ENSIGN GLOBAL COLLEGE, KPONG

EASTERN REGION, GHANA

DEPARTMENT OF PUBLIC HEALTH

DEPARTMENT OF COMMUNITY HEALTH

ASSESSING KNOWLEDGE ON SEASONAL MALARIA CHEMOPREVENTION; SICAPP USABILITY AND DATA QUALITY AMONGST COMMUNITY HEALTH WORKERS IN THE UPPER WEST REGION OF GHANA

By

HAMMOND NII SARKWAH

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AUGUST, 2024

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A THESIS SUBMITTED TO THE DEPARTMENT OF COMMUNITY HEALTH, FACULTY OF PUBLIC HEALTH, ENSIGN GLOBAL COLLEGE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER OF PUBLIC HEALTH DEGREE

AUGUST, 2024

DECLARATION

I hereby declare that except for reference to other people's work, which I have dully cited, this project submitted to the faculty of Public Health, Ensign Global College, Kpong is the result of my investigation under the supervision of Dr. Edward Kofi Sutherland, and has not been presented for any other degree elsewhere.

Sarkwah, Hammond Nii, (237100264) …… ……..……..…

(Student's Name and ID) Signature Date

Certified by:

Dr. Edward Kofi Sutherland ……... …..……..……..

(Supervisor) Signature Date

Certified by:

Dr Stephen Manortey …….. ……..

(Head of Academic Program) Signature Date

DEDICATION

I dedicate this academic work to Almighty God. I deeply thank my parents, siblings, and beloved children, Evan and Ivan, for their prayers, support, and unwavering encouragement throughout my career journey. With commitment and diligence as my guiding principles, I completed this work successfully.

ACKNOWLEDGEMENT

This thesis marks the culmination of my journey towards a Master's in Public Health, and I owe a great debt of gratitude to many who have supported and guided me along the way. I would like to express my profound gratitude to Gifty Francisca Ben-Aryee. Her encouragement facilitated my pursuit of this degree, and her unwavering technical support throughout my study has been invaluable.

I also wish to sincerely thank my supervisor, Dr. Edward Sutherland, academic advisors, colleagues, and friends who provided insight and encouragement throughout this process. To the community health workers in the Upper West Region of Ghana, who participated in this study and shared their knowledge and experiences, I am deeply appreciative.

Finally, I am grateful to my family for their endless support and patience during this challenging and rewarding journey.

Thank you all for your contributions to this work.

DEFINITION OF TERMS

Malaria: Malaria is a life-threatening disease caused by parasites transmitted to people through the bites of infected female *Anopheles* mosquitoes.

Seasonal malaria chemoprevention (SMC): is the intermittent administration of a curative dose of antimalarial medicine to children at high risk of severe malaria living in areas with seasonal transmission, regardless of whether they are infected with malaria

ABBREVIATIONS

CHW- Community Health Worker

GHS- Ghana Health Service

NMEP - National Malaria Elimination Program

NMESP - National Malaria Elimination Strategic Plan

SiCApp - Seasonal Malaria Chemoprevention in Children Application

SMC - Seasonal Malaria Chemoprevention

SUS - System Usability Scale

WHO - World Health Organization

ABSTRACT

Background: Although Seasonal Malaria Chemoprevention (SMC) was introduced in 2012 to mitigate challenges with early diagnosis and treatment, manual documentation and logistics issues remain. To address these problems, the Seasonal Malaria Chemoprevention in Children Application (SiCApp) was developed to enhance data management and streamline SMC implementation. This study was conducted to assess community healthcare workers' (CHWs) knowledge of SMC, SiCApp's usability, and to analyse the quality of data from SiCApp in the Upper West Region of Ghana.

Methodology: A cross-sectional survey using a structured questionnaire was conducted from March 2024 to August 2024. The study utilized a random sampling technique and had a sample size of 346 CHWs. The study assessed SiCApp's effectiveness by evaluating CHWs' SMC knowledge, usability, and data quality in terms of timeliness and completeness. Binary logistic regression analysed the influence of socio-demographic factors and SMC knowledge on usability and data quality.

Results: The study found that 58.1% of CHWs had high knowledge of SMC, while 41.9% had low knowledge, and although the SiCApp's accuracy and completeness were high, 52% of users deemed its usability unacceptable. CHWs from Nadowli (AOR = 0.262, 95% CI: 0.0956–0.718, p = 0.009), Nandom (AOR = 0.135, 95% CI: 0.0395–0.461, p = 0.001), and Wa West (AOR = 0.266, 95% CI: 0.1307–0.543, p < 0.001) were more knowledgeable about SMC than those in Lawra. Additionally, those with 11 years of experience were more knowledgeable than those without experience (AOR = 0.243, 95% CI: 0.0931–0.633, p = 0.004).

Conclusion: The study highlighted the need for specialised training for less experienced CHWs, improvements to SiCApp's user interface, and better resource allocation to underperforming regional districts to enhance malaria interventions and ensure the effectiveness and sustainability of digital health tools in public health.

TABLE OF CONTENTS

Tables

LIST OF FIGURES

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Malaria remains a critical global health challenge, with Sub-Saharan Africa bearing the brunt of its impact. In 2010, malaria caused an estimated 216 million clinical cases and 655,000 deaths worldwide, with 91% of these fatalities occurring in Sub-Saharan Africa (WHO, 2013; Mitchell et al., 2021; Heroza et al., 2022). Malaria remains a significant public health threat, particularly in sub-Saharan Africa, which accounted for 95% of cases and 96% of deaths in 2020 (Oladipo et al., 2022). Challenges persist despite progress in reducing mortality rates by 57% between 2000 and 2015 (Gething et al., 2016). Children under five years old are particularly vulnerable, accounting for 86% of all malaria deaths in 2010 (WHO, 2013). Despite ongoing efforts to control malaria, early diagnosis and treatment remain challenging, especially in remote areas where healthcare infrastructure is lacking (Wangeci, 2021). To address these challenges, Seasonal Malaria Chemoprevention (SMC) was introduced in 2012 as a preventive measure during periods of intense malaria transmission in the Sahel region. SMC has significantly reduced malaria mortality among children, but its implementation has been hindered by issues in documentation and logistics, complicating the timely delivery of preventive treatment (Baba et al., 2020; Coldiron et al., 2017).

To improve the implementation of SMC, digital tools like mobile applications have been proposed to enhance case identification, streamline dosage administration, and improve documentation processes, especially in remote regions (Balla et al., 2022; Coldiron et al., 2017). In Ghana, the National Malaria Elimination Program (NMEP) developed the Seasonal Malaria Chemoprevention in Children Application (SiCApp) to address these challenges. SiCApp is an Android-based mobile application that facilitates comprehensive control over

registration and dosing processes for SMC interventions. Its offline functionality is particularly crucial in addressing connectivity issues in remote areas, allowing healthcare providers to manage SMC interventions more efficiently and ultimately improving malaria control efforts in Ghana (NMESP, 2024).

The SiCApp's usability and effectiveness will be assessed using the System Usability Scale (SUS), a standardized tool for evaluating digital platforms (Balla et al., 2022). The success of such tools depends not only on their ease of use but also on the quality of the data they generate, including timeliness, completeness, and accuracy (Balla et al., 2022). Accurate documentation and timely intervention are crucial for effective malaria prevention, and SiCApp aims to enhance these aspects, ultimately improving malaria control efforts in resource-limited settings (Brooke, 1996; Balla et al., 2022). Therefore, the study will examine SiCApp using the SUS to assess its effectiveness in addressing manual data capture challenges and improving data quality for SMC campaigns, aiming to optimize the app for sustainability in Ghana's Upper West Region.

1.2 Problem Statement

Since its introduction in 2019, Ghana's Seasonal Malaria Chemoprevention in Children Application (SiCApp) was designed to resolve long-standing issues in manual data collection for the National Malaria Elimination Program (NMEP), such as inefficient data entry, poor logistics management, and frequent data losses. These problems, particularly pronounced in vulnerable regions like the Upper West, hampered the program's ability to deliver timely and accurate malaria data. Despite SiCApp's implementation, its actual effectiveness in improving data quality, logistics, and reporting efficiency remains unassessed, creating a critical gap in understanding its impact on malaria control efforts (NMEP, 2018; Coldiron et al., 2017).

Given the rapid pace of technological advancements in global health, ensuring that SiCApp aligns with best practices in malaria control is essential. However, the absence of a formal usability and performance assessment limits the ability of stakeholders to refine and sustain the tool for long-term success. This study aims to address that gap by examining Community Health Workers' (CHWs) knowledge of SMC, calculating the System Usability Scale (SUS) index for SiCApp, and exploring how socio-demographic factors, facility conditions, and SMC knowledge influence its usability. Additionally, it assesses the quality of data generated by the app and its effectiveness in addressing logistical issues previously associated with manual data collection (Balla et al., 2022; Mitchell et al., 2021).

The Upper West Region, as the first in Ghana to implement SMC, was selected as the research site due to its experienced CHWs and its exclusive reliance on SMC and minimal malaria interventions, apart from Indoor Residual Spraying (IRS). This focused approach makes it an ideal region for examining the SiCApp's performance. Despite five years of SiCApp's use by the NMEP, there has yet to be an assessment of its ability to resolve the data collection problems it was developed to address. This research seeks to fill that gap, contributing to the broader goal of malaria elimination in Ghana.

1.3 Rationale of the Study

This study aims to assess knowledge on seasonal malaria chemoprevention; SiCApp usability and data quality amongst community health workers in the Upper West Region of Ghana. The focus is on determining whether SiCApp effectively addresses issues from the previous manual data systems, such as inefficiencies and data management challenges. By assessing its impact on data entry, compilation, and logistics, the study seeks to enhance SiCApp and inform future malaria interventions and electronic data capture strategies. It will also explore user satisfaction, ease of use, and performance in areas with limited internet connectivity, ensuring the app's adaptability and sustainability for future public health needs.

1.4 Conceptual Framework

The conceptual framework emphasises the relationship between Community Health Workers (CHWs) socio-demographic factors, their knowledge of Seasonal Malaria Chemoprevention (SMC), the usability of the SiCApp system, and the resulting quality of data collected. It posits that socio-demographic factors like age, gender, and experience, alongside CHWs' SMC knowledge level (categorised as high or low), significantly influence both the usability of the SiCApp and the quality of the data generated. Usability is evaluated in terms of the app's efficiency, effectiveness, and user satisfaction, while the completeness, accuracy, and timeliness of the information collected measures data quality. The framework suggests a direct correlation between CHWs' knowledge level and their ability to use the SiCApp effectively, affecting the data quality. This updated model highlights the interconnectedness of these factors, offering a more comprehensive approach for analysing the relationship between CHW knowledge levels and SiCApp usability, with the ultimate goal of improving SMC program outcomes through more reliable data collection.

CONCEPTUAL FRAMEWORK

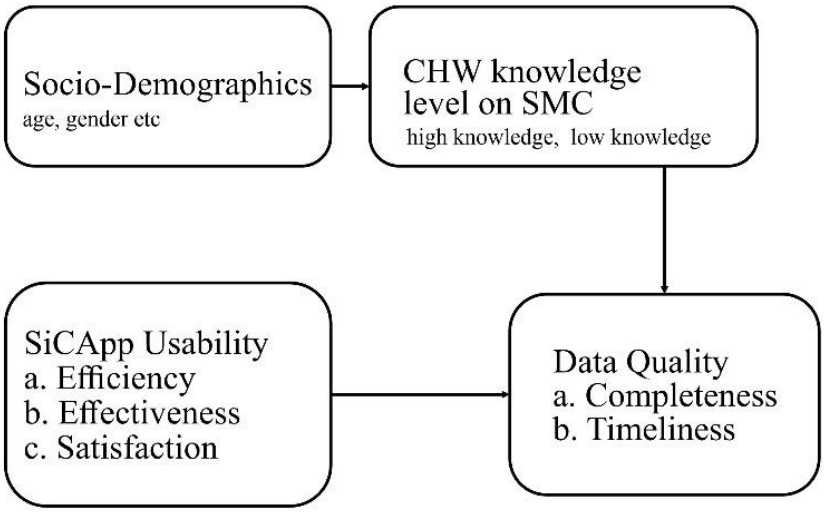


Figure 1:1 A self-constructed conceptual framework

1.5 Research Questions

1. What is the level of knowledge of CHW in SMC?
2. What is the system usability scale index for SiCApp?
3. What is the quality of data produced from the SiCApp?
4. What is the extent to which socio-demographic variables predict CHW's level of SMC knowledge?

1.6 General Objective

To assess knowledge on seasonal malaria chemoprevention, SiCApp usability, and data quality amongst community health workers in the Upper West Region of Ghana.

1.7 Specific Objectives

1. To examine Community Health Workers (CHW) knowledge on SMC.
2. To calculate the System Usability scale index for SiCapp.
3. To assess the quality of data generated from the SiCApp Tool.
4. To determine the socio-demographic factors associated with CHW Knowledge on SMC.

1.8 Profile of Study Area

The study was conducted in the Upper West Region of Ghana, which has been actively involved in the Seasonal Malaria Chemoprevention campaign since 2015. This region, the youngest and smallest in Ghana until 2017, comprises eleven administrative districts and has a projected 2024 population of about 965,147. Managed by eleven District Health Management Teams and supervised by the Regional Health Management Team, the region's health infrastructure includes 442 facilities, with three districts lacking a district or private hospital. The Regional Health Management Team oversees health planning and implementation, serving a diverse population across numerous health centres and sub-districts.

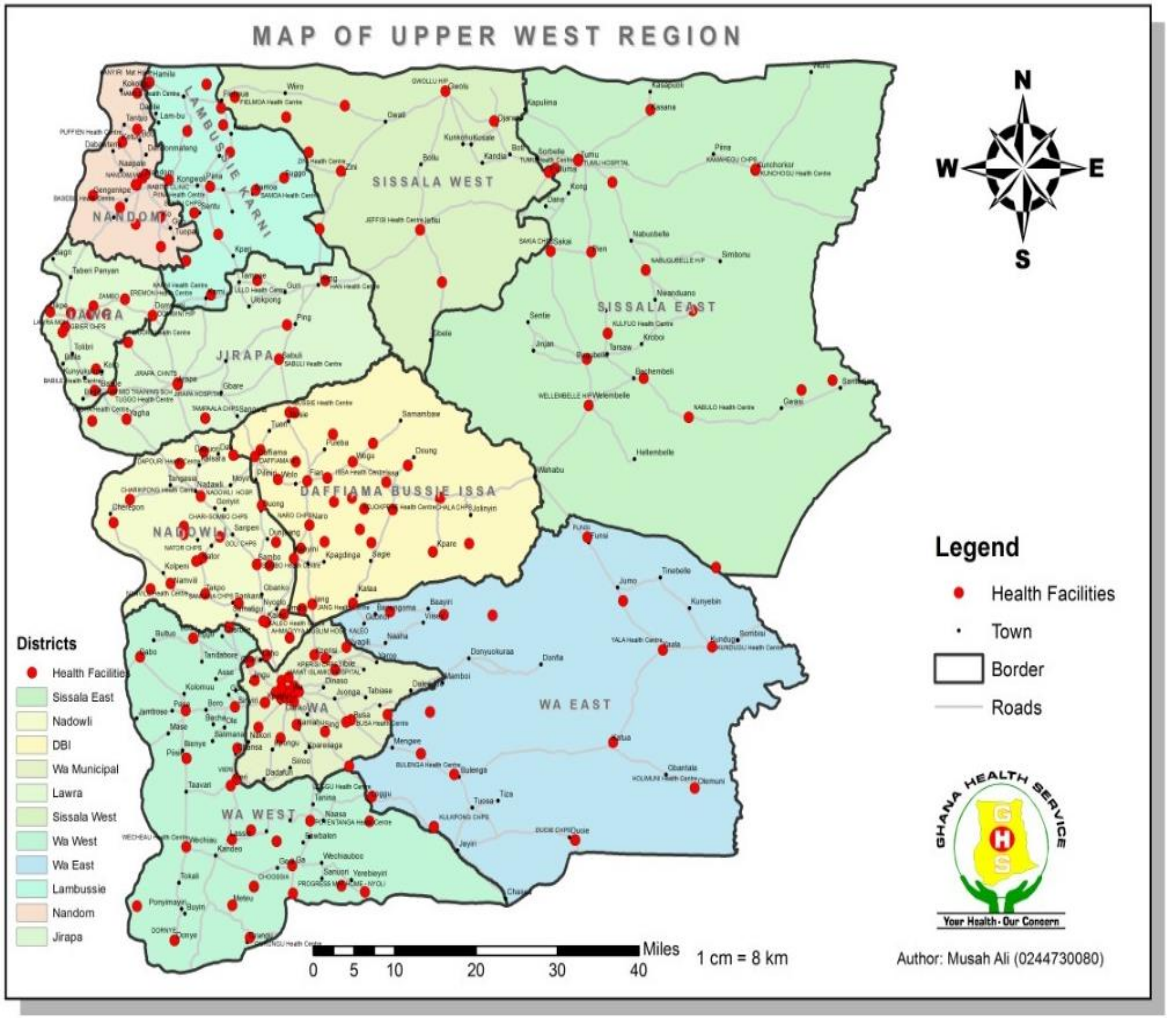


Figure 2: A profile of the Upper West region of Ghana

Source: https://lgs.gov.gh/upper-west/

1.9 Scope of Study

This study is delimited by its focus on community health workers (CHWs) in the Upper West Region of Ghana, which may affect the generalizability of the findings to other regions with varying socio-economic and infrastructural conditions. Additionally, it determines the usability of the Seasonal Malaria Chemoprevention in Children Application (SiCApp) without considering other factors that might influence malaria intervention outcomes, such as broader health system constraints or community engagement. Therefore, the study may not fully address malaria control's diverse challenges and effectiveness across different settings.

1.10 Organization of Report

Chapter one covers the study's background. Chapter two provides a review of relevant literature. Chapter three details the study's methodology. Chapter four presents the study's results. Chapter five discusses the findings and their implications. Chapter six summarises the conclusions and offers recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This study aims to assess knowledge of seasonal malaria chemoprevention, SiCApp usability, and data quality among community health workers in the Upper West Region of Ghana. This chapter encompasses a literature review on the following topical areas: Search for relevant information took place in four main databases (PubMed, Scopus, JSTOR and Web of Science). Additional hand searches took place in the WHO library, institutional documents (Ghana Health Service) and Google Scholar.

2.2.1 Seasonal Malaria Chemoprevention (SMC)

Seasonal Malaria Chemoprevention (SMC) was recommended by the World Health Organization (WHO) in 2012 as a preventive intervention for children aged 3-59 months in areas with highly seasonal malaria transmission, particularly in the Sahel region of Africa (Coldiron et al., 2017). SMC involves administering monthly courses of antimalarial drugs during the peak malaria transmission season, typically lasting 3-4 months. The standard regimen consists of sulfadoxine-pyrimethamine (SP) and amodiaquine (AQ), with SP given as a single dose on the first day, followed by three daily doses of AQ (Coldiron et al., 2017). The primary objective of SMC is to clear existing parasites and provide prophylactic protection against new infections, significantly reducing the incidence of clinical malaria in young children during the high-risk period (Coldiron et al., 2017).

The Sahel region, encompassing countries such as Mali, Burkina Faso, Niger, and parts of Nigeria, has been a key focus for SMC implementation due to its highly seasonal malaria transmission pattern. The concentrated transmission during the short rainy season, lasting 3-4 months, makes SMC particularly effective in this area (Ming et al., 2023). A meta-analysis demonstrated a 75% reduction in clinical malaria cases compared to placebo (Coldiron et al.,

2017), and observational studies in program settings have shown promising outcomes. For example, in Mali, parasitaemia prevalence at the end of the high transmission season was lower in SMC-receiving areas (18%) compared to non-SMC areas (46%) (Coldiron et al., 2017). By 2016, over 12 million children were receiving SMC, reflecting its perceived value in addressing the high burden of malaria in the region (Coldiron et al., 2017).

2.2.2 Mobile Health Applications

Mobile health applications (mHealth apps) have revolutionised healthcare since their emergence in the early 2000s, spurred by advancements in mobile technology and widespread smartphone adoption. Initially rooted in eHealth with SMS-based interventions like the SMS for Life program, which improved malaria treatment management in sub-Saharan Africa, mHealth expanded significantly with the advent of smartphones around 2007. This development allowed for real-time health monitoring and patient management, with platforms like Apple's HealthKit and Google's Fit further enhancing personalized healthcare by integrating health data across devices (Istepanian & Woodward, 2004; Mechael, 2009; Barrington et al., 2010; Boulos et al., 2014; Free et al., 2013; Lazarus, 2015).

Beyond data management, mHealth applications improve patient engagement and communication between healthcare workers. They enable health providers to maintain constant contact with patients, send reminders for medication adherence, and monitor patients' health status remotely, contributing to better health outcomes. Research on mHealth in various public health domains has shown that such applications significantly increase patient adherence to prescribed regimens, reduce follow-up losses, and provide patients with educational materials to support their health decisions (Aranda-Jan et al., 2014; Free et al., 2013). In the context of malaria prevention, mobile tools ensure that community health workers (CHWs) are better equipped to follow treatment protocols and manage drug supplies, contributing to more reliable delivery of preventive measures like SMC (Coldiron et al., 2017). However, the success of

mHealth applications depends on their usability and adoption by CHWs, emphasizing the need for continuous evaluation using frameworks like the System Usability Scale (SUS) to optimize their design and functionality (Brooke, 1996).

The impact of mHealth apps on public health has been profound, particularly in disease management and outbreak control. They have been crucial during crises like the COVID-19 pandemic for contact tracing and health monitoring, as well as in managing chronic diseases such as diabetes and hypertension, where they have improved health outcomes like glycemic control and blood pressure management (Sarasohn-Kahn, 2012; Logan et al., 2012; Firth et al., 2017). Moreover, mHealth apps have significantly enhanced access to healthcare services in remote and underserved areas, reducing healthcare costs, supporting health education, and improving data collection for public health monitoring, thereby promoting health equity and extending the reach of healthcare professionals through telemedicine (Anderson et al., 2020; Kruse et al., 2017; Dullet et al., 2017; Mackay, 2014; Smith, 2018; Talhouk et al., 2020).

Studies on mHealth tools in malaria-endemic regions have shown that digital applications help mitigate the common pitfalls of manual data collection, such as data loss, entry errors, and delays in reporting, which are critical in interventions like SMC (Tomlinson et al., 2013; Steinhardt et al., 2022). Applications like SiCApp, designed for offline use, are particularly beneficial in rural areas with limited internet access, ensuring that data capture and case management continue uninterrupted (NMESP, 2024). The role of mHealth tools extends beyond data capture; they also facilitate communication between healthcare workers and supervisors, enhance logistics management, and improve adherence to treatment guidelines (Mitchell et al., 2021; Coldiron et al., 2017). For instance, mobile applications have been instrumental in tracking patient adherence to antimalarial treatment protocols, ensuring timely follow-ups, and reducing gaps in treatment (Wangeci, 2021).

Finally, the integration of mHealth applications into national health systems depends on their ability to generate high-quality data that can inform public health policy. The quality of data collected through these systems—measured by completeness, accuracy, and timeliness—is crucial for evaluating the success of interventions like SMC and making evidence-based adjustments to malaria control strategies (Steinhardt et al., 2022; Wangeci, 2021). SiCApp's role in improving the timeliness and accuracy of reporting directly influences the effectiveness of the National Malaria Elimination Program, as it enables faster identification of treatment gaps, better resource allocation, and more informed decision-making. However, socio-demographic factors and varying levels of technological proficiency among CHWs may affect the app's usability, underscoring the need for continuous training and system improvements to optimize its impact (Mitchell et al., 2021; Balla et al., 2022). As mobile health technologies evolve, their role in improving global health outcomes, particularly in the context of malaria prevention, will likely expand, making them an indispensable part of future healthcare interventions.

2.2.3 Seasonal Malaria Chemoprevention in Children Application (SiCApp)

The Ghana National Malaria Control Programme (NMCP) introduced the SiCapp Android-based application in 2019 to enhance data quality, facilitate data collation, analysis, and accessibility, and reduce the workload on community health workers (HCWs) and distributors (Balla et al., 2022). SiCapp was deployed in all Seasonal Malaria Chemoprevention (SMC) implementation areas in Northern Ghana (Balla et al., 2022). This application was tailored to the NMCP's needs, as it was developed in-house by NMCP IT staff, allowing for easy modifications to address gaps identified during program implementation, thus avoiding delays associated with external developers (Balla et al., 2022).

The SiCApp Android-based application, introduced by Ghana's NMCP in 2019, supports household and child registration, dose compliance, and coverage monitoring during SMC

campaigns (Balla et al., 2022). It helps track doses, identify missed doses, and monitor volunteer performance (Ming et al., 2023; Coldiron et al., 2017). Despite higher initial costs, digitization is expected to be cost-effective long-term but challenges such as internet connectivity (Balla et al., 2022).

2.2.4 Usability and Functionality of the SMC SiCApp

The SMC (Seasonal Malaria Chemoprevention) application is designed to streamline malaria intervention efforts, offers several key functionalities and usability features tailored for community health workers (CHWs). The app includes a registration module that allows users to efficiently register households and children for SMC and Point Mass Distribution (PMD) with a single form as depicted in figure 3. It also provides the ability to update previously registered households and track children from past SMC campaigns as depicted in figure 4. The dashboard displays important statistics such as the number of registered households, children, used blisters, and wasted blisters, making it easy for volunteers to monitor their progress as shown in figure 5.

The app's interface includes features like a splash screen, login page, and a volunteer dashboard, which are designed to be intuitive and user-friendly. The registration process is straightforward, with clear steps for enrolling households and children as depicted in figure 6. The application also supports offline registration and dosing, allowing CHWs to continue their work even without internet access as shown in figure 7. Additionally, the app provides options to edit and synchronize data, ensuring that all information is accurately recorded and up-to-date as shown in figure 8.

Lastly, the app requires detailed input for each child during registration and dosing. Volunteers must ensure that all fields are accurately completed for a successful Day 1 registration and dosing process as depicted in figure 9.

Overall, the SMC application is designed to enhance the efficiency of malaria intervention programs by simplifying data collection, improving data accuracy, and making it easier for CHWs to manage their workload.

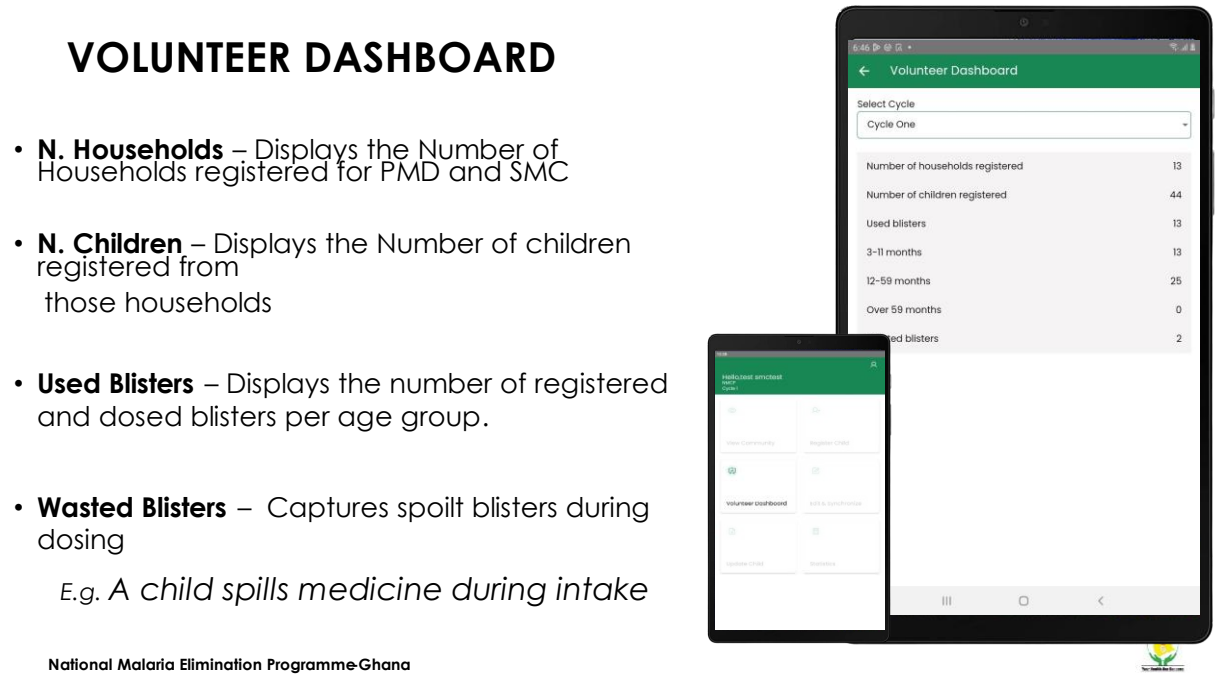


Figure 3: Signing-in a volunteer into the application

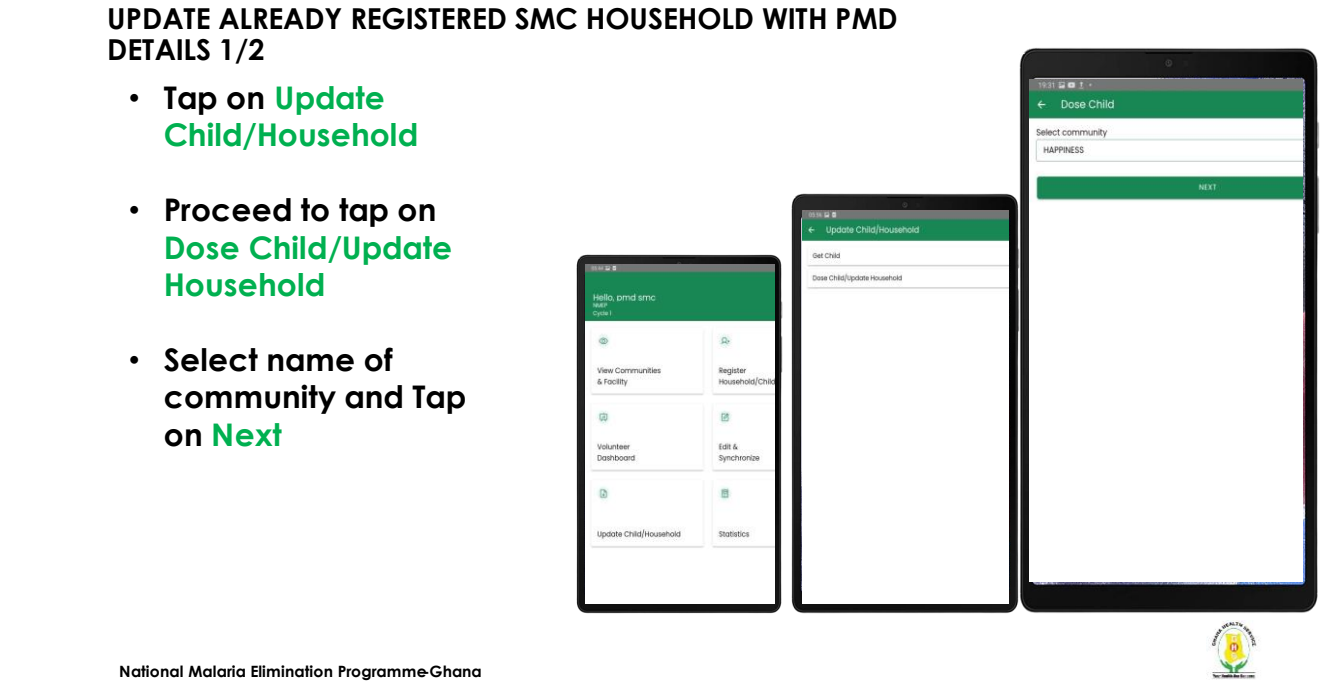
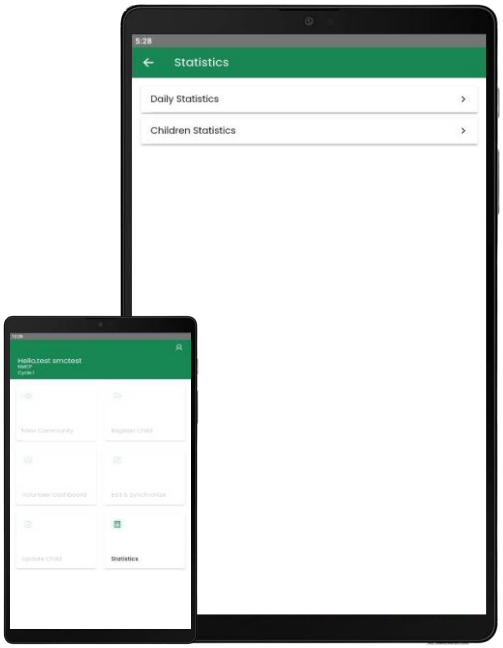


Figure 4: Showing display to update registration

STATISTICS

- Displays the following cards:
- **Daily Statistics:** Display the daily work done by a volunteer.
- **Children Statistics:** This interface gives a breakdown of the work done by a volunteer per cycle



National Malaria Elimination Programme-Ghana

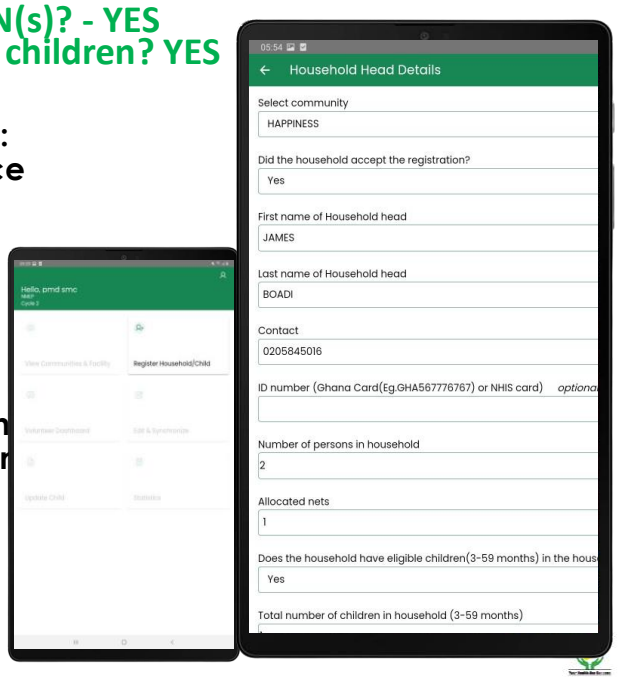
Figure 5: Showing display on statistics gathered by the application

PMD AND SMC – 1/4

Did the household accept the LLIN(s)? - YES
Does the household have eligible children? YES

If the household accepts the ITN registration and has eligible children:

- **Select Yes from the ITN acceptance dropdown**
- **Fill details of the beneficiary**
- **Select Yes from the eligible children available dropdown**
- **Fill details of number of children in household and number of children available**
- **Tap on Next to proceed to the success page**



National Malaria Elimination Programme-Ghana

Figure 6: Shows display for acceptance and eligibility of service.

OFFLINE REGISTRATION

This interface displays the name of Household Head , **Number of Registered Children and Number of households** who have been registered for the first time for PMD/SMC

Select Community to display volunteer work done.

- Tap on '**view more**' to:
  Edit details
  Register another Child

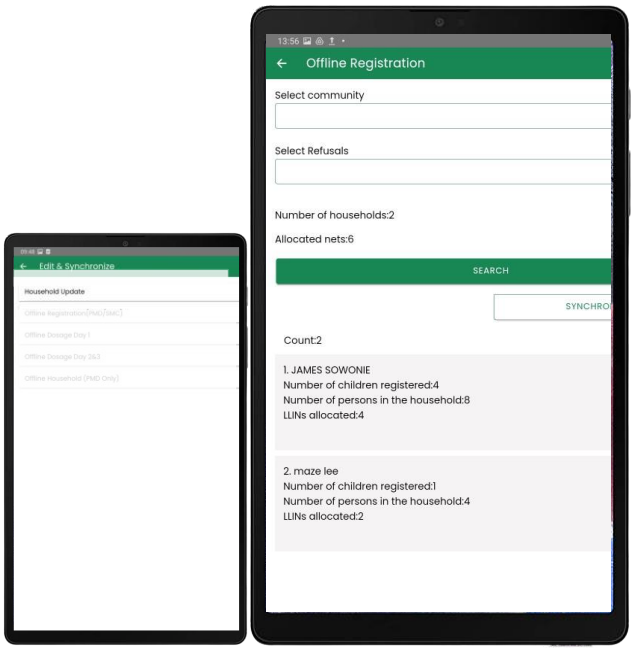


Figure 7: Showing the displaying for adding another child to the service.

EDIT & SYNCHRONIZE

- **Household Update:** Displays registration done offline.
- **Offline Registration(PMD/SMC):** Displays the total number of households partaking in both SMC and PMD and newly registered children in an existing household.
- **Offline Dosage Day 1:** Displays the total number of children dosed on Day 1 for cycles 2,3 and 4 already in the system

•**Offline Dosage Day 2&3:** Displays the total number of children dosed for days 2 and 3.

•**Offline Household(PMD Only):** Displays the total number of households participating in only PMD

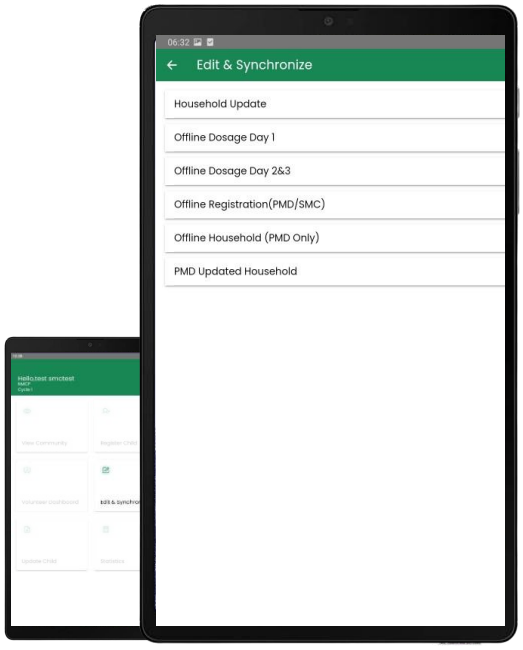
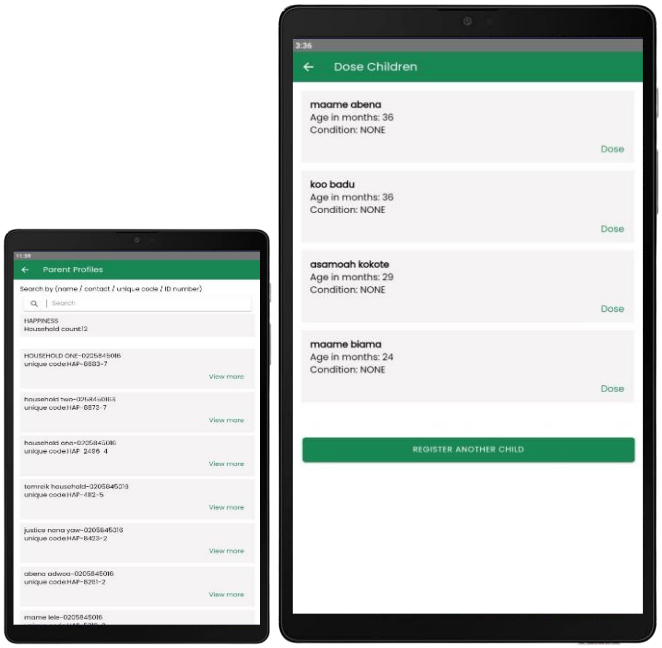


Figure 8: Showing the display for offline registration.

DOSE CHILD 2/3

- Tap on ***view more*** to display all children in the household
- Tap on ***dose*** to dose eligible children.
- Tab on ***Register Another Child*** to add a child to the same household.

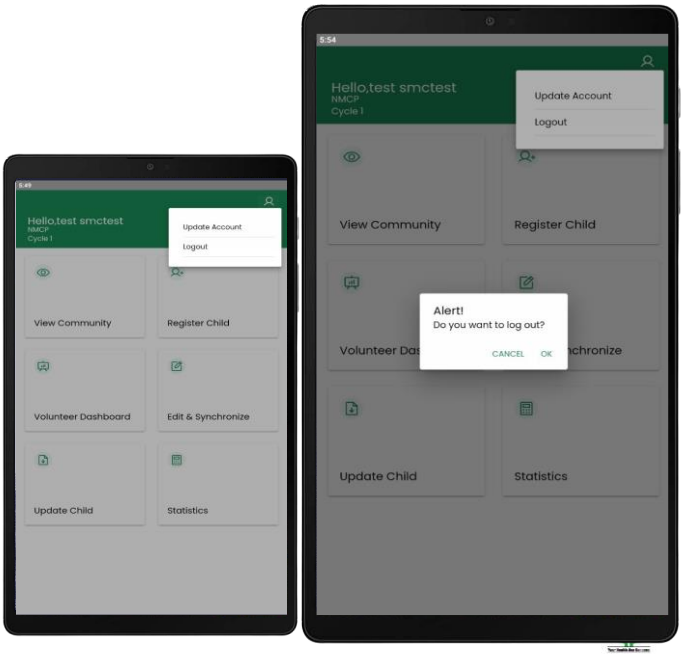


National Malaria Elimination Programme-Ghana

Figure 9: Showing the display for dosing.

LOG OUT
SIGN OUT

- Sign out of the system by tapping on the account icon.



National Malaria Elimination Programme-Ghana

Figure 10: showing the display for logging out after.

2.4.1 Community Health Workers ' Knowledge on SMC

Community Health Workers (CHWs) are vital in providing health services in rural and underserved areas, particularly in implementing Seasonal Malaria Chemoprevention (SMC). Their knowledge of SMC, including the correct timing, dosing, and management of side effects, is critical for successfully executing these interventions. This understanding not only helps in administering the medication effectively but also contributes to epidemiological surveillance, allowing for the monitoring of malaria outbreaks and resistance patterns, which in turn enables the adaptation of interventions as needed (Kalne et al., 2022; Mupara et al., 2023; Sondo et al., 2022; Gilmartin et al., 2021; WHO, 2022; Salangwa & Lusale, 2023; Caputo & Manica, 2020).

Despite the importance of CHWs' knowledge of SMC, limited literature directly addresses this topic. However, studies on caregiver adherence provide some insights into the potential knowledge levels of healthcare professionals involved in SMC. For example, Salangwa and Lusale (2023) found that 90.7% of caregivers were aware that SMC medications prevent malaria, suggesting that with proper training and oversight, adherence to SMC protocols could be significantly improved. This finding emphasises the need to enhance healthcare providers' knowledge and skills to improve rural health outcomes (Coe et al., 2022). Nonetheless, challenges in implementing mHealth tools for SMC programs include low literacy and technological skills among older CHWs, limited funding, and infrastructure issues (Kasiime et al., 2024).

2.4.2 Overview of System Usability Scale Index for mHealth applications and SiCApp

Assessing the System Usability Scale (SUS) index for the Seasonal Malaria Chemoprevention in Children Application (SiCApp) involves evaluating its user-friendliness, efficiency, and overall satisfaction from users' perspectives. The SUS, a widely recognized tool for measuring usability, provides a quick and reliable gauge of ease of use, efficiency, and user satisfaction,

making it applicable to mobile health applications despite not being specifically designed for them (Hyzy et al., 2022; Hajesmaeel-Gohari et al., 2022). It assesses ease of use by measuring how intuitive and straightforward the application is for health workers to navigate, with high scores indicating user-friendliness. Efficiency is determined based on how well the application supports routine tasks, such as administering treatments and reporting data, with high scores reflecting streamlined workflows and reduced time and effort (Hajesmaeel-Gohari et al., 2022; Muro-Culebras et al., 2021).

Overall, user satisfaction is a critical measure of usability, reflecting users' contentment with their experience and identifying any frustrations (Hyzy et al., 2021; Muro-Culebras et al., 2021). High satisfaction levels suggest that the app meets user expectations and provides a positive experience, while low satisfaction may reveal issues like technical glitches or a complicated interface (Muro-Culebras et al., 2021; Petros, 2023). The SUS index helps identify areas needing improvement, enabling ongoing application refinement to meet user needs better (Hyzy et al., 2021; Balla et al., 2021). Digital data collection tools like SiCApp offer advantages over paper-based systems in data quality and accessibility, and evaluating them with the SUS index ensures their effectiveness in supporting health workers' malaria prevention efforts (Balla et al., 2021).

2.4.3 Timeliness and Completeness

Data quality is crucial for the effectiveness of Seasonal Malaria Chemoprevention (SMC) programs, directly impacting the accuracy of interventions, resource allocation, and assessment of program impact (de Cola et al., 2024; Merle, 2023). Critical dimensions of data quality include completeness and timeliness—ensuring all necessary information is collected, correct, and available promptly. Completeness refers to the extent to which all the required information is collected and reported, ensuring no gaps that could lead to underestimation of coverage or misallocation of resources. Despite its importance, maintaining high data quality is challenging

due to issues like data disaggregation and socio-demographic influences (Nice et al., 2020; Doumbia, 2021). As a result, continuous improvement in data collection processes, health workers' skills, and technology use will be essential for enhancing data quality and thereby strengthening malaria prevention efforts.

Data timeliness and completeness are fundamental aspects of data quality that significantly influence the success of health interventions like Seasonal Malaria Chemoprevention (SMC) programs. Timeliness refers to the prompt availability of data, ensuring that it is accessible for decision-making and adjustments in ongoing interventions. Timely data is essential for the dynamic nature of SMC programs, where quick access to information allows health workers and policymakers to respond to real-time challenges, such as changes in malaria incidence or logistical constraints (Mare et al., 2022; Turner et al., 2021). Delays in data availability can hinder the implementation of corrective measures, resulting in missed opportunities for optimised resource allocation and potentially reducing the program's impact.

Data completeness ensures that all relevant data points are captured, providing a holistic view of program activities. Incomplete data can lead to underreporting of intervention coverage, making it difficult to assess the reach and efficacy of the SMC program (Wesolowski et al., 2020; de Cola et al., 2024). For instance, missing information on socio-demographic variables may skew the analysis of malaria risk factors, resulting in inefficient targeting of resources. In the context of SMC, where interventions must cover a large population over multiple rounds, incomplete data could lead to significant underestimation of at-risk groups, adversely affecting the effectiveness of the intervention (Ncube et al., 2023). Consequently, ensuring both timeliness and completeness in data collection is critical for optimising malaria prevention strategies and achieving broader public health goals.

2.4.4 Quality of Data Generated from SiCApp

The quality of data generated by the SiCApp is vital for effective malaria control, as it impacts decision-making, progress monitoring, and impact evaluation (Hyzy et al., 2022; Rajvanshi et al., 2021). Essential aspects of data quality include accuracy, completeness and timeliness. The World Health Organization (2021) underscores the necessity of reliable health information systems (HISs) for evidence-based policy development. However, many low-income and middle-income countries face challenges with paper-based data collection (PBDC) systems, which can compromise data quality and burden reporting, thus impeding health system effectiveness and the achievement of Sustainable Development Goals (Arhin et al., 2023; Tilahun et al., 2021).

Integrating mobile technology with CHWs significantly enhances data collection and decision-making for managing illnesses in children under five (Mahmood et al., 2020; Gopalakrishnan et al., 2022). Digital data collection (DDC) tools, such as those used in SMC campaigns across Africa, improve data quality and timeliness but depend on reliable internet connectivity and power infrastructure (Balla et al., 2022). The SiCApp, introduced in Ghana in 2019, demonstrates effective local customisation, offering functionalities for household enumeration, dose compliance tracking, and volunteer performance monitoring (Balla et al., 2022). Evaluations using the SUS Index indicate SiCApp's user-friendliness and effectiveness, though other applications like Red Rose also offer specific advantages. These findings highlight the need for tailored digital tools, infrastructure investment, and cost-effectiveness analyses to optimise DDC systems and achieve health-related SDGs (López et al., 2023; Rashidian et al., 2021). The quality of data produced by the SiCApp has not yet been determined and is therefore included as a specific objective in this research study.

2.4.5 Influence of Socio-demographic factors, knowledge of SMC and facility factors on SiCApp usability

Socio-demographic factors such as age, education level, and socio-economic status significantly impact the usability of mHealth applications like the Seasonal Malaria Chemoprevention Mobile Application (SiCApp). Older community health workers (CHWs) often face challenges with adopting mHealth technologies due to a steeper learning curve, which contrasts with the generally higher engagement of younger, tech-savvy CHWs (Kasiime et al., 2024; Greuel et al., 2023). Higher educational levels are linked to better utilisation of these applications, and socio-economic status affects access to resources and training, influencing performance (Wagaba et al., 2023; Baba et al., 2020).

The knowledge level of CHWs about Seasonal Malaria Chemoprevention (SMC) also impacts SiCApp's usability. CHWs well-versed in SMC protocols are more likely to effectively use the application's functionalities (Xu et al., 2023; Baker et al., 2022). Facility factors, such as reliable internet connectivity, adequate SMC medication supplies, and supportive administrative structures, are crucial for effective mHealth application use (Owoyemi et al., 2022; Westgard & Orrego-Ferreyros, 2022). Facilities lacking these resources can hinder SMC implementation, while supportive supervision and regular feedback from facility managers can enhance usability (Charanthimath et al., 2022; Kinshella et al., 2021). Addressing these factors through targeted training and infrastructure improvements can significantly improve the delivery of SMC services.

2.4.6 Predictors of Data Quality among CHWs

The quality of routine health information systems is critical for effective healthcare delivery, impacting diagnosis, treatment, and decision-making (Hoxha et al., 2022; Tasri & Tasri, 2020). In low-income countries, data quality issues are prevalent, with inaccuracies ranging from 34% to 72% and low data uptake for decision-making (Rendell et al., 2022; Lemma et al., 2020).

Key factors influencing data quality include inadequate training, suboptimal tools, and a challenging organizational environment. Despite investments in health information systems, many health professionals in developing countries need more skills for effective data management (Sheikh et al., 2021; Ngusie et al., 2021).

Studies highlight that inadequate training, lack of supportive supervision, low confidence, and ineffective feedback mechanisms contribute to poor data quality among health professionals (Wubante et al., 2023; Chekol et al., 2021). Addressing these issues requires improving training programs, feedback systems, and resource allocation. Supportive work environments, knowledge of data management, and favorable attitudes toward data practices are crucial for enhancing data quality (Ngusie et al., 2021; Solomon et al., 2021). Additionally, advanced technological tools such as electronic health records with error-checking features, along with supportive organizational cultures and standardized protocols, can significantly improve data accuracy and reliability (Zhang et al., 2023; Ababneh, 2021; Rumisha et al., 2020). Comprehensive improvements in these areas can lead to better data management practices and overall healthcare outcome.

3.0 CHAPTER THREE

METHODOLOGY

3.1 Study Method and Design

This study aimed to assess knowledge of seasonal malaria chemoprevention, SiCApp usability, and data quality among community health workers in the Upper West Region of Ghana. This approach allowed for data collection from community health workers, offering a comprehensive snapshot of user perceptions. The cross-sectional nature of the design had limitations, such as only capturing data at one point in time and not accounting for seasonal variations. Despite these, the study employed validated measures and robust statistical tools to generalise the findings across the region (Babbie, 2021).

3.2 Data collection techniques and tools

The study utilized a four-part questionnaire to collect data from CHWs in the Upper West Region of Ghana. The first part gathered sociodemographic information and details on training related to SMC. The second part assessed CHWs' knowledge of SMC, focusing on their understanding of protocols and key components. The third part employed the System Usability Scale (SUS) to determine the usability of the SiCApp mobile application, measuring aspects like complexity and user support needs. The final part assessed the quality of data generated by SiCApp during SMC cycle 1 based on the registrations conducted by community health workers.

To evaluate the quality of the SiCApp data for this research, a sample of 10 out of 15 registration and dosing datasets was selected from the data provided by 346 Community Health Workers (CHWs), resulting in the analysis of 346,000 data points. The quality was assessed across three dimensions: timeliness, completeness, and accuracy. The data was evaluated on a

scale of 1 to 10, with 10 representing the earliest and the latest data submission by CHWs and their supervisors. This scale measured the promptness of data submission for decision-making. The completeness of data was scored on a scale of 3, 7, and 10. A score of 10 was given when a CHW completed the required three visits to each child or household. Points were allocated as follows: 4 points for the first visit and dosing on day one, 3 points for the second visit on day two, and 3 points for the third visit on day three, totalling 10 points. Accuracy was guaranteed by the SiCApp system, which includes validation rules that prevent data errors, ensuring 100% data accuracy.

3.3 Study Population

Community health workers in the Upper West region of Ghana who participated in the 2024 SMC campaign constituted the target population due to their direct involvement in implementing the Seasonal Malaria Chemoprevention program using SiCApp. In total, about 1400 community healthcare workers were in the region.

3.4 Study Variables

The study variables included socio-demographic factors like age, education level, and socio-economic status, which influenced CHW's proficiency with digital tools and their knowledge of SMC. The level of SMC knowledge among CHWs and the usability of the SiCApp, measured by the System Usability Scale (SUS), were key variables. Binary logistic regression was used to analyse how these factors predicted SMC knowledge, SiCApp usability, and data quality.

3. 4.1 Inclusion Criteria

1. Community health workers with at least three (3) years of experience using SICAPP for Seasonal Malaria Chemoprevention campaign.

3.4.2 Exclusion Criteria

1. Community health workers without experience using SICAPP for Seasonal Malaria Chemoprevention campaign and with less than three years of experience using SiCApp.
2. Community health workers not involved in the Seasonal Malaria Chemoprevention campaign.

3.5 Sample Size and Sampling Technique

The sample size was calculated using the formula by Yamane (1967)

$$n = \frac{N}{1 + N(e)^2}$$

Where n denotes sample size, N is the Population Size and e is the Margin of error set at 5% or 0.05. The proportion of the population the children under five years is taken to be 1400 conventional of children under five.

$$n = \frac{1400}{1+1400(0.05)^2}$$

$$n = \frac{1400}{1+1400(0.0025)}$$

$$n = 311$$

To account for a 10% non-response rate, the study required a total of 342 community health workers (CHWs), with an additional 31 CHWs included to address potential non-responses, following Babbie's (2021) recommendation of adding up to 20% of the estimated sample for high non-response surveys.

The study utilised a stratified random sampling technique to achieve a representative sample of CHWs across the Upper West Region of Ghana, divided into three distinct zones: northern, central, and southern. This stratification was essential to ensure that the sample accurately reflected the diversity of experiences and perspectives of CHWs in different parts of the region.

Within each zone, the number of CHWs selected was proportionate to the population size of that zone, ensuring that larger zones contributed more participants to the study. In comparison, smaller zones were still adequately represented.

A randomisation process for selecting Community Health Workers (CHWs) within each zone after stratification was done using simple random sampling. In this method, a list of all eligible CHWs within each stratified zone was compiled. From this list, each CHW was assigned a unique identifier or number. A randomisation tool, a random number generator, was then used to select the required number of CHWs from each zone randomly. This ensured that every CHW in the population had an equal probability of being chosen, making the sample representative and reducing selection bias.

This stratification by zone, followed by random selection within each zone, enhanced the sample's representativeness. By capturing the varied experiences of CHWs from different geographic and demographic backgrounds, this approach bolstered the reliability and validity of the study findings, ensuring that they could be generalised to the broader population of CHWs in the Upper West Region. The total population of CHW from each district is represented in table 1.0.

Table 1.0 CHW population by District

District	Total Number of CHW	25% of Total
Lawra	208	52
Nadowli	120	30
Sissala East	28	7
Sissala West	160	40
Wa Municipal	360	90
Wa West	400	100
Total	**1,276**	**342**

3.6 Pretesting

A pretest of the questionnaire was conducted with twenty (20) CHWs in the Upper East Region to ensure clarity, user-friendliness, and comprehensibility. This process allowed for identifying and correcting any ambiguous questions, assessing the survey's completion time, and detecting technical issues. Feedback from the pretest was used to refine the questionnaire, improving its reliability and validity. Pretest results were excluded from the final analysis, ensuring that only data from the revised instrument were used for the study.

3.7 Data Handling

Data collected from community health workers with extensive experience using SiCApp in the Upper West Region was entered into Stata, a statistical tool, for the analysis. The data was cleaned by removing missing entries and duplicates, with every effort to guarantee participants' anonymity (Kadam, 2017). Confidentiality and security of the information provided by respondents were fundamental priorities. Access to respondent information was strictly limited to authorized research team members and designated supervising personnel. To further ensure anonymity and protect respondents' identities, no personally identifiable information was collected; instead, each respondent was assigned a unique identification number or code, allowing for anonymous responses while enabling accurate data analysis.

3.8 Data Analysis

The study examined multiple aspects of the SiCApp’s effectiveness and impact. The level of knowledge of CHWs regarding SMC was assessed by calculating frequencies and percentages of knowledge items, categorizing overall knowledge into "low" and "high," and presenting results in a bar graph. Thirteen items (13) were used to assess the knowledge of CHWs on SMC. CHWs who correctly answered at least 74% (approximately nine items) were categorised as having "low knowledge on SMC," while those who scored 75% or higher were categorised as having "high knowledge on SMC." SiCApp’s usability was examined using the

SUS, with responses analysed and presented graphically to measure user satisfaction and identify areas for improvement. Ten items were used to assess the usability of the SiCApp system, consisting of both positively and negatively worded statements. To calculate the usability score, one point was subtracted from the score of each positively worded item, while the score of each negatively worded item was subtracted from five. The adjusted scores were summed (ranging from 0 to 40) and then multiplied by 2.5 to produce a SUS ranging from 0 to 100. The average SUS score was 50.52, which served as the threshold for categorising usability as acceptable or unacceptable. To evaluate the quality of the SiCApp data for this research, a sample of 10 out of 15 registration and dosing datasets was selected from the data provided by 346 Community Health Workers (CHWs), resulting in the analysis of 3,460 data points. The quality was assessed across three dimensions: timeliness, completeness, and accuracy. The data was evaluated on a scale of 1 to 10, with 10 representing the earliest and the latest data submission by CHWs and their supervisors. This scale measured the promptness of data submission for decision-making. A score of 10 was given when a CHW completed the required three visits to each child or household. Points were allocated as follows: 4 points for the first visit and dosing on day one, 3 points for the second visit on day two, and 3 points for the third visit on day three, totalling 10 points.

The study also used binary logistic regression to explore the predictive power of socio-demographic variables and SMC knowledge on CHWs' SMC knowledge and SiCApp usability. Additionally, the influence of these factors on data quality was examined through binary logistic regression, aiming to identify key predictors of data quality and guide improvements in data management practices.

3. 9 Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board of Ensign Global College and the Ghana Health Service, Upper West Region (ID: SN-264/01). Participants, primarily CHWs, were fully informed about the study's objectives, procedures, risks, and benefits, and informed consent was secured to ensure voluntary participation. Confidentiality and anonymity were maintained, with data reported in aggregate to protect identities. The research adhered to principles of beneficence and non-maleficence, prioritizing participants' well-being and minimising risks throughout the study.

3.10 Limitations of Study

The study's limitations include its cross-sectional design, which may not capture seasonal variations or long-term changes in SiCApp usability. Self-reported data from community health workers may introduce bias. The exclusion of less experienced CHWs and those not involved in the SMC campaign might affect the generalizability of the findings. Additionally, some ambiguities and potential risks of confidentiality breaches may remain despite pretesting the questionnaire and implementing strong data security measures.

3.11 Assumptions of Study

The study assumed that CHWs in the Upper West Region of Ghana had varying levels of experience and proficiency with the SiCApp, influenced by their socio-demographic factors. It was presumed that the SUS effectively measured user satisfaction and usability, highlighting the application's strengths and areas for improvement. The study also assumed that the data from SiCApp represented the overall quality of data in malaria prevention efforts and that the findings would provide insights for optimizing SiCApp and enhancing malaria intervention strategies in resource-limited settings.

4.0 CHAPTER FOUR

RESULTS

4.1 Introduction

The results of this study provide an analysis of the socio-demographic characteristics of Community Health Workers (CHWs) in the Upper West Region of Ghana, the quality of data input into the SiCApp system, and the socio-demographic predictors of CHWs' knowledge of Seasonal Malaria Chemoprevention (SMC). The study sample consisted of 346 CHWs, with a majority being male, under 30 years of age, and married. The educational background varied, with most participants having secondary education. The findings also explored the relationship between CHWs' socio-demographic factors and their level of SMC knowledge, utilising binary logistic regression to identify significant predictors. Additionally, the study assessed the data quality generated by CHWs through the SiCApp system, focusing on the timeliness, accuracy, and completeness of data inputs. The subsequent sections present detailed findings, highlighting key patterns and associations relevant to implementing SMC and the functionality of digital tools in public health.

4.2 Socio-demographic characteristics of participants

The socio-demographic characteristics of the participants revealed that the majority were male, with 222 individuals (64.2%), while 124 (35.8%) were female. In terms of age, 165 participants (47.7%) were 30 years old or younger, 119 (34.4%) were between 31 and 40 years old, and 62 (17.9%) were 41 years old or older. Regarding marital status, the majority were married, comprising 226 individuals (65.3%), followed by 112 (32.4%) who were single, 6 (1.7%) who were widowed, and 2 (0.6%) who were divorced. Educational levels varied, with most participants having secondary education 208 (60.1%), followed by tertiary education 96 (27.7%), primary education 34 (9.8%), and no education 8 (2.3%). In terms of work experience

as Community Health Workers (CHWs), 226 participants (65.3%) had five years or less of experience, 84 (24.3%) had 6 to 10 years of experience, and 36 (10.4%) had 11 years or more. Finally, regarding the frequency of training received, 50 participants (44.8%) had received training once, 54 (15.7%) had received training twice, 86 (25%) had received training three times, and 54 (15.7%) had received training four or more times. See Table 4.1 for details.

Table 1: Socio-demographic characteristics of community health workers (N=346)

Variable	Categories	Frequency (N)	Percentage (%)		
Sex	Female	124	35.8%		
	Male	222	64.2%		
Age (years)	30 years	165	47.7%	33.3	9.18
	31-40 years	119	34.4%		
	41 years	62	17.9%		
Marital status	Divorced	2	0.6%		
	Married	226	65.3%		
	Single	112	32.4%		
	Widowed	6	1.7%		
Level of education	No education	8	2.3%		
	Primary education	34	9.8%		
	Secondary education	208	60.1%		
	Tertiary	96	27.7%		
Working experiences as a CHW (Years)	5years	226	65.3%	5.97	2.36
	6-10 years	84	24.3%		

Variable	Categories	Frequency (N)	Percentage (%)
	11 years	36	10.4%
Frequency of training received	Once	50	44.8%
	Twice	54	15.7%
	Thrice	86	25%
	Four times	54	15.7%
Place of residence	Lawra	52	15%
	Nadowli	30	8.7%
	Nandom	25	7.2%
	Sissala East	7	2%
	Sissala West	40	11.6%
	Wa Municpal	90	26%
	Wa West	102	29.5%

4.3 Level of community healthcare providers' knowledge on SMC

The results indicated that 145 (41.9%) of CHWs possessed low knowledge of SMC, while the majority 201 (58.1%) CHWs had high knowledge of SMC. See Figure 11 for details.

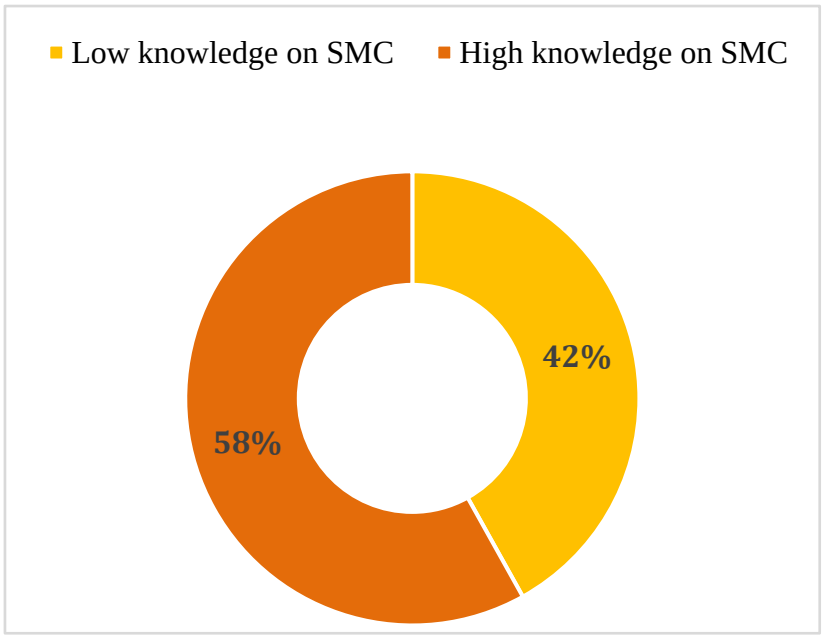


Figure 11: Level of community healthcare providers' knowledge on SMC

4.4 SiCApp System Usability Index

The results showed that 48% (166 users) found the SiCApp system acceptable, while 52% (180 users) considered it unacceptable, indicating a slight majority of users found the system unsatisfactory.

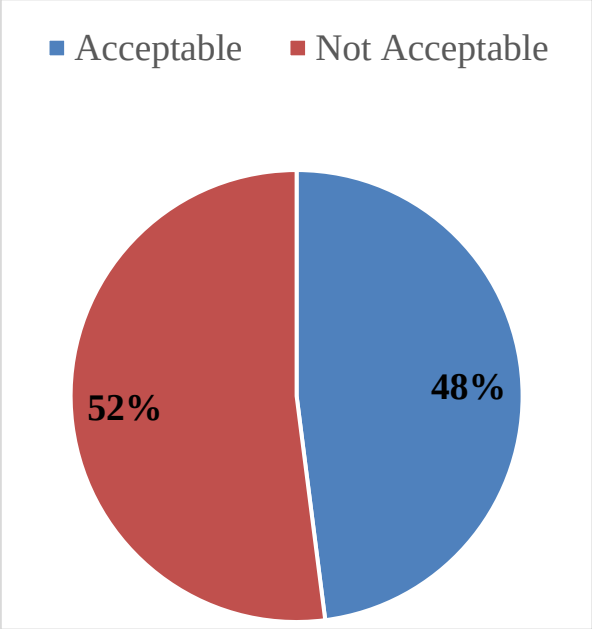


Figure 12: SiCApp usability acceptance

4.5 SiCApp data quality

The data quality analysis from the SiCApp users highlights key findings: all 346 users (100%) were rated low regarding the timeliness, signaling a significant challenge in this area. Regarding data completeness, 57 users (16.5%) were rated low due to failure to complete three visits to clients. In contrast, the majority, 289 users (83.5%), completed their visits to clients and entered data associated with their visits.

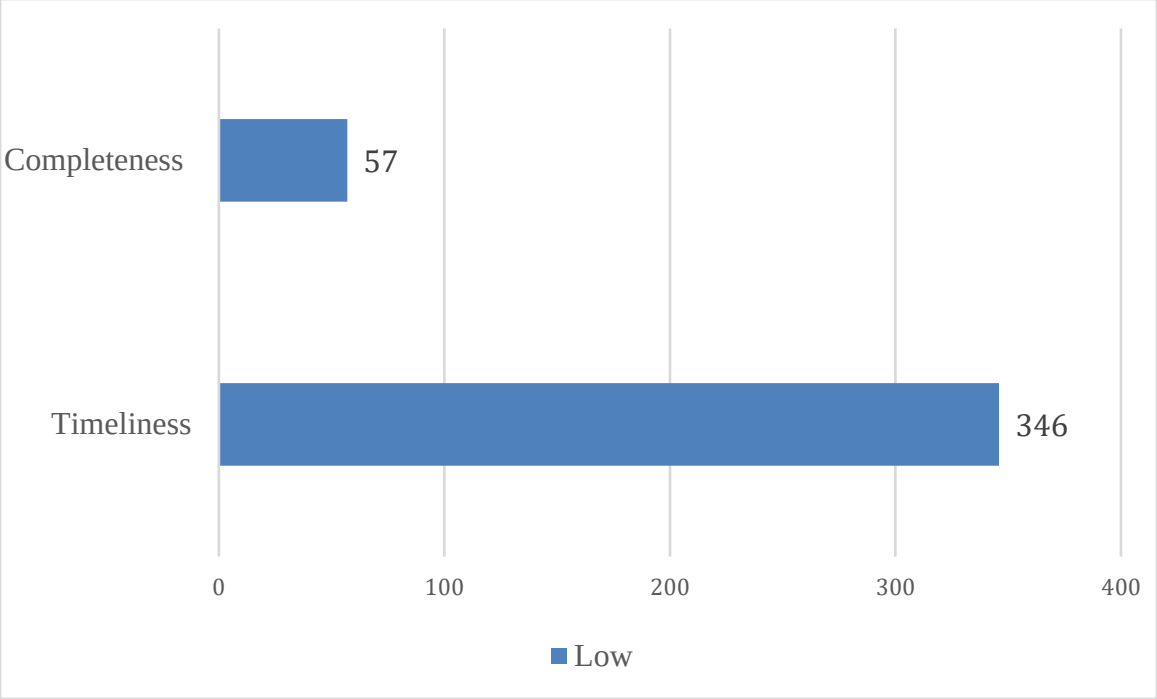


Figure 13: Distribution of data quality by sampled SiCApp users.

4.6 Socio-demographic predictors of CHW's level of SMC knowledge

Binary logistic regression was done to understand the socio-demographic predictors of CHW's SMC knowledge level. The dependent variable (SMC knowledge level) was dichotomised. First, a bivariate association (chi-square) was conducted to determine the socio-demographic variables associated with CHW'S SMC knowledge level. The statistically significant variables at the bivariate phase were then entered into the multivariate (binary logistic regression) model. The bivariate analysis between socio-demographic factors and SMC knowledge level shows that the district ($X^2 = 32.1$, $p = 0.001$) and working experience as a CHW ($X^2 = 10.6$, $p = 0.005$) were significantly associated with SMC knowledge level. Other factors like sex, age, marital status, and education level did not show significant associations ($p > 0.05$).

Table 2: Bivariate association between socio-demographic factors and SMC knowledge level

Variable	Categories	Knowledge level of SMC		X^2	p-value (0.05)
		High	Low		
District	Lawra	21(61.1%)	31(9%)	32.1	0.001
	Nadowli	22(6.4%)	8(2.3%)		
	Nandom	21(6.1%)	4(1.2%)		
	Sissala East	4(1.2%)	3(0.9%)		
	Sissala West	13(3.8%)	27(7.8%)		
	Wa Municipal	50(14.5%)	40(11.6%)		
	Wa West	70(20.2%)	32(9.2%)		
Sex	Female	78(22.5%)	46(13.3%)	1.84	0.175
	Male	123(35.5%)	99(28.6%)		
Age	30 years	86(24.9%)	79(22.8%)	4.66	0.097
	31-40 years	75(21.7%)	44(12.7%)		
	41 years	40(11.6%)	22(6.4%)		
Marital status	Divorced	1(0.3%)	1(0.3%)	3	0.510
	Married	136(39.3%)	90(26%)		
	Single	62(17.9%)	50(14.5%)		
	Widowed	2(0.6%)	4(1.2%)		
Education level	No education	4(1.2%)	4(1.2%)	1.53	0.676
	Primary	22(6.4%)	12(3.5%)		
	Secondary	123(35.5%)	85(24.6%)		
	Tertiary	52(15%)	44(12.7%)		
W. Experiences	5 years	126(36.4%)	100(28.9%)	10.6	0.005
	6-10 years	45(13%)	39(11.3%)		
	11 years	30(8.7%)	6(1.7%)		

Table 3: Multivariate logistic regression of socio-demographic predictors of CHWs knowledge level of SMC

						95% Confidence Interval	
Predictor	Estimate	SE	Z	p-value	AOR	Lower	Upper
District:							
Lawra	Ref	Ref	Ref	Ref	Ref	Ref	ref
Nadowli	-1.339	0.514	-2.603	0.009	0.262	0.0956	0.718
Nandom	-2.004	0.627	-3.197	0.001	0.135	0.0395	0.461
Sissala East	-0.754	0.861	-0.876	0.381	0.470	0.0869	2.544
Sissala West	0.240	0.450	0.532	0.595	1.271	0.5256	3.073
Wa Municipal	-0.630	0.364	-1.732	0.083	0.533	0.2612	1.086
Wa West	-1.323	0.363	-3.640	< .001	0.266	0.1307	0.543
Working experience (Years)							
years	Ref	Ref	Ref	Ref	Ref	Ref	ref
6-10 years	0.107	0.280	0.383	0.701	1.113	0.6431	1.928
11 years	-1.415	0.489	-2.894	0.004	0.243	0.0931	0.633
AOR_Adjusted Odds ratio							

Table 3 presents the multivariate logistic regression. The model explains 16.1% of the variance in the outcome (Nagelkerke's $R^2 = 0.161$) and is statistically significant with an adjusted odd ratio (AOR) value of 44.2 and a p-value less than 0.001. This indicates that the predictors in the model significantly improve the fit compared to a null model, although a substantial portion of the variance remains unexplained. The multivariate logistic regression analysis shows that CHWs from Nadowli (AOR = 0.262, 95% CI: 0.0956–0.718, p = 0.009), Nandom (AOR = 0.135, 95% CI: 0.0395–0.461, p = 0.001), and Wa West (AOR = 0.266, 95% CI: 0.1307–0.543, p < 0.001) were significantly less likely to report low levels of knowledge on SMC compared to those from Lawra. CHWs with 11 or more years of experience were also less likely to report low knowledge levels (AOR = 0.243, 95% CI: 0.0931–0.633, p = 0.004). No significant associations were found for CHWs from Sissala East, Sissala West, Wa Municipal, or those with 6-10 years of experience. This suggested that CHWs in Nadowli, Nandom and Wa West areas or with more experience tend to be better informed about SMC.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

This study aims to assess CHWs' knowledge on SMC, the system usability scale (SUS) index of the SiCApp, and the quality of data generated by the application. The study also investigates how socio-demographic factors influence knowledge of SMC and the SUS index. Through a cross-sectional survey design, the research provides insights into the effectiveness of SiCApp in improving SMC implementation. It identifies areas for enhancement to support malaria control efforts in the region better. This chapter summarizes the findings, discusses their implications, and interprets the results.

5.2 CHW'S knowledge on SMC

The finding indicates that a significant portion of CHWs need more knowledge of SMC, which could hinder the effectiveness of malaria prevention efforts. Nearly half of the surveyed CHWs have a low level of SMC knowledge. This finding aligns with existing literature that emphasises the importance of continuous training and education for CHWs to ensure the effective implementation of SMC programs, as gaps in knowledge can significantly undermine malaria control efforts (Gilmartin et al., 2021; Salangwa & Lusale, 2023). To buttress this, a systematic review by Chipukuma et al. (2018) indicated the critical role of training CHWs before implementing malaria interventions. The review highlighted that CHWs who are well-trained and adequately equipped are more motivated and perform better in tasks such as administering malaria treatment. In addition, Osagiede et al. (2023) showed that while 65% of Community health workers (CHWs) in Edo State, Nigeria were aware of the SMC strategy, a significant majority (71.5%) did not adhere to the national guidelines for malaria

chemoprevention in children. This may also be because of the inadequate knowledge of the national guidelines for SMC

The high level of SMC knowledge among some CHWs can be attributed to targeted training programs and the availability of resources that enhance their understanding of malaria prevention protocols (Balla et al., 2022). However, the significant number of CHWs with low knowledge may stem from inconsistent training opportunities, limited access to ongoing professional development, and challenges such as low literacy and technological skills, particularly among older CHWs (Kasiime et al., 2024; Audibert & Tchouatieu, 2021). Additionally, resource constraints, such as insufficient supervision and inadequate infrastructure, can further impede CHWs' ability to fully grasp and implement SMC strategies effectively (Salangwa & Lusale, 2023).

The disparity in SMC knowledge among CHWs directly impacts malaria control efforts, as those with lower knowledge may be less effective in administering treatment and educating communities, leading to suboptimal implementation of SMC interventions (Gilmartin et al., 2021). This gap can result in inconsistent data entry and reporting when using SiCApp, undermining the app's effectiveness in monitoring and managing malaria prevention efforts (Balla et al., 2022). Consequently, the success of malaria control initiatives could be compromised, with potential increases in malaria incidence and mortality in affected areas (Kalne et al., 2022). Addressing these knowledge gaps is critical for maximising the benefits of SiCApp and achieving more effective and reliable malaria control outcomes, which is the end goal of the Ghana Seasonal Malaria Control public health program (Salangwa & Lusale, 2023).

5.3 SiCApp usability

The study’s finding indicates that more than half of the users are dissatisfied with the usability of the SiCApp system, which could hinder its effectiveness in supporting malaria prevention efforts. The high percentage of users finding the system unacceptable suggests there may be issues with the app's design, functionality, or ease of use, which could lead to reduced engagement, inaccurate data entry, and, ultimately, a negative impact on the overall success of the malaria control program.

The finding that 52% of users deemed the SiCApp system's usability unacceptable aligns with similar concerns raised in previous studies regarding the usability challenges of mHealth applications in resource-limited settings. For instance, Hyzy et al. (2022) highlighted that usability issues in digital health apps often stem from complex interfaces and insufficient user training, leading to decreased user satisfaction and effectiveness. Similarly, a study by Balla et al. (2022) found that the effectiveness of digital data collection tools like SiCApp is often compromised by design flaws that hinder usability, particularly in low-resource environments. These findings underscore the importance of user-centred design and thorough testing in developing mHealth tools to ensure they meet the needs of their intended users and enhance their engagement and performance in critical health interventions.

The dissatisfaction with the SiCApp usability may be due to several practical reasons. Firstly, the complexity of the app's interface might overwhelm users, particularly those with limited technical skills or experience with digital tools, leading to frustration and errors (Hyzy et al., 2022). Secondly, inadequate training and support for CHWs on effectively using the app could result in difficulties navigating the system and utilizing its features to their full potential (Balla et al., 2022). Additionally, poor infrastructure, such as unstable internet connectivity or unreliable power supply in rural areas, could further hinder the app's usability, making it

difficult for users to access or use it consistently (Kasiime et al., 2024). These factors combined can significantly impact the overall user experience, leading to dissatisfaction with the system.

Furthermore, the knowledge level on Seasonal Malaria Chemoprevention (SMC) could influence the acceptance and effective use of the SiCApp system. For instance, CHWs with higher knowledge of SMC may be more aware of the importance of accurate data collection and the role that digital tools like SiCApp play in supporting malaria prevention efforts. Conversely, CHWs with lower knowledge of SMC might struggle to see the app's relevance, leading to dissatisfaction with its usability. This lack of understanding could contribute to difficulties in navigating the app, decreased engagement, and potential errors in data entry, ultimately hindering the success of the malaria control program.

The dissatisfaction with SiCApp's usability could have several negative impacts on malaria elimination efforts. Firstly, suppose CHWs find the app difficult to use. In that case, they may be less likely to engage with it consistently, leading to incomplete or inaccurate data collection, which is critical for monitoring and evaluating the effectiveness of SMC interventions (Balla et al., 2022). This can result in gaps in the data, making it challenging to track malaria cases accurately or to ensure that preventive measures are being applied effectively. Additionally, poor usability may reduce the efficiency of CHWs in the field, as they may spend more time troubleshooting the app or entering data, rather than focusing on patient care and community education (Hyzy et al., 2022).

This could slow down the implementation of SMC programs, ultimately reducing their coverage and effectiveness. Over time, these issues could undermine the trust of CHWs in digital tools, leading to a reluctance to adopt new technologies that are crucial for improving public health outcomes, including malaria control (Kasiime et al., 2024). Finally, dissatisfaction with SiCApp could signal the need for significant revisions or redesigns of the app, requiring additional resources and time that could have been directed towards scaling up

successful interventions. This could delay the broader deployment of digital tools in malaria control efforts, potentially affecting the momentum of ongoing campaigns to reduce malaria incidence in high-risk areas.

5.4 Data quality

5.4.1 Timeliness of data

The low timeliness rating among all users in their data input indicates substantial delays in submitting data through the SiCApp system. This assessment was based on a scale from 1 to 10, where a score of 10 represented the earliest data submissions and 1 indicated the latest. The consistently low scores suggest that CHWs and their supervisors often submitted registration and dosing data late, potentially delaying higher-level critical decision-making processes.

This pattern points to challenges in prompt data entry, which may be influenced by factors such as internet connectivity issues, the design of the SiCApp system, or the workflow of CHWs in the field. This could mean that the data being collected is not up-to-date, which is critical for timely decision-making in malaria control efforts. The low ratings on timeliness in data input through the SiCApp system are consistent with challenges identified in the literature concerning digital health tools in resource-limited settings.

According to protocol, CHWs are not to synchronise their data by themselves after completing the day's work unless they first meet with their supervisors for a work review and record offline data on their data tracking sheet before synchronisation. Another limitation is poor internet connectivity, which prevents supervisors from recording offline data on the registration tracking sheet before syncing, and this issue is further compounded by poor device functionality that delays data synchronisation. Given these challenges, it may be necessary to consider submitting data directly from the community level after training CHW. According to Balla et al. (2022), delays in data entry are often caused by factors such as poor internet

connectivity, insufficient training, and a lack of user-friendly interfaces, which hinder the ability of CHWs to input data promptly.

Additionally, Audibert and Tchouatieu (2021) highlight those logistical issues, such as limited access to electricity in rural areas, can further exacerbate delays, as CHWs may struggle to use the app consistently. Practical reasons for these findings include the reliance on unstable internet connections, which can prevent timely data submission, and the complexity of the app's interface, which may slow down the data entry process as CHWs navigate the system (Kasiime et al., 2024). Furthermore, inadequate training on timely data entry and the absence of real-time support or troubleshooting options could also contribute to these delays.

The impact of this finding is significant, as delayed data input can result in outdated information being used for decision-making, potentially leading to ineffective or mistimed interventions in malaria control. This could reduce the overall effectiveness of SMC programs, leading to increased malaria incidence and undermining the goals of the SiCApp system to enhance the efficiency and accuracy of malaria prevention efforts (Hyzy et al., 2022).

5.4.2 Data completeness

The finding that 83.5% of data collected through SiCApp is complete suggests that most CHWs thoroughly document all necessary visits and information as required by the system. This high data completeness indicates that the SiCApp system effectively captures the essential data needed to monitor and evaluate the SMC program properly. Complete data is critical for ensuring accurate analysis, effective decision-making, and the successful implementation of malaria control strategies. However, the 16.5% of incomplete data entries highlight potential challenges that could impact the overall understanding of the SMC intervention's effectiveness.

In the context of this study, data completeness is defined as the successful documentation of all three required visits by CHWs to each child or household. The scoring system, which

allocates points for each visit (4 points for the first visit and dosing, 3 points each for the subsequent visits), reflects the thoroughness of the CHWs in meeting their obligations. The relatively high level of data completeness may be attributed to the user-friendly design of SiCApp, which prompts CHWs to complete all necessary fields, and the training provided to CHWs on the importance of thorough data collection (Balla et al., 2022).

However, 16.5% of incomplete data entries could be due to various factors, such as time constraints, workload pressures, or technical difficulties that might prevent CHWs from completing all required visits or entering all necessary information (Mahmood et al., 2020). The impact of this finding on malaria control efforts is significant, as high data completeness ensures that health authorities have a comprehensive view of the situation, enabling more accurate assessments of SMC interventions and better-informed decisions regarding resource allocation and program adjustments.

This finding aligns with the literature that emphasizes the importance of data completeness for the effective functioning of health information systems (Rajvanshi et al., 2021). Ensuring that data completeness is maintained or improved can enhance the effectiveness of malaria control strategies and support the achievement of health-related Sustainable Development Goals (Tilahun et al., 2021; Arhin et al., 2023). Additionally, it reinforces the value of SiCApp as a reliable tool for data collection while also highlighting the need for continuous improvements to address the factors leading to incomplete data entries.

5.5 Socio-demographic predictors of CHW's knowledge on SMC

This finding suggests that CHWs from Nadowli district (AOR = 0.262, 95% CI: 0.0956–0.718, p = 0.009), Nandom district (AOR = 0.135, 95% CI: 0.0395–0.461, p = 0.001), and Wa West district (AOR = 0.266, 95% CI: 0.1307–0.543, p < 0.001) are generally more knowledgeable about SMC compared to their counterparts in Lawra. Additionally, CHWs with more than 11 years of experience working as CHWs are more knowledgeable about SMC than those with

less experience (AOR = 0.243, 95% CI: 0.0931–0.633, p = 0.004). CHWs in Nadowli, Nandom, and Wa West likely have better access to training, resources, or stronger health infrastructure, enhancing their SMC knowledge compared to those in Lawra. Additionally, CHWs with over 11 years of experience are more knowledgeable due to prolonged exposure and familiarity with SMC practices. According to literature, socio-demographic factors like experience and location significantly influence CHWs' ability to implement SMC protocols and use tools like SiCApp, with more experienced CHWs being more proficient in utilizing these digital tools (Xu et al., 2023; Baker et al., 2022).

Furthermore, reasons for these findings may include better access to continuous training and more robust support systems such as established mentorship and peer support networks, where experienced CHWs guide their less experienced colleagues, fostering knowledge transfer and skill enhancement in the districts of Nadowli, Nandom, and Wa West, to enhance CHWs' knowledge and effectiveness (Owoyemi et al., 2022).

The higher SMC knowledge among CHWs with over 11 years of experience can be attributed to their extensive practical experience, continuous education, and deep familiarity with the communities they serve (Wagaba et al., 2023). Their long-term involvement in multiple SMC campaigns has equipped them with better problem-solving skills, a stronger understanding of local needs, and greater confidence in using digital tools like SiCApp (Kasiime et al., 2024). This experience enhances their ability to deliver effective malaria prevention services, making them more proficient in implementing SMC protocols and contributing to improved malaria control outcomes (Owoyemi et al., 2022). The implications of this finding for malaria control are significant, as it suggests that providing targeted training and support in specific regions can enhance CHWs' knowledge, leading to more effective implementation of SMC programs. This, in turn, could lower malaria incidence and improve overall health outcomes.

5.6 Implications of Findings

5.6.1 Malaria Control:

The finding that experienced CHWs and those from specific districts have higher SMC knowledge implies that these regions may achieve better malaria control outcomes. This suggests that leveraging the expertise of these CHWs could be crucial in areas with higher malaria incidence. It also implies that regions with lower CHW knowledge may require additional support to improve their effectiveness in SMC implementation, directly impacting malaria control efforts by potentially reducing the spread of the disease (Owoyemi et al., 2022).

5.6.2 mHealth in Malaria Prevention:

The variation in CHWs' ability to use mHealth tools like SiCApp, depending on their experience and location, implies that mHealth strategies must be adaptable to different user profiles. This finding highlight that the effectiveness of mHealth interventions in malaria prevention can vary significantly based on the users' familiarity and comfort with digital tools. Consequently, mHealth solutions must be flexible to accommodate different levels of digital literacy and experience, ensuring broader applicability and effectiveness (Kasiime et al., 2024).

5.6.3 Health Policy:

The disparities in SMC knowledge among CHWs across different districts imply that health policies should focus on addressing these regional inequalities. This suggests that policymakers must consider geographic and experience-based differences when allocating resources and designing training programs. Trained policy approaches could help optimize resource use and improve the overall impact of SMC programs across varying contexts (Baker et al., 2022).

5.6.4 Training of CHWs:

The finding that experience significantly influences SMC knowledge among CHWs implies that training programs should not be one-size-fits-all. The implication is that training should be differentiated, with more experienced CHWs receiving advanced training that builds on

their existing knowledge, while less experienced CHWs might benefit from more foundational training. This approach could enhance the overall effectiveness of CHWs in implementing SMC, leading to better health outcomes (Wagaba et al., 2023).

5.7 Research:

To provide a comprehensive assessment and recommendations for upgrading the SiCApp, follow-up qualitative studies should focus on understanding the respondents' perceptions of its usage. Additionally, regular and scheduled continuous improvements to the SiCApp interface, informed by ongoing research on the System Usability Scale (SUS) index, are essential for increasing its acceptance among Community Health Workers (CHWs). Research efforts should target identifying the most effective ways to support CHWs with varying levels of experience and those in different regions, ensuring the tool's effectiveness and user satisfaction across diverse contexts.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study aimed to assess the knowledge of CHWs on SMC, examine the usability of the SiCApp tool, determine data quality, and examine the socio-demographic factors that predict SMC knowledge. The study found that 58.1% of Community Health Workers (CHWs) had high knowledge of Seasonal Malaria Chemoprevention (SMC), while 41.9% had low knowledge. Notably, CHWs in the Nadowli, Nandom, and Wa West districts demonstrated significantly higher SMC knowledge compared to those in Lawra, and those with over 11 years of experience were more knowledgeable than those with 5 years or less. Regarding the SiCApp system, 52% of users found its usability unacceptable, with only 48% considering it acceptable. Despite these usability challenges, the accuracy and completeness of data input were relatively high, though all users were rated low on timeliness. These findings demonstrate the critical influence of socio-demographic factors like experience and location on CHWs' ability to effectively implement SMC protocols, revealing both strengths and weaknesses in current malaria prevention strategies. The disparities in knowledge and the usability issues identified suggest that while digital tools like SiCApp have made strides in malaria control, targeted improvements are necessary. This highlights the importance of tailoring interventions to meet the unique needs of CHWs based on their experience and geographic context, which could optimize CHW training, enhance mHealth applications, and ultimately strengthen the effectiveness of malaria prevention programs.

6.2 Recommendations

1. This study's findings highlight the need for tailored training and improved digital tools to enhance the effectiveness of CHWs in malaria prevention. Addressing knowledge disparities based on experience and location, and refining the usability of the SiCApp tool, can strengthen data quality and improve decision-making in SMC programs. These insights offer practical steps for enhancing health system support in malaria-endemic areas.

2. The Ghana Health Service and relevant health training institutions should develop targeted training programs for CHWs in districts like Lawra and for those with less experience as CHWs. These programs should enhance SMC knowledge and practical skills, ensuring that all CHWs are equally equipped to implement malaria prevention protocols effectively.

3. The National Malaria Elimination Program (NMEP) and its digital health partners should work on improving the usability of the SiCApp system, mainly focusing on making the app more user-friendly and addressing issues related to data timeliness. This could involve redesigning the interface, providing additional user training, and ensuring reliable internet access in rural areas.

4. To maintain and improve the knowledge levels of experienced CHWs, continuous professional development (CPD) programs should be instituted by GHS. These programs should offer advanced training opportunities that build on existing knowledge and skills, emphasizing the latest SMC practices and the effective use of digital tools like SiCApp.

5. The NMEP could employ a blended training approach for supervisors by developing an online version (eLearning approach) where resource materials are available anytime. This method would allow supervisors to reference training materials continuously, and the NMEP could update these resources as needed rather than relying solely on costly and infrequent face-to-face training sessions that occur just twice during the SMC campaign period.

6. The National Malaria Elimination Programme should implement regular monitoring and evaluation mechanisms to assess the effectiveness of training programs and the use of SiCApp. Feedback from CHWs should be collected and analysed to make necessary adjustments to both the app and the training content, ensuring continuous improvement.

7. CHWs in the Upper West and its districts where malaria is endemic, especially those with lower SMC knowledge, should be supported by community engagement initiatives led by local health authorities. These initiatives should focus on increasing community awareness about malaria prevention, complementing the efforts of CHWs and enhancing the overall effectiveness of SMC programs.

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APPENDICES

APPENDIX 1-Survey Questionnaire

Part 1: Sociodemographic information

1. Gender

   [ ] Male [ ] Female

2. Age (years) …….
3. Marital status

   [ ] Single [ ] Married [ ] Widowed [ ] Divorced

4. Highest level of education

   [ ] No education [ ] Primary [ ] Secondary [ ] Tertiary

5. How long have you been working as a Community Health Worker (CHW)?.....
6. Supervisors encourage the use if SiCAPP
   a. Yes
   b. No
7. Have you received formal training specifically related to SMC?
   a. Yes
   b. No
8. Are there continuous training opportunities for CHWs on SMC?
   a. Yes
   b. No
9. Which of the following describes your workload at your current facility
   a. Heavy
   b. Moderate
   c. Low
10. My facility has stable internet access.
    a. Yes
    b. No
11. Please indicate your level of agreement with the following statement: "I feel confident in my understanding of what SMC entails."
    a. Strongly Agree
    b. Agree

c. Neutral
d. Disagree
e. Strongly Disagree

PART 2: Assessment of Community Health Workers' Knowledge in Seasonal Malaria Chemoprevention (SMC).

Your responses will contribute to our understanding of the level of knowledge among Community Health Workers (CHWs) regarding Seasonal Malaria Chemoprevention (SMC).

12. What is the age group for eligible SMC children?
    a. 0 – 59 months
    b. 3 – 59 months
    c. 3 – 69 months
13. How frequently is SMC typically administered in your community?
    a. Once a month
    b. Once every two months
    c. Once every three months
    d. Other (please specify)
14. How many minutes do you wait after administering SMC medication before leaving a household?
    a. 22 – 25 minutes
    b. 15 – 20 minutes
    c. 10 – 15 minutes
    d. 5 – 10 minutes
15. What are the main components of SMC? (Select all that apply)
    a. Distribution of long-lasting insecticidal nets (LLINs)
    b. Administration of antimalarial medication
    c. Indoor residual spraying (IRS)
    d. Health education and promotion
16. How do you assess the effectiveness of SMC in your community?
    a. Reduction in malaria cases
    b. Increase in LLINs utilisation
    c. Compliance with medication regimen
    d. Other (please specify)
17. How many times do you administer SMC medication per cycle

a. 3 times
b. 4 times
c. 5 times
d. 6 times

18. What medication or component of smc medication administer to SMC eligible children
    a. sulphadoxine-pyrimethamine plus amodiaquine (SP+AQ)
    b. Sulphur drug
    c. chloroquine phosphate
    d. RDT

15. Overall, how would you rate your knowledge level regarding SMC?
    a. Very Low
    b. Low
    c. Moderate
    d. High
    e. Very High

16. What condition prevents a child from receiving SMC medication?
    a. Sick
    b. History of ADR
    c. Allergy
    d. All of the Above

PART 3: System Usability Scale (SUS) Assessment for SiCApp is to assess the usability of SiCApp (System for Community Health Application).

Instructions: Please indicate your level of agreement with each statement by selecting the corresponding option on the scale provided (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I found SiCApp to be unnecessarily complex.					
2. I think I would need the support of a technical person to be able to use SiCApp.					
3. I thought the system was easy to use.					
4. I imagine that most people will learn to use SiCApp very quickly.					
5. I needed to learn a lot of things before I could get going with SiCApp.					
6. I thought there was too much inconsistency in SiCApp.					
7. I found SiCApp very cumbersome to use.					
8. I found the various functions in SiCApp were well integrated.					
9. I think that I would like to use this system frequently.					
10. I felt very confident using the system.					

Part 4: Rating scale for data quality of participants

1. Completeness:

   Summary of Scores (Completeness):
   4 = day 1
   3 = day 2
   3 = day 3

2. Accuracy:

   ○ 1: Data is highly inaccurate with frequent errors.

   ○ 2: Data contains many errors, reducing its reliability.

   ○ 3: Data has several errors but can be used with significant caution.

   ○ 4: Data has some errors, affecting its overall reliability.

   ○ 5: Data is moderately accurate with noticeable inaccuracies.

   ○ 6: Data is fairly accurate with a few errors.

   ○ 7: Data is mostly accurate with minor inaccuracies.

   ○ 8: Data is very accurate with rare errors.

   ○ 9: Data is almost entirely accurate with insignificant errors.

   ○ 10: Data is fully accurate with no errors.

3. Timeliness:

   Summary of Scores (Timelines):

   17:00 - 19:59: Score = 10

   20:00 - 21:59: Score = 9

   22:00 - 22:59: Score = 8

   00:00 - 03:59: Score = 7

   04:00 - 05:59: Score = 6

   06:00 - 10:59: Score = 5

11:00 - 11:59: Score = 4

12:00 - 13:59: Score = 6

14:00 - 15:59: Score = 7

16:00 - 16:59: Score = 8

Thank you for your participation

Knowledge of CHWs on SMC

Frequencies of 4. What is the purpose of the SiCapp (Seasonal Malaria Chemoprevention in Children Mobile Application

4. What is the purpose of the SiCapp (Seasonal Malaria Chemoprevention in Children Mobile Application	Counts	% of Total	Cumulative %
To help in children diagnosis and treatment	8	2.3 %	2.3 %
To help in children diagnosis and treatment	96	27.7 %	30.1 %
To monitor children health	3	0.9 %	30.9 %
To register and track eligible children for SMC	238	68.8 %	99.7 %
To register and track eligible children for SMC	1	0.3 %	100.0 %

Frequencies of 5. What is the age group for eligible SMC children?

5. What is the age group for eligible SMC children?	Counts	% of Total	Cumulative %
0 – 59 months	11	3.2 %	3.2 %
3 – 59 months	296	85.5 %	88.7 %
3 – 69 months	3	0.9 %	89.6 %
I am not sure	36	10.4 %	100.0 %

Frequencies of 6. How frequently should SMC typically be administered in your community?

6. How frequently should SMC typically be administered in your community?	Counts	% of Total	Cumulative %
I am not sure	4	1.2 %	1.2 %
Once a month	320	92.5 %	93.6 %

Frequencies of 6. How frequently should SMC typically be administered in your community?

6. How frequently should SMC typically be administered in your community?	Counts	% of Total	Cumulative %
Once every three months	16	4.6 %	98.3 %
Once every two months	6	1.7 %	100.0 %

Frequencies of 7. How many minutes should you wait after administering SMC medication before leaving a household?

7. How many minutes should you wait after administering SMC medication before leaving a household?	Counts	% of Total	Cumulative %
10 – 15 minutes	102	29.5 %	29.5 %
15 – 20 minutes	18	5.2 %	34.7 %
22 – 25 minutes	1	0.3 %	35.0 %
5 – 10 minutes	223	64.5 %	99.4 %
I am not sure	2	0.6 %	100.0 %

Frequencies of 8. What are the main components of SMC?

8. What are the main components of SMC?	Counts	% of Total	Cumulative %
Administration of antimalarial medication	346	100.0 %	100.0 %

Frequencies of 9. How is the effectiveness of SMC assessed in your community?

9. How is the effectiveness of SMC assessed in your community?	Counts	% of Total	Cumulative %
Compliance with medication regimen	63	18.2 %	18.2 %
I am not sure	2	0.6 %	18.8 %

Frequencies of 9. How is the effectiveness of SMC assessed in your community?

9. How is the effectiveness of SMC assessed in your community?	Counts	% of Total	Cumulative %
Reduction in malaria cases	281	81.2 %	100.0 %

Frequencies of 10. How many times should SMC medication be administered per cycle?

10. How many times should SMC medication be administered per cycle?	Counts	% of Total	Cumulative %
Five times	37	10.7 %	10.7 %
Four times	187	54.0 %	64.7 %
I am not sure	2	0.6 %	65.3 %
Six times	1	0.3 %	65.6 %
Three times	119	34.4 %	100.0 %

Frequencies of 11. What medication or component of SMC medication is administered to SMC-eligible children?

11. What medication or component of SMC medication is administered to SMC-eligible children?	Counts	% of Total	Cumulative %
Chloroquine phosphate	4	1.2 %	1.2 %
I am not sure	15	4.3 %	5.5 %
RDT	1	0.3 %	5.8 %
Sulphadoxine-pyrimethamine plus amodiaquine (SP+AQ)	326	94.2 %	100.0 %

Frequencies of 12. What condition prevents a child from receiving SMC medication?

12. What condition prevents a child from receiving SMC medication?	Counts	% of Total	Cumulative %
Child not eaten	12	3.5 %	3.5 %
Common cold	10	2.9 %	6.4 %
Recent immunization	68	19.7 %	26.0 %
Sick	256	74.0 %	100.0 %

Frequencies of 13. What are ADRs in SMC drug administration?

13. What are ADRs in SMC drug administration?	Counts	% of Total	Cumulative %
Adverse Drug Reaction	324	93.6 %	93.6 %
Adverse Drug Recreation	2	0.6 %	94.2 %
Adverse Drug Regression	2	0.6 %	94.8 %
Adverse Drug Relapse	1	0.3 %	95.1 %
I am not sure	17	4.9 %	100.0 %

Frequencies of 14. Please indicate your level of agreement with the following statement: "A child can react negatively to SMC medication"

14. Please indicate your level of agreement with the following statement: "A child can react negatively to SMC medication"	Counts	% of Total	Cumulative %
I am not sure	6	1.7 %	1.7 %
No	53	15.3 %	17.1 %
Yes	287	82.9 %	100.0 %

Frequencies of 15. Please indicate your level of agreement with the following statement: "When there is an Adverse Event, Caregivers must seek immediate medical care for the child"

15. Please indicate your level of agreement with the following statement: "When there is an Adverse Event, Caregivers must seek immediate medical care for the child"	Counts	% of Total	Cumulative %
I am not sure	2	0.6 %	0.6 %
No	9	2.6 %	3.2 %
Yes	335	96.8 %	100.0 %

Frequencies of 16. Please indicate your level of agreement with the following statement: "After the drug has been administered, Community Health Workers must document the dosing details in the Maternal and Child Health Record Book"

16. Please indicate your level of agreement with the following statement: "After the drug has been administered, Community Health Workers must document the dosing details in the Maternal and Child Health Record Book"	Counts	% of Total	Cumulative %
I am not sure	1	0.3 %	0.3 %
No	5	1.4 %	1.7 %
Yes	340	98.3 %	100.0 %

APPENDIX 2: IRB CLEARANCE FORM

ENSIGN GLOBAL
COLLEGE

OUR REF: ENSIGN/IRB/EL/SN-264/01 April 18, 2024.
YOUR REF:

INSTITUTIONAL REVIEW BOARD SECRETARIAT

Hammond Nii Sarkwah
Ensign Global College
Kpong.

Dear Hammond,

ETHICAL CLEARANCE TO UNDERTAKE POSTGRADUATE RESEARCH

At the General Research Proposals Review Meeting of the *INSTITUTIONAL REVIEW BOARD (IRB)* of Ensign Global College held on Thursday, April 11, 2024, your research proposal entitled **"A Usability Evaluation of Sicapp (Seasonal Malaria Chemoprevention in Children Mobile Application) in the Upper West Region of Ghana"** was considered.

The following recommendation(s) and change(s) are to be effected in order for approval and ethical clearance to collect data for the said research under academic supervision.

1) **Add title of the study to the questionnaire**
2) **Provide signed permission letter from the Upper West Regional Health Directorate**
3) **State how long data will be kept.**

We wish you all the best.

Sincerely,

Mr. Patrick Kuma
(Registrar/ IRB Administrator)

APPENDIX 3: CONSENT FORM FROM REGIONAL DIRECTORATE

In case of reply, the number and the date of this letter should be quoted

OUR CORE VALUES
Professionalism
People centredness
Team Work
Integrity
Discipline
Innovation

My Ref:
Your Ref:

Regional Health Directorate
Ghana Health Service
P. O. Box 298
Wa
Upper West Region

22nd April, 2024

Tel: +2330392096685
GPS Address: XW -0020-2007
Email: rdhs.uwr@ghs.gov.gh

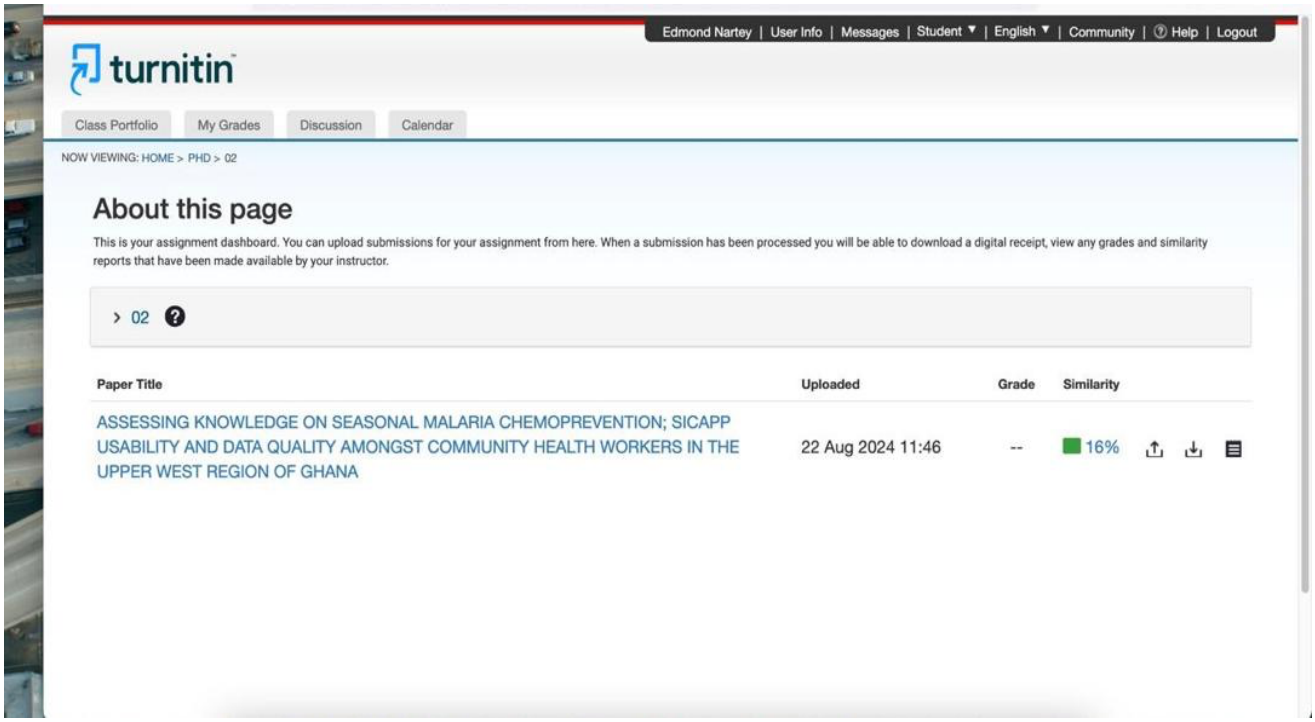
RE-ETHICAL CLEARANCE TO UNDERTAKE POSTGRADUATE RESEARCH

In reference to your letter dated April 18, 2024 with your reference number ENSIGN/IRB/SN-264/01, I write to approval or grant the permission to the applicant, MR. **HAMMOND NII SARKWAH** to carry out the research works in the Upper West Region for his academic purpose.

The research topic/title; **A Usability Evaluation of Sicapp (Seasonal Malaria Chemoprevention in Children Mobile Application)** is a mobile application which has been used in the region for a period of Five (5) years, and evaluating its usefulness is highly recommended.

Thank you.

DR. COLLINS BOATENG DANQUAH
DEPUTY DIRECTOR PUBLIC HEALTH
UPPER WEST REGION.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ASSESSING KNOWLEDGE ON SEASONAL MALARIA CHEMOPREVENTION; SICAPP USABILITY AND DATA QUALITY AMONGST COMMUNITY HEALTH WORKERS IN THE UPPER WEST REGION OF GHANA
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