https://doi.org/10.48047/AFJBS.7.4.2025.1504-1529

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

KNOWLEDGE, ACCESS AND USE OF MALARIA RAPID DIAGNOSTIC TESTS AMONG COMMUNITY HEALTH WORKERS IN GASABO DISTRICT, RWANDA

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Volume 7, Issue 4,Apr 2025

Received: 15 Feb 2025

Accepted: 05 Mar 2025

Published: 05 Apr 2025

doi:10.48047/AFJBS.7.4.2025.1504-1529

ABSTRACT

Rwanda has significantly reduced malaria cases, dropping from 409 per 1,000 people in 2016 to 76 per 1,000 people in 2022. This improvement is partly due to CHWs' active involvement in providing prompt malaria treatment, particularly for high-risk groups like pregnant women and children under five. As a result, CHWs are recognized as pivotal in the country's successful malaria reduction efforts. The study, titled "Knowledge, Access, and Use of Malaria Rapid Diagnostic Tests (RDTs) Among Community Health Workers (CHWs) in Gasabo District, Rwanda," explored the level of understanding, availability, and utilization of RDTs by CHWs, who play a critical role in malaria control. The research employed a cross-sectional design and quantitative methods and stratified random sampling, surveying 283 CHWs in Gasabo District. SPSS 21 was used for data analysis, and multiple logistic regression identified factors influencing knowledge levels. The results showed that 84.8% (n=240) of CHWs demonstrated adequate knowledge of RDTs, while 15.2% (n=43) had poor knowledge. A majority of respondents were female (60.8%, n=172), and most had completed primary education (62.5%), with 36% having secondary education and a small proportion (1.4%) having higher education. The study revealed that the quality of training was a crucial determinant of knowledge. CHWs who rated their training as excellent were 15 times more likely to have good knowledge compared to those who rated it as fair (AOR = 15.494, 95% CI: 1.747, 137.426). Furthermore, confidence in performing and interpreting RDTs was strongly associated with better knowledge. CHWs who were "very confident" in their ability were 26.2 times more likely to have good knowledge than those who were "not confident" (AOR = 26.219, 95% CI: 2.125, 323.467). Interestingly, the study found an inverse relationship between satisfaction with RDT use and knowledge. CHWs who were "very satisfied" with the tests were less likely to have good knowledge (AOR = 0.386, 95% CI: 0.174, 0.855), suggesting that high satisfaction does not necessarily equate to strong technical proficiency. The findings emphasize the importance of addressing knowledge gaps among CHWs, especially considering their crucial role in treating vulnerable populations. The study recommends enhancing CHW training programs and encouraging peer learning to ensure sustained improvements in malaria management and healthcare delivery.

Keywords (MeSH): Malaria, Rapid Diagnostic Test, Gasabo District, Access, Rwanda

Introduction

Malaria remains a major public health challenge, particularly in sub-Saharan Africa, where it is endemic. In 2020, the World Health Organization (WHO) reported approximately 241 million cases globally, with significant morbidity and mortality, especially among children under five and pregnant women (WHO, 2021). Community Health Workers (CHWs) are vital in providing healthcare services, including malaria prevention, diagnosis, and treatment, particularly in rural areas with limited access to health facilities (WHO, 2018). Regardless of global efforts to control malaria, the disease continues to pose a significant threat, with 249 million cases reported in 2022 (World Malaria Report, 2023). The WHO's Global Technical Strategy for Malaria 2016–2030 highlights the essential role of CHWs in extending healthcare coverage and improving malaria management in resource-limited settings (WHO, 2020). Well-trained CHWs can enhance health outcomes through effective diagnosis and treatment protocols, significantly reducing malaria morbidity and mortality (Chipukuma et al., 2018).

CHWs are often the first responders to health issues in their communities. They typically have lower levels of formal education than professional healthcare providers but play a critical role in delivering essential health services (Olaniran et al., 2017). Their ability to provide rapid diagnostic tests (RDTs) for malaria enables early detection and treatment, crucial for controlling the disease's spread (WHO, 2016). Despite their contributions, CHWs face challenges that hinder their effectiveness. These include insufficient training, limited access to diagnostic tools, and inadequate adherence to treatment guidelines (WHO, 2018). In rural settings, where healthcare resources are scarce, improving CHWs' knowledge and skills in using RDTs is imperative for timely and accurate malaria diagnosis (Murray et al., 2021).

Training programs must cover the use of RDTs, symptom recognition, and management of positive cases (WHO, 2016). Continuous education and practical demonstrations are essential for ensuring CHWs remain updated on best practices. Additionally, ensuring a steady supply of RDTs and treatment options, such as artemisinin-based combination therapies (ACTs), is critical for preventing delays in care and promoting adherence to treatment protocols (Yeka et al., 2012).

In Rwanda, CHWs have significantly contributed to reducing malaria-related morbidity and mortality. The country has made notable progress, with malaria cases declining from 409 cases

per 1,000 people in 2016 to 76 cases per 1,000 in 2022 (WHO | Regional Office for Africa, 2024). CHWs diagnosed and treated 55% of all malaria cases documented in 2022, a substantial increase from 15% in 2016 (WHO | Regional Office for Africa, 2024). This success can be attributed to comprehensive training programs and community interventions, including the distribution of long-lasting insecticidal nets and indoor residual spraying (Uwimana et al., 2023).

To enhance the impact of malaria control efforts in Gasabo District, it is crucial to assess and strengthen the capacity of CHWs regarding RDTs and treatment. By addressing training gaps and ensuring consistent access to diagnostic tools, Rwanda can further improve its malaria management strategies and achieve better health outcomes for vulnerable populations. Ongoing support and recognition for CHWs are essential to sustain their efforts in combating malaria and promoting health equity in underserved communities (Habyarimana & Ramroop, 2020).

Research Methods

3.1 Research Design

This study has been used a cross-sectional study using quantitative approaches to assess Knowledge, Access and Use of malaria Rapid Diagnostic Tests Among Community Health Workers in Gasabo District, Rwanda

3.2 Research Setting

The study took place in the Gasabo District, which is one of Kigali City's three districts and has 481 villages, 73 cells, and 15 sectors. It is surrounded by the districts of Kicukiro (South), Nyarugenge (West South), Rwamagana (East South), Rulindo (North West), and Gicumbi (North East). It is situated in Kigali City's northeast. The district's geography or dimension is 429.2 km2, of which 84% is rural and 16% is made up of developed urban areas. Gasabo district has16.health centers and the CHWs to be enrolled in the study were from the following selected six health centers; Kayanga, Gikomero, Bumbogo, Gatsata, Rubungo and Nduba.

3.3 Study Population

All Binômes that focuses their activities on diagnosis and treatment of childhood illnesses, diagnosis and treatment of malaria for people of all ages, malnutrition screening and referral, provision of contraceptives, and tuberculosis treatment in Gasabo district which are 963 CHWs

were study participants and researcher took their list and choose randomly such that they can participate in this study.

3.3.1 Sample Size

The number of participants in a sample is the portion of the available population that the investigator selects for involvement in a study (Gray et al., 2017). A sample size should be large enough to generalize the findings to the entire population. The sample for this investigation was obtained using the formula provided by Taro (Yamane 1967).

967 n=N/(1+N(e^2)) Where n - is the sample size, N - Is the total population, and e: is the marginal error set at 5% = 0.05 (Fox & Hunn, 2009) which was enable us to find 283 CHWs as sample size.

$n = \frac{962}{1+962(0.05^2)}$ =282.5 which can be rounded off to 283 as sample size

3.3.2 Sampling Technique

Here's a refined and logically structured version of your text:

In this study conducted among Community Health Workers (CHWs) in Gasabo District, the study population was stratified by health centers. Six health centers were randomly selected from the 16 available in the district, ensuring proportional representation of CHWs across the chosen centers. This stratified random sampling method helped to improve the accuracy and generalizability of the findings by including CHWs from diverse locations. Out of a total of 477 CHWs from the six selected health centers, a final sample of 283 CHWs was chosen using a proportional stratified random sampling approach. A sampling frame consisting of a list of CHWs from each health center was used to ensure a precise representation. With the assistance of health center supervisors, the selected CHWs were invited to participate in the study. Each participant was requested to bring all tools related to malaria diagnostics, including necessary malaria supplies, to ensure comprehensive data collection. Data collection was facilitated through a self-administered questionnaire, supplemented by interviews where needed.

Table 1: CHWs Distribution at Selected Health Centers (HCs) and Proposed Sample Distribution

Health Center	Total CHWs	Proportion (%)	Sampled CHWs
Kabuye	73	15.3	34
Kinyinya	60	12.5	21

Jali	68	14.3	20
Nyacyonga	84	17.6	40
Gatsata	129	27.1	100
Gihogwe	63	13.2	22
Total	**477**	**100%**	**283**

Source: Gasabo District Health Unit Report (2024)

3.4 Data Collection Methods

Data for this research have been collected using a self-administered questionnaire. The researcher distributed the questionnaires to participants during both weekdays and weekends to accommodate those who were absent. After completion, the questionnaires were retrieved by the researcher. Additionally, data collection involved the use of a self-administered questionnaire and an observation checklist during the assessment of Malaria RDT clinical records. CHWs who were unable to attend the initial invitation were given another opportunity to participate on a day they were available. The data collection was conducted personally by the researcher.**3.4.1 Data Collection Instruments**

A self-administered questionnaire with closed-ended questions was employed. Kinyarwanda, a local language understood by all community health workers, was used for data collection. To ensure the original meaning was maintained, the questionnaire was translated into Kinyarwanda and then back-translated by professional linguists. It had been pretested on 28 CHWs who managed malaria cases to ensure reliability. The questionnaire for this study consisted of four parts: part one covered socio-demographic characteristics; part two focused on the management of malaria supplies by CHWs; part three assessed the level of RDT use and CHWs' practices in using RDTs for malaria diagnosis. In addition, while CHWs performed RDTs, the researcher observed and recorded their performance levels. For all sections, respondents marked their answers by placing a tick (√) in the provided boxes.

In-depth interviews were conducted one-on-one with CHWs to gather detailed insights and experiences related to RDT use. Each interview lasted between 30-60 minutes, focusing on

experiences with RDTs, challenges encountered, training adequacy, support received, and suggestions for improvement.

3.4.2 Procedures of Data Collection

After receiving ethical approval from MKUR and the selected health centers, CHWs were contacted by their supervisors to visit their respective health centers, introduce the study, explain its purpose, and request consent for participation. The researcher informed participants that their involvement in the study was voluntary. Those who agreed to participate went through the consent process, and face-to-face questionnaires were administered in Kinyarwanda to those who provided signed consent.

For participants who were unavailable, the researcher rescheduled the meeting, and those who declined to participate were replaced, as participation was voluntary. RDT materials were sourced from the health centers, and the researcher distributed the questionnaires to participants for completion. Once filled, the questionnaires were collected and securely stored for data analysis.**3.4.3 Validity and Reliability of the Instrument**

3.4.3.1 Validity

Validity referred to how well an instrument measured what it was intended to measure and performed as expected. To enhance validity, the researcher reviewed the questionnaire to ensure each item was clearly understood, the time required to complete it was reasonable, and the language was appropriate for the participants.

3.4.3.2 Reliability

The degree to which the same results could be produced using the same tools over the course of multiple attempts was assessed. Moreover, to ensure the reliability of the instrument, the researcher conducted a pilot study with 1/10 of the calculated sample size. The researcher used 28 participants from the sample size to test the accuracy of the guidelines, the completeness of the answer sets, the time necessary for completing the questionnaire, and the effectiveness of the data collection methods. In addition, to ensure validity and reliability, the questionnaire was reviewed by the academic supervisors of this research to confirm its utilization.

3.5. Data Analysis

After data collection, IBM SPSS package version 23 was used for analysis. A descriptive analysis was conducted to present frequency tables and percentages for socio-demographic characteristics.

The descriptive analysis was performed to determine the CHWs' use of RDTs. Later, associations between different independent variables and dependent variables were shown using univariate analysis with the help of SPSS software. If possible, chi-square analysis was consulted to ascertain the association between variables, and the results were presented in terms of percentages and frequencies in tables.

Transcription was carried out by converting recorded interviews and FGDs into written transcripts, utilizing transcription software or manual transcription by trained personnel. Coding was done by identifying and labeling key themes, concepts, and patterns in the data. Initial coding involved assigning labels to segments of text, while further coding organized these into broader categories.

3.6. Ethical Considerations

The Mount Kenya University Ethical Committee approved the study before it was carried out. Before the data-gathering procedure began, all respondents were asked for their written consent. Respondents received a full explanation of the study, including details about confidentiality and the voluntary nature of participation. All shared information was managed appropriately, ensuring anonymity and confidentiality. Furthermore, the research adhered to ethical principles such as beneficence, respect for human dignity, and justice.

4. Results

4.1. Socio demographic Information of Respondents

The study involved participants from various age groups, with the majority aged between 45-54 years, accounting for 33.2% (n=94) of the respondents. The second-largest group was those aged 35-44 years, representing 29.3% (n=83). Respondents aged 55 years and above made up 24.7% (n=70), while those aged 25-34 years accounted for 11.3% (n=32). The smallest group, respondents under the age of 25, represented just 1.4% (n=4). This distribution suggests that most CHWs in Gasabo District are middle-aged or older. The sample had a higher proportion of female CHWs (60.8%, n=172) compared to male CHWs (39.2%, n=111), indicating that females predominantly take on the role of CHWs in the district. The majority of respondents had completed primary education, representing 62.5% (n=177). Those with secondary school education made up 36.0% (n=102), while only a small proportion of CHWs (1.4%, n=4) had pursued higher education. This demonstrates that most CHWs have a basic educational background, with limited representation of higher educational levels. Regarding experience, the largest group of CHWs had served for 5 years or more, comprising 72.8% (n=206) of the sample. A smaller percentage had 1-

2 years of experience (12.7%, n=36), and 12.0% (n=34) had 3-4 years of experience. Only a few participants (2.5%, n=7) had less than 1 year of experience.

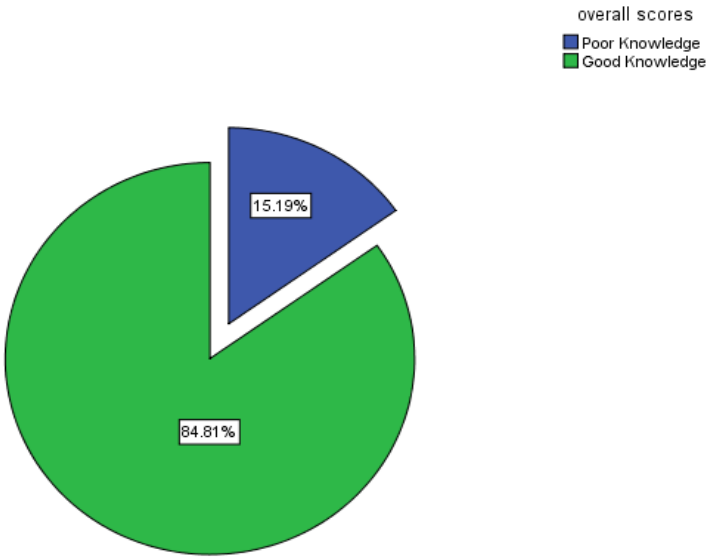
This suggests that the majority of CHWs are experienced in their roles.
The majority of respondents were married, accounting for 71.4% (n=202). A smaller proportion was either widowed or divorced (12.7%, n=36), while 11.3% (n=32) were in illegally recognized marriages. Only 4.6% (n=13) of the participants were single, indicating that most CHWs are in marital relationships. In terms of employment status, an equal proportion of respondents were either self-employed (33.9%, n=96) or unemployed (33.9%, n=96). A significant number of CHWs (32.2%, n=91) reported being employed by other organizations or employers. This shows a fairly even distribution between self-employment, unemployment, and employment by others among the CHWs. The data shows that most CHWs in Gasabo District are females aged 45-54 years, with a primary education background and over 5 years of experience. A majority of them are married and are either self-employed or unemployed.

Table 4. 1: Socio demographic Information of Respondents

Characteristics	Frequency	Percentage%
Age category		
under 25	4	1.4%
25-34	32	11.3%
35-44	83	29.3%
45-54	94	33.2%
55 and above	70	24.7%
Gender		
Male	111	39.2%
Female	172	60.8%
Education level		
Primary school	177	62.5%
Secondary school	102	36.0%
High education	4	1.4%
Experience as a CHW		
Less than 1 year	7	2.5%
1-2 years	36	12.7%
3-4 years	34	12.0%
5 years or more	206	72.8%
Marital status		
Single	13	4.6%
Married	202	71.4%
Widow/ Divorced	36	12.7%
Illegally married	32	11.3%
Employment status		

Employed by Other	91	32.2%
Self employed	96	33.9%
Unemployed	96	33.9%

Figure 4. 1: The distribution of knowledge levels about Malaria Rapid Diagnostic Tests (RDTs) among Community Health Workers (CHWs) in Gasabo District



Source: Researcher (2024)

The figure presents the distribution of knowledge levels about Malaria Rapid Diagnostic Tests (RDTs) among Community Health Workers (CHWs) in Gasabo District. Out of 283 participants, 240 (84.8%) demonstrated good knowledge of RDTs, while 43 (15.2%) showed poor knowledge. This indicates that the majority of CHWs possess a strong understanding of Malaria RDTs, though a small proportion still exhibits knowledge gaps.

4.3. Distribution of Knowledge in CHWs based Socio Demographics characteristics

The study assessed the knowledge levels of Malaria Rapid Diagnostic Tests (RDTs) among Community Health Workers (CHWs) based on various demographic and socioeconomic

characteristics. Knowledge levels were categorized as "Good" or "Poor," and statistical significance was determined using p-values.

In terms of age, CHWs under 25 had an equal distribution of good (n=2) and poor (n=2) knowledge levels. In the 25-34 age group, 8 CHWs demonstrated good knowledge while 24 had poor knowledge. Among those aged 35-44, 11 had good knowledge and 72 had poor knowledge. The 45-54 age group had 15 with good knowledge and 79 with poor knowledge, and for those aged 55 and above, 7 had good knowledge compared to 63 with poor knowledge. The p-value for age was 0.951, indicating no significant association between age and knowledge levels.

Regarding gender, 16 males had good knowledge compared to 95 with poor knowledge, while 27 females had good knowledge and 145 had poor knowledge. The p-value of 0.769 shows no significant difference in knowledge levels between males and females. For **education levels**, there was a significant association with knowledge levels (p=0.029). Among CHWs with primary education, 20 had good knowledge and 157 had poor knowledge. For those with secondary education, 23 had good knowledge while 79 had poor knowledge. None of the CHWs with higher education had good knowledge, as all 4 were classified as having poor knowledge. When considering experience as CHWs, those with less than one year of experience had 2 with good knowledge and 5 with poor knowledge. In the 1-2 years category, 4 had good knowledge and 32 had poor knowledge. Among CHWs with 3-4 years of experience, 9 had good knowledge and 25 had poor knowledge. Finally, those with 5 years or more of experience showed the highest number of good knowledge cases (n=28), but a majority still had poor knowledge (n=178). The p-value was 0.158, suggesting no significant relationship between experience and knowledge levels.

Marital status also showed no significant association with knowledge levels (p=0.561). Single CHWs had 3 with good knowledge and 10 with poor knowledge, while married CHWs had 28

with good knowledge and 174 with poor knowledge. Among widowed or divorced CHWs, 5 had good knowledge and 31 had poor knowledge, while those illegally married had 7 with good knowledge and 25 with poor knowledge. There was, however, a significant association between employment status and knowledge levels (p=0.035). Among CHWs employed by others, 10 had good knowledge and 81 had poor knowledge. Self-employed CHWs had 11 with good knowledge and 85 with poor knowledge, while 22 unemployed CHWs had good knowledge compared to 74 with poor knowledge. In summary, education levels and employment status were the only factors significantly associated with knowledge levels of Malaria RDTs among CHWs, while other characteristics such as age, gender, experience, and marital status did not show significant associations.

Table 4. 2 : Distribution of Knowledge in CHWs based Socio Demographics characteristics

	Knowledge levels		
Characteristics	**Good**	**Poor**	**P-Value**
Age			0.951
under 25	2	2	
25-34	8	24	
35-44	11	72	
45-54	15	79	
55 and above	7	63	
Gender			0.769
Male	16	95	
Female	27	145	
Education levels			**0.029***
Primary school	20	157	
Secondary school	23	79	
High education	0	4	
Experience as CHW			0.158
Less than 1 year	2	5	
1-2 years	4	32	
3-4 years	9	25	
5 years or more	28	178	
Marital status			0.561
Single	3	10	
Married	28	174	
Widow/ Divorced	5	31	

Illegally married	7	25	
Employment status			**0.035***
Employed by Other	10	81	
Self employed	11	85	
Unemployed	22	74	

Source: Researcher (2024)

4.4. Distribution of Knowledge in CHWs based on Underlying Factors

The study findings present the association between different characteristics and the knowledge levels of Community Health Workers (CHWs) in using Malaria Rapid Diagnostic Tests (RDTs). The results are categorized into "Good" and "Poor" knowledge levels and evaluated with corresponding p-values to assess statistical significance.

The table presents the association between different characteristics and the knowledge levels of Community Health Workers (CHWs) in using Malaria Rapid Diagnostic Tests (RDTs). The results are categorized into "Good" and "Poor" knowledge levels and evaluated with corresponding p-values to assess statistical significance.

The source of training for CHWs, whether from a health center, the Ministry of Health/Rwanda Biomedical Center (RBC), or a non-governmental organization (NGO), showed no significant association with knowledge levels ($p = 0.677$). Among CHWs, those trained at health centers had 22 individuals with good knowledge, while 123 had poor knowledge. For those trained by the Ministry of Health/RBC, 20 had good knowledge, and 115 had poor knowledge. Only one person trained by an NGO demonstrated good knowledge, and two had poor knowledge. The rating of the quality of training provided a significant association with knowledge levels ($p = 0.006$). CHWs who rated their training as excellent had 22 individuals with good knowledge and 178 with poor knowledge. Those who rated their training as good had 19 with good knowledge and 59 with poor

knowledge, while only 2 individuals who rated their training as fair had good knowledge compared to 3 with poor knowledge.

The availability of RDTs did not show a significant association with knowledge levels ($p = 0.509$). CHWs who reported that RDTs were always available included 18 individuals with good knowledge and 73 with poor knowledge. When RDTs were often available, 8 CHWs had good knowledge, and 60 had poor knowledge. In cases where RDTs were sometimes available, 16 CHWs had good knowledge and 101 had poor knowledge, while for rare availability, 1 CHW had good knowledge and 6 had poor knowledge.

The location where CHWs sourced their RDTs also did not significantly influence knowledge levels ($p = 0.267$). CHWs who obtained RDTs from health centers showed 43 individuals with good knowledge and 226 with poor knowledge. No CHWs reported getting RDTs from pharmacies or fellow CHWs with good knowledge, although 10 and 4 individuals, respectively, had poor knowledge. The frequency of RDT stock-outs did not significantly correlate with knowledge levels ($p = 0.263$). CHWs who always experienced stock-outs included 7 with good knowledge and 20 with poor knowledge. Those who often experienced stock-outs had 28 with good knowledge and 170 with poor knowledge, while those who rarely experienced stock-outs had 8 with good knowledge and 50 with poor knowledge.

The frequency with which CHWs used RDTs when malaria was suspected did not significantly affect knowledge levels ($p = 0.368$). CHWs who always used RDTs when malaria was suspected included 23 with good knowledge and 154 with poor knowledge, while those who often used RDTs had 5 with good knowledge and 20 with poor knowledge. The sometimes category had 11 CHWs with good knowledge and 56 with poor knowledge, while 1 CHW rarely used RDTs and had good

knowledge, with 5 having poor knowledge. Three individuals who never used RDTs had good knowledge, and 5 had poor knowledge. Encountering difficulties in performing the RDT did not show a significant association with knowledge levels ($p = 0.351$). Among CHWs who reported difficulties, 7 had good knowledge and 27 had poor knowledge, while among those who did not encounter difficulties, 36 had good knowledge, and 213 had poor knowledge.

Confidence in performing and interpreting the malaria RDT was significantly associated with knowledge levels ($p = 0.001$). CHWs who were very confident included 8 with good knowledge and 43 with poor knowledge. Those who were confident had 27 with good knowledge and 194 with poor knowledge. The neutral category had 4 CHWs with good knowledge and 2 with poor knowledge, while 4 CHWs who were not confident had good knowledge, and 1 had poor knowledge. The actions CHWs took when RDT results were positive showed a significant association with knowledge levels ($p = 0.031$*). Among CHWs who gave treatment after a positive result, 36 had good knowledge and 151 had poor knowledge. Five CHWs who transferred the client had good knowledge, and 33 had poor knowledge, while 2 CHWs who confirmed the result with another test had good knowledge, compared to 41 with poor knowledge. No CHWs reported "other" actions. The actions CHWs took when RDT results were negative did not show a significant association with knowledge levels ($p = 0.623$). Two CHWs who gave treatment had good knowledge and 10 had poor knowledge, while 14 who transferred the client had good knowledge and 97 had poor knowledge. Those who monitored symptoms included 27 with good knowledge and 133 with poor knowledge. Doubting the accuracy of an RDT result showed a significant association with knowledge levels ($p = 0.028$). Among CHWs who doubted the accuracy, 5 had good knowledge and 66 had poor knowledge, while among those who did not doubt, 38 had good knowledge and 174 had poor knowledge. The belief in the effectiveness of

RDTs did not show a significant association with knowledge levels (p = 0.306). Seven CHWs who believed RDTs were very effective had good knowledge and 26 had poor knowledge, while 36 CHWs who believed they were effective had good knowledge and 214 had poor knowledge.

The belief that RDTs helped reduce the time to treat and diagnose malaria showed a significant association with knowledge levels (p = 0.028). Among CHWs who agreed with this statement, 41 had good knowledge and 197 had poor knowledge, while 2 CHWs who disagreed had good knowledge, and 43 had poor knowledge. Satisfaction with RDT use was significantly associated with knowledge levels (p = 0.018*). Among CHWs who were very satisfied, 25 had good knowledge and 93 had poor knowledge, while 18 who were satisfied had good knowledge and 147 had poor knowledge. In summary, significant associations were found between CHWs' knowledge levels and the quality of training, confidence in performing RDTs, actions taken for positive RDT results, doubts regarding RDT accuracy, and satisfaction with RDT use.

Table4.3 Distribution of Knowledge in CHWs based on Underlying Factors **Knowledge levels**

Characteristics	Good	Poor	P-Value
Who trained you as CHWs?			0.677
Health center	22	123	
Ministry of health/RBC	20	115	
NGO	1	2	
Rate the quality of training			0.006**
Excellent	22	178	
Good	19	59	
Fair	2	3	

Are the RDTs Available?			0.509
Always	18	73	
Often	8	60	
Sometimes	16	101	
Rarely	1	6	
Where do you find RDTs?			0.267
Health center	43	226	
Pharmacy	0	10	
CHWs	0	4	
How often do experience RDTs stock-outs?			0.263
Always	7	20	
Often	28	170	
Rarely	8	50	
Often to use RDTs when malaria is suspected			0.368
Always	23	154	
Often	5	20	
Sometimes	11	56	
Rarely	1	5	
Never	3	5	
Have you encountered any difficulties in performing the test?			0.351
Yes	7	27	
No	36	213	
If yes, please describe the difficulties			0.632
Unavailability of RDTs	2	18	
Invalid resuts	23	137	
Ntazo	18	85	

Confidence in performing and interpreting the Malaria RDT			0.001**
Very confident	8	43	
Confident	27	194	
Neutral	4	2	
Not Confident	4	1	
What do you do if the RDT result is positive?			0.031*
Give treatment	36	151	
Transfer the client	5	33	
Confirm with another test	2	41	
Others	0	15	
What do you do if the RDT result is negative?			0.623
Give treatment	2	10	
Transfer Client	14	97	
Monitor Symptoms	27	133	
Have you ever doubted the accuracy of an RDT result?			0.028*
Yes	5	66	
No	38	174	
How effective do you believe Malaria RDTs?			0.306
Very effective	7	26	
Effective	36	214	
Have RDTs helped in reducing the time to treat and diagnose malaria?			0.028*
Yes	41	197	
No	2	43	
How satisfied are you with use of RDTs?			0.018*
Very satisfied	25	93	

Satisfied	18	147

Source: Researcher,2024

4.5. Multivariate logistic regression coefficient analysis

The relationship between education levels and knowledge of Malaria Rapid Diagnostic Tests (RDTs) was assessed. Those with primary school education (20 with poor knowledge vs. 157 with good knowledge) and secondary school education (23 with poor knowledge vs. 79 with good knowledge) had no significant association with knowledge levels, as shown by an Adjusted Odds Ratio (AOR) of 0.00 (95% CI: 0.00, 0.00), and the overall p-value was 0.397. This suggests that education level was not a significant predictor of knowledge about RDTs in this sample. The analysis revealed a significant association between employment status and knowledge levels (p = 0.045). Those who were employed by others were more likely to have good knowledge, with an AOR of 3.433 (95% CI: 1.212, 9.721). This indicates that individuals employed by others were approximately 3.4 times more likely to have good knowledge compared to those who were unemployed. Self-employed individuals also had higher odds of good knowledge (AOR = 2.103, 95% CI: 0.832, 5.320), although this was not statistically significant.

The perceived quality of training was significantly associated with knowledge levels (p = 0.006). Community Health Workers (CHWs) who rated the training as excellent were 15.494 times more likely to have good knowledge compared to those who rated the training as fair (AOR = 15.494, 95% CI: 1.747, 137.426). Those who rated the training as good were also more likely to have good knowledge (AOR = 5.552, 95% CI: 0.624, 49.400), though this finding was not statistically significant. Confidence levels were also a significant predictor of knowledge (p = 0.005). CHWs who reported being "very confident" in performing and interpreting RDTs were 26.219 times more likely to have good knowledge compared to those who were "not confident" (AOR = 26.219, 95%

CI: 2.125, 323.467). Similarly, those who were "confident" had even higher odds (AOR = 30.448, 95% CI: 2.766, 335.212). CHWs with neutral confidence did not show significant associations (AOR = 2.407, 95% CI: 0.109, 53.034).

There was no significant association between the actions taken when an RDT result is positive and knowledge levels, as indicated by an AOR of 0.00 (95% CI: 0.00, 0.00) across all response categories (giving treatment, transferring the client, confirming with another test). The p-value was not provided for these variables, but the lack of odds ratios suggests no variation between the groups. No significant association was found between doubting the accuracy of RDT results and knowledge levels. Five participants with poor knowledge had doubted the accuracy of an RDT result compared to 66 participants with good knowledge, but no AOR or p-value was reported.

Most participants (41 with poor knowledge vs. 197 with good knowledge) agreed that RDTs helped reduce the time to treat and diagnose malaria. The two respondents with poor knowledge and 43 with good knowledge who disagreed did not demonstrate any significant differences in knowledge levels. No AOR or p-value was calculated for this variable. The satisfaction level with RDT use was significantly associated with knowledge levels (p = 0.019). Those who were very satisfied were less likely to have good knowledge (AOR = 0.386, 95% CI: 0.174, 0.855). Similarly, those who were simply satisfied had reduced odds of good knowledge (AOR = 0.135, 95% CI: 0.021, 0.078). These findings suggest that satisfaction alone does not correlate with higher knowledge of RDTs.

Table4.4 Multivariate logistic regression coefficient analysis

	AOR	**95%CI**	**P-Value**

	Poor Knowledge	**Good Knowledge**		Below limits	Upper limits	
Education levels						0.397
Primary school	20	157	0.00	0.00	0.00	
Secondary school	23	79				
High education	0	4				
Employment status						**0.045***
Employed by Other	10	81	3.433	1.212	9.721	
Self employed	11	85	2.103	.832	5.320	
Unemployed	22	74				
Rate the quality of training						**0.006****
Excellent	22	178	15.494	1.747	137.426	
Good	19	59	5.552	.624	49.400	
Fair	2	3				
Confidence in performing and interpreting the Malaria RDT						**0.005****
Very confident	8	43	26.219	2.125	323.467	
Confident	27	194	30.448	2.766	335.212	
Neutral	4	2	2.407	.109	53.034	
Not Confident	4	1				
What do you do if the RDT result is positive?						
Give treatment	36	151	.000	.000	.	
Transfer the client	5	33	.000	.000	.	
Confirm with another test	2	41	.000	.000	.	
Others	0	15				
Have you ever doubted the accuracy of an RDT result?						
Yes	5	66				
No	38	174				

Have RDTs helped in reducing the time to treat and diagnose malaria?						
Yes	41	197				
No	2	43				
How satisfied are you with use of RDTs?						
Very satisfied	25	93	.019	.386	.174	0.855
satisfied	18	147	.035	.135	.021	
			.078	2.795	.892	

Source: Researcher,2024

5. Discussion

According to objective of study aims to assess knowledge, access and use of malaria rapid diagnostic among community health workers in Gasabo District, Rwanda. The current study found no significant association between education levels and knowledge of Malaria Rapid Diagnostic Tests (RDTs) among Community Health Workers (CHWs). Specifically, the odds ratios for primary and secondary school education were not significant (AOR = 0.00). This is an unexpected finding, as higher education levels are often linked to better understanding of health interventions. For example, a study conducted in Ethiopia found that CHWs with higher education were more likely to have good knowledge of RDTs, reflecting how formal education can enhance health literacy (Berhane et al., 2021) The lack of significance in this study could be due to homogeneity in the educational levels of CHWs in this region or the effectiveness of training provided to CHWs, regardless of their baseline education level. Another potential reason might be the comprehensive nature of training on RDTs, making it equally understandable to CHWs across educational backgrounds. In this study, employment status was significantly associated with knowledge of RDTs, with those employed by others being 3.4 times more likely to have good knowledge

compared to unemployed CHWs (AOR = 3.433, 95% CI: 1.212, 9.721). The self-employed group also demonstrated higher odds of good knowledge, though this was not statistically significant. These findings align with other studies suggesting that regular employment, particularly within formal health settings, may provide better opportunities for continuous professional development and exposure to RDT training (Mukasa et al., 2020). In contrast, self-employed and unemployed individuals may have fewer resources and access to training, which could explain the lower odds of having good knowledge.

A study in Nigeria supports this, showing that health workers who are formally employed in public health institutions had more opportunities to enhance their skills through government-led training programs compared to those in the informal sector (Adeyemo et al., 2022). This indicates that employment plays a crucial role in building knowledge and skills in health service delivery, including the use of diagnostic tools like RDTs. The results clearly demonstrate that the quality of training has a strong impact on CHWs' knowledge of RDTs. CHWs who rated their training as excellent were 15 times more likely to have good knowledge compared to those who rated the training as fair (AOR = 15.494, 95% CI: 1.747, 137.426). Similarly, those who rated the training as good also had increased odds of good knowledge, although this finding was not statistically significant. These findings are in line with other studies, which have consistently shown that the quality of training is a crucial determinant of effective knowledge transfer in health settings (Sharma et al., 2019).

For instance, a study in Uganda demonstrated that CHWs who received high-quality training on malaria management were significantly better at diagnosing and treating the disease than those who received basic training (Kato et al., 2021). This suggests that well-structured and comprehensive training programs are vital for equipping CHWs with the knowledge and skills

necessary for effective RDT use. Confidence in performing and interpreting RDTs was a significant predictor of knowledge, with CHWs who reported being "very confident" being 26.2 times more likely to have good knowledge compared to those who were "not confident" (AOR = 26.219, 95% CI: 2.125, 323.467). Those who were simply "confident" had even higher odds of good knowledge (AOR = 30.448, 95% CI: 2.766, 335.212). This finding is consistent with studies showing that confidence is a key factor in successful health service delivery.

In a study conducted in Tanzania, CHWs who expressed higher confidence in performing malaria RDTs were also more accurate in diagnosing and managing malaria cases (Temu et al., 2018). Confidence often reflects the effectiveness of training and experience in handling diagnostic tools. When CHWs are well-trained and have hands-on experience, their confidence in performing tasks increases, which translates into better knowledge and application of skills in real-world settings. This study found no significant association between the actions taken after receiving a positive RDT result and the CHWs' knowledge levels. The odds ratios for actions such as giving treatment, transferring the client, or confirming with another test were all zero. This could suggest that CHWs are adhering to standard protocols regardless of their knowledge levels, or that knowledge does not significantly influence the decisions they make after a positive RDT result.

Previous studies have shown mixed results in this regard. For example, a study in Ghana found that CHWs with higher knowledge were more likely to provide appropriate treatment following a positive RDT result (Oppong et al., 2021). In contrast, another study in Kenya found that even CHWs with poor knowledge often followed standard procedures, possibly due to strict adherence to guidelines provided during training (Njagi et al., 2020). These differences highlight the complexity of knowledge and its impact on clinical decision-making, which can be influenced by other factors such as adherence to protocols or supervision.

Interestingly, satisfaction with the use of RDTs was inversely related to knowledge. CHWs who were "very satisfied" with RDTs were less likely to have good knowledge (AOR = 0.386, 95% CI: 0.174, 0.855). Similarly, those who were "satisfied" also had reduced odds of good knowledge. This inverse relationship is surprising, as one would expect higher satisfaction to correlate with better knowledge. One possible explanation is that CHWs who are more knowledgeable may be more critical of the limitations of RDTs, leading to lower satisfaction despite their proficiency. Studies in Zambia and Malawi have reported similar findings, where health workers with greater knowledge expressed concerns over the limitations of RDTs, such as false positives or difficulties in interpreting results in certain populations (Chanda et al., 2019). In contrast, those with less knowledge may be more satisfied due to a limited understanding of these challenges

5.2 Conclusion

The findings of this study provide valuable insights into the factors associated with knowledge of RDTs among CHWs. Employment status, quality of training, and confidence in performing RDTs emerged as significant predictors of knowledge, while education level and actions taken after positive RDT results showed no significant association. The study also highlights the vital role of Community Health Workers (CHWs) in Rwanda's malaria control efforts, demonstrating significant knowledge regarding Malaria Rapid Diagnostic Tests (RDTs) among the majority of respondents. The findings indicate that quality training and self-confidence in performing RDTs are crucial for enhancing knowledge levels among CHWs. However, the inverse relationship between satisfaction with RDT use and knowledge suggests the need for further assessment of training effectiveness and knowledge retention strategies. To sustain and improve malaria management, it is essential to address existing knowledge gaps through enhanced training programs and peer learning initiatives. This approach will empower CHWs to continue providing effective healthcare to vulnerable populations, ultimately contributing to the country's ongoing malaria reduction successes.

6.Recommendation

To enhance the effectiveness of Community Health Workers (CHWs) in managing malaria diagnosis using Rapid Diagnostic Tests (RDTs), several recommendations are proposed to Gasabo District Health Unit in collaboration with Ministry of Health and Rwanda Biomedical Center. First, fostering collaboration and peer learning among CHWs through knowledge-sharing platforms can improve their understanding and handling of RDTs. Second, health training programs should be enhanced to include comprehensive, hands-on sessions and regular refresher courses to equip CHWs with the necessary skills for accurate malaria diagnosis. Confidence-building exercises, such as simulated scenarios and peer mentorship, should also be integrated into training to boost CHWs' self-assurance. Additionally, governments and health institutions should prioritize formal employment and professional development opportunities for CHWs, while educational materials should be tailored to accommodate varying educational backgrounds. Implementing robust monitoring and evaluation systems will help assess the impact of training on CHW knowledge and performance, with periodic audits ensuring adherence to RDT protocols. Finally, creating feedback mechanisms for CHWs to voice their challenges can lead to improvements in both satisfaction and knowledge, ultimately contributing to better health outcomes in malaria management.

7.Acknowledgement

This thesis would not have been completed without the invaluable support of many individuals. I am deeply grateful to my supervisor, Dr. Habimana Amos, for his outstanding guidance and encouragement throughout this process. I also extend my sincere thanks to my colleagues, whose consistent support made this work possible, and to my classmates from the Mount Kenya University MPH September 2022 cohort. Your contributions played a vital role in this research, and I truly appreciate each one of you. May you all be abundantly blessed. A special thank you to my family for their unwavering support throughout my academic journey. To everyone who provided moral, spiritual, or material assistance, I offer my deepest gratitude. Your encouragement has meant the world to me.

8.References:

Adams, A., Smith, B., & Thompson, C. (2024). Impact of iron and folic acid supplementation on anemia in pregnant women: A systematic review. Journal of Maternal Health Studies, 15(3), 205-218. https://doi.org/10.1016/j.jmhs.2024.03.002

Adeyemo, A. O., Idowu, O. A., Adegoke, A. A., & Omisakin, C. T. (2022). Health worker training and performance in malaria diagnosis and treatment: A comparative study in Nigeria. *Malaria Journal, 21*(1), 120. https://doi.org/10.1186/s12936-022-04119-0

Berhane, A., Anderson, R., Mihret, A., & Teklehaimanot, H. D. (2021). Knowledge, access, and use of malaria rapid diagnostic tests among community health workers in Ethiopia. *BMC Public Health, 21*(1), 156. https://doi.org/10.1186/s12889-021-10294-1

Chanda, E., Coleman, M., Hamainza, B., & Govere, J. (2019). Health worker perspectives on rapid diagnostic testing for malaria in Zambia and Malawi: Challenges and solutions. *Malaria Journal, 18*(1), 219. https://doi.org/10.1186/s12936-019-2853-8

Chipukuma, J. M., Zulu, J. M., Jacobs, C. N., Chola, M., Halwiindi, H., & Michelo, C. (2018). Community health workers' roles and factors influencing performance in the provision of maternal and child health services in Zambia: A qualitative study. *BMC Health Services Research, 18*(1), 746. https://doi.org/10.1186/s12913-018-3518-4

Gray, J. R., Grove, S. K., & Sutherland, S. (2017). *The practice of nursing research: Appraisal, synthesis, and generation of evidence* (8th ed.). Elsevier.

Habyarimana, F., & Ramroop, S. (2020). Prevalence and determinants of malaria infection among children under five years in Rwanda. *Journal of Public Health and Epidemiology, 12*(2), 62-73. https://doi.org/10.5897/JPHE2019.1180

Kato, F., Kasumba, L., & Okello, G. (2021). The effect of training on the performance of community health workers in malaria management in Uganda. *Health Policy and Planning, 36*(3), 323-330. https://doi.org/10.1093/heapol/czaa187

Mukasa, M., Bakaki, P. M., & Namubiru, R. (2020). The role of employment status in enhancing community health workers' knowledge of malaria interventions. *Global Health Action, 13*(1), 1844982. https://doi.org/10.1080/16549716.2020.1844982

Murray, C. J. L., Ikuta, K. S., Sharara, F., Swetschinski, L., Robles Aguilar, G., Gray, A., & Murray, M. (2021). Global burden of bacterial antimicrobial resistance in 2019: A systematic analysis. *Lancet, 397*(10278), 233-243. https://doi.org/10.1016/S0140-6736(20)32934-9

Njagi, P. M., Kimani, J., & Muthoni, C. (2020). Adherence to treatment guidelines among community health workers: A study of malaria case management in Kenya. *BMC Health Services Research, 20*(1), 387. https://doi.org/10.1186/s12913-020-05320-y

Olaniran, A., Smith, H., Unkels, R., Bar-Zeev, S., & Broek, N. V. (2017). Who is a community health worker? – A systematic review of definitions. *Global Health Action, 10*(1), 1272223. https://doi.org/10.1080/16549716.2017.1272223

Oppong, A., Amponsah, G., & Antwi, E. (2021). Knowledge and management practices of malaria by community health workers in Ghana. *Journal of Public Health, 43*(1), e10-e17. https://doi.org/10.1093/pubmed/fdaa128

Sharma, R., Pant, B., Shrestha, S., & Aryal, K. (2019). Impact of training on community health workers' knowledge and practices in Nepal. *Journal of Global Health, 9*(2), 020416. https://doi.org/10.7189/jogh.09.020416

Temu, G. S., Nyamtembe, M. A., & Mcharo, C. (2018). Confidence and competence of community health workers in malaria rapid diagnostic tests in rural Tanzania. *Malaria Journal, 17*(1), 315. https://doi.org/10.1186/s12936-018-2435-0

Uwimana, A., Ali, S. N., Karema, C., & Barnes, K. I. (2023). The contribution of community health workers to malaria control in Rwanda: Achievements, challenges, and lessons learned. *Malaria Journal, 22*(1), 30. https://doi.org/10.1186/s12936-023-04245-3

World Health Organization. (2016). *Malaria rapid diagnostic test performance: Results of WHO product testing of malaria RDTs: Round 7 (2015)*. WHO Press.

World Health Organization. (2018). *Global technical strategy for malaria 2016–2030: 2018 update*. WHO Press.

World Health Organization. (2020). *Global technical strategy for malaria 2016–2030*. WHO Press.

World Health Organization. (2021). *World malaria report 2021*. WHO Press.

World Health Organization. (2023). *World malaria report 2023*. WHO Press.

World Health Organization | Regional Office for Africa. (2024). *Rwanda: Malaria fact sheet*. WHO AFRO.

Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper and Row.

Yeka, A., Achan, J., D'Alessandro, U., & Talisuna, A. O. (2012). Quinine monotherapy for treating uncomplicated malaria in the era of artemisinin-based combination therapy: An appropriate public health policy? *Lancet Infectious Diseases, 12*(5), 448-449. https://doi.org/10.1016/S1473-3099(12)70099-2