the implementation of longitudinal mixed-methods research to monitor changes in knowledge, attitudes, and practices over time. Lastly, it is recommended that further research be conducted to evaluate the effectiveness of training programs and explore improved strategies for caregiver communication and vaccine compliance, which will help shape long-term healthcare strategies for malaria vaccine programs.

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