Study Report

Performance & Utilization of Handwashing Stations deployed in response to COVID-19 in Kenya: A Rapid Assessment

Funder: UK Foreign, Commonwealth and Development Office through Unilever for the Hygiene Behavior Change Coalition

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

CDC	The Centers of Disease Control and Prevention
COVID-19	Coronavirus Disease 2019
DALY	Disability-Adjusted Life Years
HBCC	Hygiene and Behavior Change Coalition
HCAI	Healthcare-associated infections
HWS	Hand Washing Station(s)
GDP	Gross Domestic Product
GHP	Global Handwashing Programme
JJF	Jonathan & Jackson Foundation
JMP	Joint Monitoring Programme
LSHTM	London School of Hygiene and Tropical Medicine
MOH	Ministry of Health
MRSA	methicillin-resistant *Staphylococcus aureus* infections
NBCC	National Business Compact on Coronavirus
ODK	Open Data Kit
SHOFCO	Shining Hope for Communities
UBOS	Uganda Bureau of Statistics
UNICEF	United Nations Children's Fund
UV	Ultraviolet
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Abstract

Handwashing, although a simple task, is lifesaving and adherence to proper hand hygiene has been strongly linked to prevention of gastrointestinal infections, respiratory infection, influenza, healthcare-associated infections, and coronavirus. Since the onset of COVID-19, governments and stakeholders have made huge investments on handwashing infrastructure through fragmented and uncoordinated efforts. There is however limited evidence on the functionality, use and usability, and operation and maintanance of HWS deployed in public setting and rapidly deployed at such scale.

In Kenya, the National Business Compact on Coronavirus (NBCC) distributed 5311 handwashing stations (HWS) to 46 counties between April and August 2020. The HWS were deployed to targeted hotspots mapped by the Ministry of Health. Each facility was allocated a paid or unpaid caretaker (depending on the distributing partner and resources available) to ensure the facility remained functional and equipped with soap and water.

This mixed-methods, observational study examined the functionality, use, usability, and appropriate messaging of the deployed HWS by partners of NBCC and and correlated with the knowledge and attitudes of users and facility managers. The study also aimed to unveil the experiences, challenges faced, practical options and opportunities presented by the implementation of this program and deployment that could inform improvements in existing public HWS; planning and selecting the most suitable options; as well as inform strategies for future roll-out for public settings in different contexts.

Systematic sampling was used to select a total of 430 HWS across five selected counties with unannounced spot checks, 30-minute structured observation of use, and user available caretakers and a sample of users were surveyed. Topics of interest were further explored through in-depth interviews with key informants and a subsample of caretakers, and during focus group discussions with community members. Spot checks were conducted at 316 (73.5%) of the selected HWS, during which 304 caretakers both paid and unpaid were interviewed. The remaining sample of HWS were missing due to various reasons including: caretaker was away, HWS and Caretaker could not traced, business and caretakers had relocated, and some of the HWS had been stolen. Ninety-seven percent of surveyed HWS had water, 88.9% had soap available for use (25% bar soap, 61.7% liquid soap and 1.6% soapy water) and 92.1% of the HWS taps were working with no leaks. However, 49.1% of the installed hand washing stations

could not be physically reached by a person in a wheelchair. Only 158 (52.0%) of caretakers had received training on management and maintenance of HWS. Training was more commonly received by paid caretakers than by unpaid caretakers (71.6% vs 43.1%, *P<0.001).* HWS attended by paid caretakers were more commonly functional than those attended by unpaid caretakers with respect to soap availability (95.9% vs 78.4%, *P=0.001).*

In conclusion, this rapid assessment demonstrated that the handwashing stations distributed by NBCC partners in response to COVID-19 in Kenya were largely functional, but of note was that a quarter of HWS were not where they were supposed to be and therefore NOT functional. A positive note is that most of the users washed their hands independently with soap and water but some improvements, e.g. heights of the tap and terrains of installation points, need to be made. There are however gaps and barriers related to access and use and recommendations include improving ease of dispensing water & soap (contact free); improving daily operation and maintenance, including replenishment of consumables; and increasing the numbers and distribution of handwashing stations, with proper coordination. Critical questions remain: will these HWS remain functional, and will they translate to sustained improvements in handwashing behaviour?

1. Introduction

Hands have moisture, natural oils and grease that offer a conducive environment for pathogens, including viruses, to survive due to protection against exposure to viricidal ultra-violet (UV) light (IES, 2020, WHO 2020). Handwashing, although a simple task, is lifesaving. Adherence to proper hand hygiene has been strongly linked to prevention of gastrointestinal infections like diarrhea, and respiratory infections spread by germs, and most recently in mitigation against the spread of COVID-19. Significant protective effects of handwashing against and in the control of influenza pandemics have been correlated with control of COVID-19 (Saunders-Hastings et al, 2017). Moreover, hand hygiene has been proven to reduce the majority of Healthcare-associated infections (HCAI) and drug-resistant infections (WHO, 2017). Despite the evidenced importance of handwashing with soap, there is a large gap between knowledge and practice of handwashing with soap at critical moments.

In 2019, UNICEF estimated that globally 2 out of 5 (3 billion) people lack functional handwashing stations with water and soap (JMP, 2020). In Eastern and Southern Africa alone, only a quarter of people (24%) had a dedicated place for handwashing with water and soap at households and premises, with country variances. In Kenya, Uganda and Tanzania, 37%, 34% and 30% of homes respectively lack basic handwashing stations with water and soap, with large disparities between the poorest and richest, and higher prevalence in urban than in rural areas (WHO, UNICEF, 2020). The situation is not any better in healthcare facilities with observed practice of recommended handwashing behavior among healthcare workers typically below 50% compliance (Sands, et al., 2020) and lower among physicians at 32% than among nurses at 48% improvement (Erasmus, et al., 2010). Metaaanalysis of several studies on hand hygiene in healthcare settings found an average median compliance rate of 40% (Erasmus, et al., 2010), affirming that hand hygiene – a critical behavior for infection control – even among health workers has been met with mixed success (Sands, et al., 2020)

Hand hygiene has received considerable attention in the global COVID-19 response, prompting large-scale mobilization and installation of handwashing facilities in households and public settings. In East Africa, government campaigns like Komesha Corona in Kenya (for Stop Coronavirus) have heightened the focus on handwashing with over 92% of people reporting that they wash their hands with soap and water more frequently during the pandemic (Amref, 2020). However, limited empirical evidence exists on the utilization of the said handwashing stations and

it is unclear whether there is a direct change in hand-washing practice attributable to the presence of the handwashing stations.

This study sought to assess the functionality, usability and appropriate messaging of the deployed HWS. It also aimed to understand the experiences, challenges faced, practical options and opportunities presented by the implementation of this program which could inform improvements in management and sustainability public HWS.

2. Problem Statement

In the epidemiological triad of COVID-19, prevention of spread of the disease fully relies on how humans disrupt its favorable environment - objects with the virus and infectious droplets emitted by sneezes and coughs.

Since the onset of COVID-19, the national government, county governments and other stakeholders have invested heavily in handwashing infrastructure. Despite widespread deployment of handwashing stations as one of the first line measures to disrupt transmission of the virus, utilization remains unevidenced. With proper coordination lacking, data and feedback on the HWS functionality, management, use and prospective sustainability are also lacking. There is no evidence yet on the public health significance of the investment in public handwashing infrastructure to the control of COVID-19.

Moreover, there is need to understand the factors that influence maintenance and utilization of these facilities that could help optimize handwashing compliance. The rapid assessment described in this report, therefore, investigates the presence and quality elements of the deployed handwashing stations and give inferences for the uptake, functionality, the usability and their sustained maintenance and operation. The findings of the study will provide insights and lessons that are very critical to bolster clear public health measures and messaging on the future deployment of HWS and re-arrangments in regards to operation and maintenance of existing public HWS in the context of COVID-19.

3. Literature Review

Introduction: Purpose and Focus of Review

The review reflects on handwashing over past centuries, including presence of supportive infrastructure and education, and levels of correspondence to actual practice. Literature of studies conducted in the recent past related to our study's objective, on assessing the availability and utilization of handwashing stations, has been collated to validate the study. Many and extensive past studies have correlated handwashing with prevention of gastrointestinal, respiratory and healthcare-associated illnesses. (Allison E. Aiello, 2018) (Stiller, 2016) (Xun, 2021) (Daniela De la Rosa-Zamboni, 2018) (Guest JF, 2019) (Watson J, 2019) (CDC, 2020; Erasmus, et al., 2010).

A meta-analysis of 26 studies by Freeman *et al* averaged the significance of handwashing with soap on the risk of diarrhea at 40% reduction contribution (Freeman, et al., 2014). Handwashing with soap is reported to be one of the most effective public health investments (Chase & Andres, 2020). The WHO commission on Macroeconomics and Health ranks an intervention as 'very cost effective' if it averts one Disability Adjusted Life Year (DALY) for less than per capita GDP. Handwashing with soap meets the criteria even in lowest per capita GDP countries, averting one DALY associated with diarrheal diseases through hygiene promotion including handwashing at a cost of $3.35 (Townsend, et al., 2017).

History of Handwashing

The practice dates to 1846 when the Father of hand hygiene, Ignaz Semmelweis noted high fever incidence and death trends among women giving birth in his hospital's maternity ward as opposed to an adjacent midwife-run ward. He was prompted to investigate, from which he established that his doctors visited the maternity ward directly after performing autopsy with likely 'cadaverous particles' in their hands as opposed to midwives who did not conduct surgeries or autopsies hence not exposed to the particles. This inspired a regulation on handwashing with chlorine on his doctors with a consequent drastic reduction on maternal deaths (GHP, 2017). Frequent handwashing interrupts transmissions in two ways, first using soap inactivates and disintegrates germs and viruses, and running water for enough time washes off the dead pathogens (Kratzel A, 2020).

Impact of Handwashing

Over the centuries, despite the availability of a basic treatment solution – the simple act of handwashing – diarrhea remains the leading killer of children with 1,300 daily deaths on average

globally (UNICEF, 2019). About 1.8 million children die each year from diarrheal diseases and pneumonia. However, despite the huge toll, progress has been made with a 64% decrease in the annual number of deaths from diarrheal among children under 5 reported diarrheal mortality between 2000 and 2018 (UNICEF, 2021). Handwashing education programs are attributed to a reduction of diarrheal morbidities by 23-40%, reducing respiratory illnesses by 16-21% in the general population and absenteeism associated with gastrointestinal illnesses among school going children by 29-57% (CDC, 2020). More children could be saved through basic interventions. Properly observed handwashing with soap is projected to protect about 1 out of every 3 young children who contract diarrhea and almost 1 in every 5 with respiratory infections majorly pneumonia (CDC, 2020). In March 2018, the United National Secretary General upon issuing a Global Call to Action for WASH in Health Facilities remarked that *"We must work to prevent the spread of disease. Improved water, sanitation and hygiene in health facilities is critical to this effort."* (United Nations, 2018). In hospitals, good hand hygiene has had a direct correlation with reduction of majority of Healthcare-associated infections (HCAI) and drug-resistant infections (WHO, 2017). One model established that every 1% hand hygiene compliance increase could save up to $40,000 in MRSA-related healthcare costs (WHO, 2017). There is ample evidence prior to COVID-19 epidemic that handwashing among healthcare workers (HCW) remained an area that needed improvement (CDC, 2019; Erasmus, et al., 2010),. Despite this convincing evidence linking hand hygiene through multimodal approach to reduction of infection rates, lack of science-based information on the definitive impact of improved hand hygiene compliance on Healthcare-associated Infections (HCAI) has been cited as a possible barrier to adherence (WHO, 2009).

Availability of Handwashing amenities in Sub-Saharan Africa

According to WHO, in 2015, despite the challenge of limited data to estimate the population with handwashing stations, available data indicates that only 15% of Sub Saharan Africa's population had access to basic handwashing stations (WHO, 2015). On the contrary, a report by The Joint Monitoring Program highlights that most Eastern and Southern Africa countries have national data on availability of handwashing stations but admits to few having comprehensive data on hygiene facilities in schools (WHO, UNICEF, 2020). The report establishes that only 24% of households in Eastern and Southern Africa have dedicated handwashing stations with water and soap available; lagging behind the rest of the UNICEF regions (WHO, UNICEF, 2020)

In 2019, 37 million of Kenyans were reported to lack basic hygiene services with soap and water. Correspondingly, national population surveys show significantly low availability of handwashing stations in Eastern Africa countries (Peter Kisaakye, 2021). Moreover, data on handwashing stations with soap and water at points of care in Kenya exists at 77% (Bennett, et al., 2015).

Determinants of handwashing

Studies globally have established that despite of the positive health benefits of handwashing, the practice is yet to be observed well. Freeman et al from analysis of 42 studies with data on handwashing prevalence published between 1990 and 2013 estimated the world population that washes hands with soap after contact with excreta at 19% (Freeman, et al., 2014). A study by Null et al indicated a 45% drop in adherence to handwashing indicators from 70% to 25% over two years (Null & Stewart, 2018) of their study. Absence of facilitating structures in the target behavior setting especially in very disadvantaged population' cohorts can limit actual practice. A study on determinants of handwashing established that households with poor access to water and sanitation amenities, lowest levels of media and education washed their hands strikingly less than the majority (Schmidt, et al., 2009). More recent studies corroborate that utilization of handwashing stations is influenced by availability and access to water, education and strategic location of the facility. (Nakanwagi, 2019) The same study pointed out being busy and forgetfulness as major reasons for inconsistent utilization of handwashing stations. Psychological factors have as well been cited as significant predators of observed handwashing behavior (Aunger, 2010). Moreover, presence of handwashing stations in public places coupled with promotion have been linked to improved hand hygiene behavior among households (Bennett, et al., 2015)

In the wake of COVID-19, proper handwashing with soap and running water has been undoubtedly the first line of defense in breaking the transmission cycle and therefore supportive infrastructure, that is, an observed designated facility, soap and water are integral to facilitate practice and behavior. Presence of a handwashing facility, water and soap has been identified in all settings as a top priority and a key indicator for national and global monitoring (JMP, 2020). Handwashing stations may be fixed or mobile and constitute a sink with tap water, a raised container or bucket with taps and tippy tap designed jugs and basins in resource-limited settings. Recommended soap includes bar soap, liquid soap, soapy water or power detergent. Some cultures however improvise the use of ash, soil, sand and other materials in the place of handwashing agents, which are considered less effective than using soap and also considered as limited handwashing facilities (JMP, 2020).

Most handwashing programs before COVID-19 promoted critical handwashing moments, that is, handwashing after defecation, and handwashing before taking food or feeding a child. In the wake of COVID-19, the World Health Organization advocates for regular handwashing with emphasis on additional moments; immediately upon returning home, before and after putting on a mask, before touching one's face, after touching common surfaces and before and after caring for the sick. Several studies have alluded to a persistent gap between perception on proper handwashing with soap and actual practice. In Kenya, studies have shown up to 100% awareness of COVID-19 prompting increased installation of handwashing stations countrywide (Population Council, 2020) Challenges cited to uptake of handwashing behavior are lack of personal water source (37%) and the high cost of sanitizers at (53%) (Population Council, 2020).

4. Intervention Description

In Kenya, the National Business Compact on Coronavirus (NBCC) – a coalition aggregating efforts of the private sector, government and the UN family towards the control of the pandemic was formed. Through the coalition, 5311 handwashing stations (HWS) were distributed to 46 of the 48 counties between April and July 2020. This distribution aimed to encourage frequent handwashing with soap in public places. The HWS were deployed and managed in hotspots identified by the Ministry of Health (MOH) through the following NBCC partners; Copia, Rotary, Shujaaz, Sanergy, Shining Hope for Communities (SHOFCO), BRCK, and Jonathan Jackson Foundation on the basis that they had a local footprint in the targeted hotspot area.

Public handwashing stations are defined from our local context, the evolving pandemic, and adapted from the Public Health law of Kenya CAP 242, where "**public building"** means a building used or constructed or adapted to be used either ordinarily or occasionally as a place of public worship or as a hospital, college, school, theatre, public hall or as a public place of assembly for persons admitted by ticket or otherwise or used or adapted to be used for any other public purpose. NBCC have broadly categorized **public settings** as any place accessible for use by anyone in the community i.e. areas for social interaction and/or economic exchange. They include bus terminus, shopping centers, markets, places of worship, high-foot traffic streets, public buildings & government offices. Furthermore, these locations were designated as 'hot spot areas' by the Ministry of Health, and a focus for the COVID-19 response.

Three types of HWS were distributed in three phases. In Phase I – distribution was conducted in the month of April where 20 liter-capacity (*pictured below*) of HWS that were not fitted with fabricated stands (these were made from improvised plastic buckets and fitted with a tap. The caretakers were required to place them on improvised flat surfaces). In hindsight, these types of HWS did not allow for a comfortable posture, nor proper drainage of waste water. Between May and June, phase II type; 60 liter-capacity neatly branded HWS fitted on a stand with a basin for collection and proper channeling of wastewater and a soap holding area were deployed alongside information posters done jointly with the MoH. An Information, Communication and Education (IEC) poster with information about the steps for proper handwashing was hung up on or next to each HWS in phase I and II. Lessons from phase I and II informed phase III design, which was deployed between end of July and August. The new prototype had a higher capacity (100 liters) water container made of bright-colored material and with a sizeable drainage pipe to better channel the water from the waste water basin. The design also accommodated foot pedals in some that when the user stepped on could dispense water without necessarily touching the taps in phase I and II stations. Moreover, all phase III HWS were also deployed with IEC posters and additional “nudges implemented, such as footprints to enable physical distant queuing and handprints to encourage use of the facility. In phase I 1500 HWS were deployed, 2253 in phase II and 1558 in phase III. Each facility had a caretaker, someone who attended to the facility to ensure soap and water is present and the facility is properly functioning. Some of the caretakers were paid or unpaid, based on the location of the HWS (high traffic area), and the budget of partners implementing the HWSs (SHOFCO paid caretakers KE500 for the first 5 months, 300 for the last 3 months with the reduction due to budget constraints. Rotary distributed HWS and engaged paid caretakers via SHOFCO).

During deployment, handwashing management guidelines were issued and these included communication on the role of the HWS recipients to regularly refill water, replenish soap for handwashing after the donated supply of 800mg by the coalition partners’ is out.

FIGURE 1: HWS DEPLOYED IN PHASE I, II AND III RESPECTIVELY FROM LEFT TO RIGHT

A lot of effort has been witnessed on distribution of HWS in Kenya in public spaces by governments, partners and philanthropists, although uncoordinated from central points. New thinking on behavior change such as nudging has been increasingly adopted and integrated to complement the deployed HWS. Under the COVID-19 context, knowledge and perception on handwashing is no longer in question. The critical challenge is on whether the gains made on deployed handwashing points and behavior change communication will be sustained longer term and whether these will continue to be used, operational and maintained in the long term. The study assesses the uptake of public handwashing stations, their functionality, the usability of these facilities and their sustained maintenance and operation.

5. Research Questions

The assessment addressed the following key questions

1. Are the handwashing stations functioning as intended?
2. Are the handwashing stations being used as intended?
3. Are the handwashing stations accessible to all, including children, elderly and those with disabilities?
4. Are the handwashing stations being well maintained?
5. Are there any barriers to use of the handwashing stations?
6. To what extent do the handwashing stations encourage proper hand washing by the individuals using them?
7. How do we ensure sustainability of the handwashing station in terms of functionality, maintenance and use?

8. What are the key strategies and factors that have contributed to what has worked and what did not work?

6. Study aims and objectives

6.1 Study aim

To assess the progress of current deployed hand washing stations among the communities and gain information on how best the HWS services can be improved in Kenya.

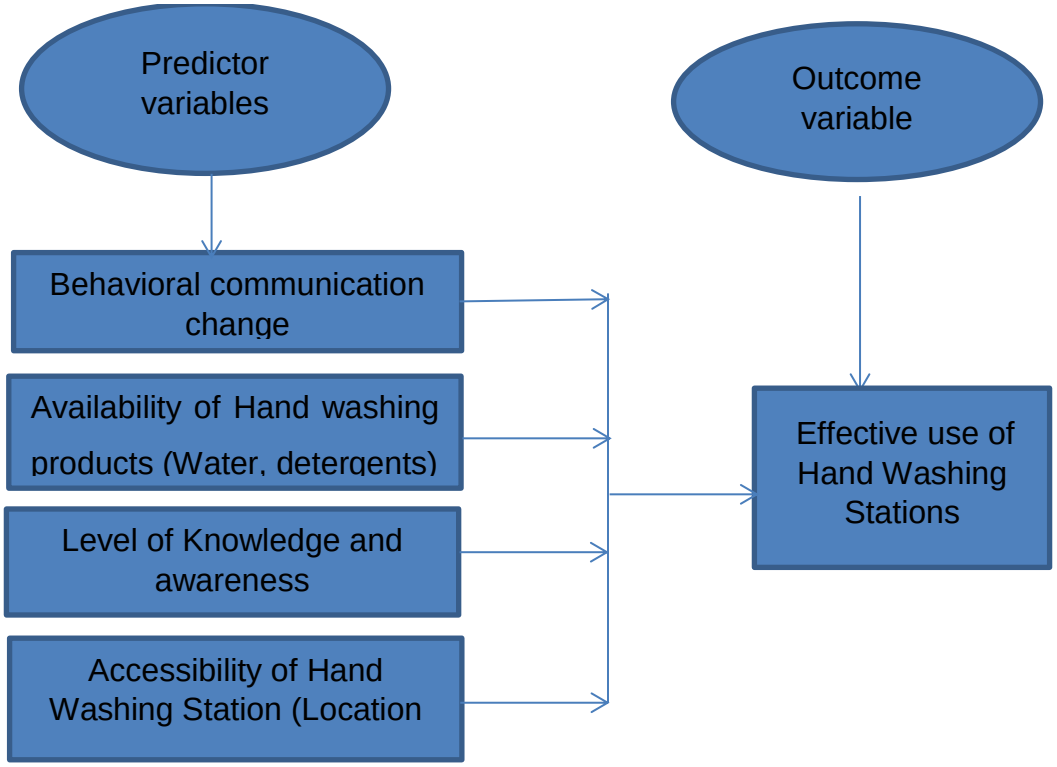
6.2 Study objectives

- To assess the current status of handwashing stations that have been deployed so far in terms of function, use, accessibility and maintenance
- To assess barriers to effective use of handwashing stations
- To identify any gaps that exist in relation to the handwashing stations and determine how best the handwashing services can be improved and sustained.

6.3 Conceptual Framework

The below conceptual framework for effective use of HWS describes the dependent and independent variables. The outcome variable is effective use of HWS whereas the independent variables that affect our predictor variables include behavioral change communication, knowledge and awareness of the importance of proper handwashing, accessibility of HWS, and availability of handwashing products.

FIGURE 2: CONCEPTUAL FRAMEWORK



7. Methods

7.1 Study design

The study was mixed-methods observational study designed to assess the current status of a sample of the handwashing stations deployed by partners of the NBCC. Quantitative research methods were used to assess the functionality of the HWS. Qualitative research methods identified motivators and barriers to usage of hand washing stations.

7.2 Study Population

The study targeted handwashing stations deployed by partners of NBCC and individuals responsible for their day to day operations. Users of these handwashing stations were also targeted.

7.3 Study sites

The study was conducted in 5 counties in Kenya; Nairobi, Kwale, Embu, Mombasa and Homabay. The counties were selected based on the following criteria:

1.) The county had to be one in which the NBCC have distributed handwashing stations as a response to COVID-19
2.) The county had to be one of the counties targeted for the DFID-Unilever Program
3.) The county must have enough handwashing stations, both in terms of volume and partner distribution for the cumulative number to be able to meet the statistical requirements

Some contextual information (Table 1) and a map (Figure 3) to illustrate the geographical location of the counties is provided below.

TABLE 1: CONTEXTUAL INFORMATION OF THE STUDY SITES. (KENYA NATIONAL BUREAU OF STATISTICS , 2019)

County	Description
Kwale	Kwale County is located in south coast of Kenya and covers a total surface area of 8,254 km^2. It is divided into 4 sub-counties and 20 assembly wards. The county has a population of 866,820 with a population density of 105 people per km^2.
Mombasa	It covers an area of 229.7 km^2 and is situated in the south eastern part of the Kenyan Coast region. The county is divided into 6 sub-counties, and 30 assembly wards. The County has a population of 1,208,333 with a population Density of 5495 people per km^2.
Embu	The County is situated in the larger eastern region of Kenya and occupies a total surface area of 2,821 km^2. It is divided into 5 sub-counties, with a total

County	Description
	of 20 county assembly wards. The County has a population of 608,599 with a population Density of 216 people per km^2.
Homa Bay	The county is situated in the larger Nyanza region of Kenya and covers an area of 3,154.7 km^2. It is subdivided into 8 sub-counties with 40 assembly wards. The county has a total population of 1,131,950 persons, and a population density of 359 people per km^2.
Nairobi	This is Kenya's capital and covers a total surface area of 704 square km. The county is subdivided into 17 Sub-Counties consisting of 85 assembly wards. The county has a total population of 4,397,073 and a population density of 6247 people per km^2.

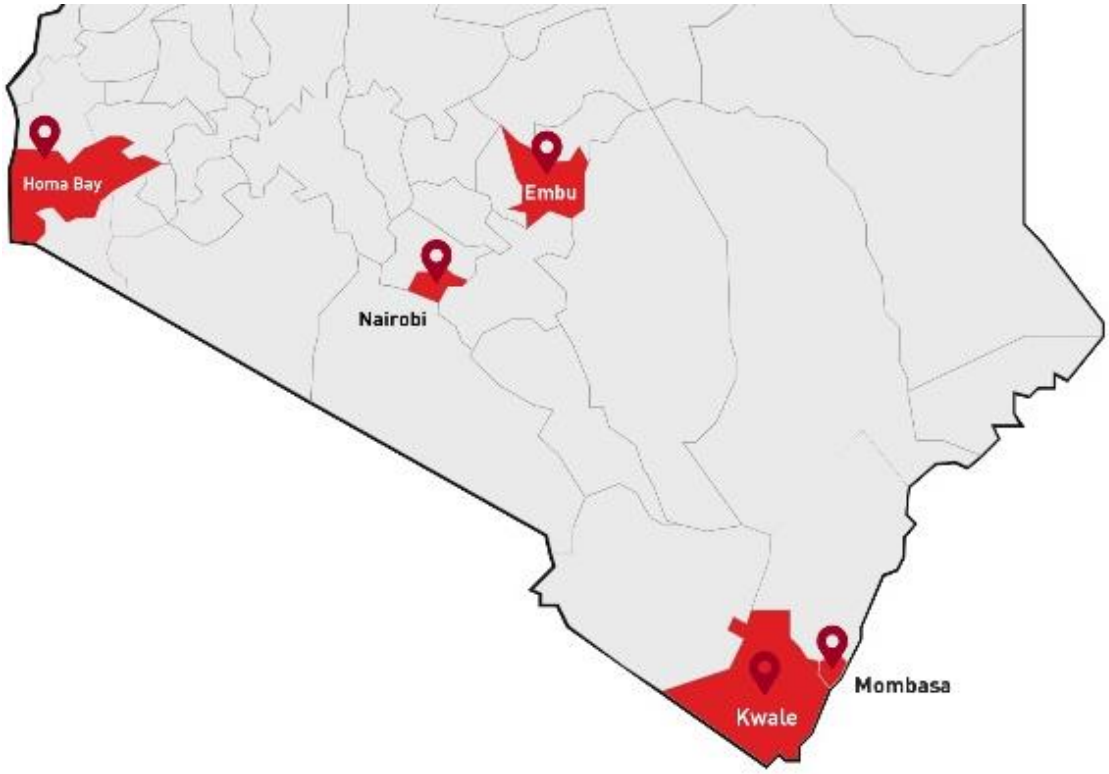


FIGURE 3: MAP OF KENYA SHOWING THE STUDY SITES. SOURCE: AMREF HEALTH AFRICA

7.4 Sample size determination

Quantitative

A finite population sample size formula was used to determine the sample size of HWS

$$n = \left\{ \frac{\frac{(Z)^2 \times P(1-P)}{(e)^2}}{1 + \frac{(Z)^2 \times P(1-P)}{(e)^2 N}} * deff \right\}$$

Where

- **z**= Selected critical value of desired level of confidence. We use 95% confidence level that correspond with Z=1.96
- **p**=prevalence (in this study, it is assumed that there is a 50-50 chance of someone visiting a HWS) = 0.5
- **e**=acceptable margin of error for this study= 5%
- **N**=population=deployed HWS in HBCC supported Counties=2056
- **deff** = design effect; due to effect of stratification, the study will assume design effect of 1.2

Applying these parameters in the formula yielded a sample size n =389. The study allowed a 10% loss of information due to lack of response. To compensate for this, the sample size was adjusted upward by 10%. Minimum sample size became 389+40=429 which was rounded to 430 HWS. The sample was distributed proportionately amongst partners as tabulated below in Table 2.

TABLE 2: SAMPLE DISTRIBUTION BY COUNTY, PARTNER, TYPE OF CARETAKER AND PHASES OF DISTRIBUTION

County	Partner	Paid caretakers	Unpaid caretakers	Facility/Phase	Month of distribution	Volume of HWS	Total
Nairobi	SHOFCO	86	0	Phase III HWS	Jul & Aug 2020	100 l	86
	JJK	0	30	Phase III HWS	Jul & Aug 2020	100 l	30
	Rotary	14	50	Phase I & II HWS	Apr/May & June 2020	20 l & 60 l	64
	Sanergy	0	15	Phase III HWS	Jul & Aug 2020	100 l	15
Kwale	Shujaaz	0	55	Phase II HWS	May & Jun 2020	60 l	55

County	Partner	Paid caretakers	Unpaid caretakers	Facility/Phase	Month of distribution	Volume of HWS	Total
Embu	COPIA	0	70	Phase I & II HWS	Apr/May & June 2020	20 l & 60 l	70
Mombasa	BRCK	0	60	Phase III HWS	Jul & Aug 2021	100 l	60
	Rotary	0	20	Phase II & III HWS	May & Jun/ Jul & Aug 2020	60 l & 100l	20
Homabay	COPIA	0	10	Phase I HWS	Apr 2020	20 l	10
	Rotary	0	20	Phase I HWS	Apr2020	20 l	20
Total		**100**	**330**				**430**

7.5 Sampling procedures

Quantitative data

For quantitative data, systematic sampling procedures was adopted, with a random start to select the HWS to be surveyed. Of the 5000 HWS deployed in the 10 HBCC target counties, a list of 2056 HWS in the 5 sampled study Counties was compiled from the partner's database. This list served as our sampling frame where a sample of 430 HWSs were selected for spot checks, caretaker survey, user exit interview, and user observation. 2 to 5 users per HWS were targeted for the exit interview. They were purposively sampled for diversity i.e., male, female, elderly people and people with visible disabilities. Inaddition, 2 to 5 users per HWS in 200 HWS were targeted to be observed.

Qualitative data

For qualitative data, key informant interviews were conducted with the main stakeholders in the HBCC program, including the NBCC WASH workstream lead, a representative from the Ministry of Health, a member of the governance team of the NBCC and at least 3 Directors of the main partner organizations. A random sample of 12 caretakers (2 each from Kwale, Mombasa, Homabay and Embu; and 4 from Nairobi) of HWS were selected from the caretakers that had not participated in the quantitative survey for indepth interviews. One community in each county was selected for focus group discussion and a purposive sample of up to 10 HWS users and non-users were invited to participate in each focus group. Users were recruited for focus groups following observed use of a HWS. Non-users were identified at the same time from passersby who do not utilize a HWS (and report never to have done so). Efforts were made to include people with disabilities in this sample.

7.6 Data collection and management

7.6.1 Data Collection

An overview of quantitative and qualitative data collection methods, respondents, research questions and sample sizes are available in Table 3.

Quantitative data collection

Quantitative data collection was conducted at 430 handwashing stations. At each station, the data was collected using four data collection tools:

1) Spot Checks of HWS
2) Structured survey with the caretaker of the handwashing station (Caretaker survey)
3) Exit interview with users of the handwashing stations (User survey)
4) Structured observations to users. Structured observations were conducted in 207 HWS out of the target of 200 as a sub-sample of the 340 HWS.

The data was collected in the order specified above by research assistants operating individually. A research assistant working between 9am and 5pm collected data from a minimum of 3 handwashing stations per day with structured observation being conducted during the last visit of the day as appropriate. A short description of the tools is provided below:

- **Spot-check:** The spot check was conducted for a period of 30 minutes in all the facilities using a structured checklist of preselected themes which included: Location, Visibility and Accessibility of Handwashing facility; Handwashing Facility Status; and Convenience and ease of use of handwashing facility.
- **Structured Observation:** this was guided by an observation schedule with a list of relevant things to look out for during the handwashing Sessions conducted over a total of 30 minutes without obstructing the station. Every 2-5 users observed were invited to participate in the user exit interview. The following parameters were observed: the type of user disaggregated by gender and age, the duration of the handwashing session, how they washed their hands, accessibility and ease of use of the facility by the individual, and whether or not soap or water was replenished during the observation period.
- **User exit interview:** Every 2-5 users observed during the structured observation were invited to participate in the interview. The survey sought to evaluate user's perception and experience of using hand-washing facilities.

- **Caretaker structured interview:** This was conducted in all stations visited where a caretaker was present. Caretakers were asked questions relating to maintenance and sustainability of the handwashing facilities

All quantitative data was collected electronically using Open Data Kit (ODK). Further details are available in 6.2 (Data Management).

Qualitative data collection

Qualitative data collection comprised key informant interviews, in-depth interviews and focus group discussions. Data was collected using interview guides with one person moderating the interviews while another took notes. All interviews were audio recorded and permission was sought prior from study participants to record the interviews.

Key Informant Interviews: Partners (from the NBCC coalition) staff in-charge of WASH activities were invited to participate in the KIIs. All the interviews were telephone based.

In-Depth Interviews: These were conducted with 12 caretakers who did not participate in the caretaker survey to provide additional information regarding maintenance and sustainability of the handwashing facilities.

Focus Group Discussions: 10-12 members of the community living or working in the vicinity of the handwashing facilities; whether users or non-users were invited to participate in FGDs. They helped to ascertain the acceptability and appropriateness of implementing handwashing facilities as a means of mitigating the spread of COVID-19 in communities.

TABLE 3: OVERVIEW OF DATA COLLECTION METHODS, PARTICIPANTS AND SAMPLE SIZE

Technique	Respondents	Research question	Sample size
Quantitative data collection			
Spot checks	N/A	1, 2, 3, 5	430
Caretaker structured interview	Caretaker of handwashing stations	4, 7	430
User exit interview	Users of handwashing stations	1,5,6	2-5 per handwashing station x 430

Structured observation	Observing users using the handwashing stations	2,3,5	30 min observation x 200
Qualitative data collection			
Key informant interviews	Partner staff in-charge of WASH activities	7, 8	At least 3
In-depth interviews	Caretakers of HWS	1, 4, 6, 7, 8	12
Focus group discussions	Members of the community (HWS users and non-users)	1,5,6,7	5 focus groups (1 per county)

7.6.2 Data Management

All data tools and data collection sessions were conducted in both English and Swahili and the Swahili ones were later translated to English after completion of data entry.

Quantitative data

Quantitative data was collected electronically using a semi structured questionnaire programmed in Open Data Kit (ODK). The data was collected using tablets configured with ODK. This helped ensure data quality and data completeness. Data was transmitted onsite to Amref Health Africa's servers, one of the NBCC partner immediately after the interviews were completed. Quantitative data collected was stored in the Amref server and repository for purposes of validating the research, furthering knowledge and to aid preservation and access. Data will be stored in this location for 5 years from the completion of the project, and then destroyed.

Qualitative data

Audio recordings from qualitative data collection was transcribed into English and stored in encrypted files and folders on password protected computers. Data was only be accessible to the study team during the study period and was backed up on external hard disks. Data will be retained for 5 years as per Amref data policy.

The destruction of data and records will be done after 5 years using a professional data erasing service to remove data on hard disk drives to prevent unauthorized re-use for soft data. Data will be destroyed with written authorization and documentation of the data and the destruction processes used.

7.6.3 Data analysis

Quantitative data

Quantitative data was exported to MS Excel then later exported to SPSS (Version 20) for descriptive analysis and Stata 16 (Stata Corp 2015, College Station, TX, USA) for chi-square test. MS Excel was used to create charts and graphs with data disaggregated and analyzed by whether they are paid/unpaid caretaker and type of facility.

Qualitative data

Qualitative data analysis was carried out using NVIVO software. Deductive and inductive approaches was used to generate themes from the transcribed data. Data was also disaggregated and analyzed by whether they were paid/unpaid and type of facility. Triangulation of the data was done by gathering and analyzing information from different data tools for a comprehensive perspective.

7.7 Quality Control

A variety of steps was instituted in order to make sure that high quality data is collected. The first area of quality control was the development of evaluation (data collection) tools. The development of the tools was carried out in close collaboration with the LSHTM co-investigators.

The research assistants underwent a three-day training on ethics, consent processes and study tools to ensure that survey procedures and tools are clear and information to be collected is understood. Some of the required qualifications of the Research assistants include: being computer literate, with KCSE certificate and a mean grade of C-. Those who understood the local language were recruited in order to mitigate the issue of language barriers.

A pre-testing of the evaluation tools was carried out before embarking on the fieldwork. All tools were pretested within the non-sampled HWS. This took place on the 3rd day of training. The pre-test gave the opportunity to assess; the reactions of the respondents to the research protocol, ability of respondents to accurately understand questions asked as well as the ability of the research assistants to ask the right questions and record them accurately. All tools were revised after the pilot testing of tools had been completed.

To ensure high quality data was collected, there was rigorous supervision in the field. There was a supervisor for every 8 research assistants. The supervisor accompanied research assistants in

the field on occasion, particularly at the start of the data collection period. They conducted spot checks on all collected questionnaires to ensure data accuracy. Callbacks was made to ensure that the respondents were truly interviewed. Study participants tracking sheets was in place to ensure that all sampled individuals are accounted for. Debrief meetings were held with data collectors at the end of each day to review questionnaires and record any incidents/events occurring during data collection.

The data was cross-checked for consistency and completeness immediately after its transmitted in the server and any issues of data quality was addressed. Prior to the analysis, further data cleaning was carried out using frequency distributions and cross-tabulations of the dataset to check for completeness of the data.

7.8 Study Limitations

There are some important limitations to this study. First, self-reported data from the caretakers on the management of the handwashing stations could have been influenced by social desirability bias. The fact that some caretakers were paid while some wanted to maintain a good image since the stations were donations could have prompted them to respond differently rather than their true behavior. In addition, the frequency of utilization of the hand washing stations could not be determined during the 2-hour period spent at each of the hand washing station as this period of time was not sufficient. Third, because of time constraints and the unique characteristics of the setting especially in rural areas, where shopping centers were not busy during morning hours, there were chances that data collected in these areas in the morning hours were not representative of the situation. Future studies in similar settings could consider collecting data throughout the day and comparing it depending on time of day. Fourth, we did not collect data to compare user's vs non-users which could have helped determine the use rate, performance and utilization. Future studies could consider collecting this data.

7.9 Ethical Considerations

7.9.1 Ethical Approval, permissions and Consent

Ethical approval for this study protocol was obtained from the London School of Hygiene & Tropical Medicine (UK) (reference number: 22704) and from Amref 's Ethical and Scientific Review Committee (ESRC) in Kenya (Reference number: P875_2020). The principal investigator and the co-investigators ensured that the study adheres to all the other standard ethical practices.

All investigators completed an ethical certification course and availed a certificate of completion as a requirement for protocol approval by ESRC. In order to gain the participants informed consent, the research aims, and processes were explained to all participants upon which the literate interviewees were asked to sign physical paper forms, whilst those illiterate were asked for thumbprint for the illiterate participants, for face-to-face interviews; whilst verbal consent were obtained for the telephone interviews. Participant information sheets were read out to participants in order to assure that all information had been covered. A witness (such as a family member, person from a neighboring house or passerby who is literate) signed to validate that this thumbprint was that of the research participant.

Relevant permission was sought from the respective county health management teams and authorities to collect data. As far as possible, data collection was planned around local community timetables and took into consideration events and routine activities.

8. Study Findings

8.1 Introduction

This study was conducted in the five counties of Nairobi, Embu, Kwale, Mombasa and Homabay in Kenya. The study targeted to observe 430 HWS and interview 430 caretakers of the HWS. However, only 73.5% of HWS were located meaning 114 HWS were not found at the location were they had been distributed (Table 4). Reasons why handwashing stations were not located are presented in Table 5. Caretakers were present at 304 out of the 316 HWS located (Table 4).

In addition, a total of 578 HWS users exit interviews, 411 user observations, 5 focus group discussions, 9 in-depth interviews and 7 key informant interviews were conducted.

TABLE 4: OBSERVED HWS, CARETAKERS INTERVIEWED AND HWS OBSERVED WITH CARETAKERS

County	Target	HWS located	HWS with caretaker present
Nairobi	195	162 (83.1%)	159 (98.1%)
Homabay	30	22 (73.3%)	22 (100%)
Mombasa	80	55 (68.8%)	50 (91.0%)
Embu	70	45 (64.3%)	41 (91.1%)
Kwale	55	32 (58.2%)	32 (100%)
Total	**430**	**316 (73.5%)**	**304 (96.2%)**

TABLE 4: REASONS WHY HWS WERE NOT LOCATED DURING THE STUDY

Reasons why HWS were not located during the study (n=144)	n	%
Caretaker was away	34	29.8
HWS and Caretaker were not traced	24	21.1
HWS was in the store	16	14.0
Absent due to business and caretaker relocated	12	10.5
HWS was at the caretakers home	9	7.9
Caretaker in the distribution list but claimed that HWS was not allocated to them	7	6.1
Caretaker claimed that HWS was tedious to keep on moving	5	4.4
HWS was stolen	4	3.5
Others (HWS is not in use because church members preferred sanitizers, HWS was returned to the supplier for repair, HWS is not use because it is not safe outside. Management of the Home for the aged is planning to fix it permanently)	3	2.6

8.2 Current status of handwashing stations

8.2.1 Functional handwashing stations

A functional handwashing facility defined as having the following present at time of observation: water in the tank, soap located on or next to the facility and a tap that is working. The results (table 6) show that 93% of the HWS had water, 88.9% had soap available for use (25.6% bar soap, 61.7% liquid soap and 1.6% soapy water) placed on or next to the HWS. From checks done on functionality of the taps, 92% of the HWS taps were working with no leaks, 5.4% were working with notable leakages and 2.5% were dysfunctional. Among those operational, 99.7% were opened and closed using hands and 0.3% using a foot pedal. However, users in 10.4% of those opened by hands experienced difficulties in opening and closing taps while washing hands. Overall, 83.9% of the handwashing stations were observed to be functional (i.e., had water, soap, visible and operational taps) with 6.6% observed as having defects ranging from minor cracks to major breakages.

A higher proportion of handwashing stations (61.1%) could be easily spotted by a user who was within the station's vicinity whereas 37% had to be located or were only easily visible when a user knew where they were. Only 1.9% presented difficulty in locating through direct observation, a possible indication of limited use.

TABLE 5: OBSERVED FINDINGS ON FUNCTIONALITY OF HANDWASHING STATIONS

Functionality of handwashing stations (n=316)	All HWS, n = 316	HWS with unpaid caretaker n=218	HWS with paid caretaker N=98	p-value
HWS is functional, n (%)*	265 (83.9%)	171 (78.4%)	94 (95.9%)	<0.001
Presence of water in the HWS				
No water	22 (7%)	19 (8.7%)	3 (3.1%)	<0.001
There is very little water in the tank	54 (17.1%)	47 (21.6%)	7 (7.1%)	
The water level is slightly below half	110 (34.8%)	76 (34.9%)	34 (34.7%)	
The water level is over half of the tank's capacity	99 (31.3%)	62 (28.4%)	37 (37.8%)	
The tank is at full capacity	31 (9.8%)	14 (6.4%)	17 (17.3%)	
Soap available for use				
Bar soap is available	81 (25.6%)	79 (36.2%)	2 (2.0%)	<0.001
Liquid soap is available	195 (61.7%)	101 (46.3%)	94 (96.0%)	
Soapy water is available	5 (1.6%)	5 (2.3%)	0 (0.0%)	
Soap is not available	35 (11.1%)	33 (15.1%)	2 (2.0%)	
Location of the soap**				
Next to the water tank	247 (87.9%)	155 (83.8%)	92 (95.8%)	0.011

Functionality of handwashing stations (n=316)	All HWS, n = 316	HWS with unpaid caretaker n=218	HWS with paid caretaker N=98	p-value
On top of the water tank	29 (10.3%)	25 (13.5%)	4 (4.2%)	
In physical custody of the caretaker (inside the business premise)	5 (1.8%)	5 (2.7%)	0	
Breakages/cracks visible on HWS	21 (6.6%)	12 (5.5%)	9(9.2%)	0.225
Status of Tap				
Faulty – not working	8 (2.5%)	7 (3.2%)	1 (1.0%)	0.033
Working but leaking	17 (5.4%)	16 (7.3%)	1 (1.0%)	
Working without leaking	291 (92.1%)	195 (89.4%)	96 (98.0%)	
Ease of use of tap				
The tap opens and closes easily	275 (87.0%)	179 (82.1%)	96 (98.0%)	<0.001
The tap is difficult to open and/or close but eventually does	33 (10.4%)	33 (15.1%)	0 (0.0%)	
The tap does not work at all	7 (2.2%)	6 (2.8%)	1 (1.0%)	
There is a foot pedal operating the tap and it works well	1 (0.3%)	0 (0.0%)	1 (1.0%)	
Visibility of the HWS (n=316)				
Easily visible in the vicinity of its setting	193 (61.1%)	125(57.3%)	68(69.4%)	0.116
Visible if you know where it is located	117 (37%)	88(40.4%)	29(29.6%)	
Was difficult to find, not visible at all	6 (1.9%)	5(2.3%)	1(1.0%)	

* Functional handwashing facility defined as having the following present at time of observation: water in the tank, soap located on or next to the facility and a tap that is working.

** Percentages were estimated from slightly smaller denominators than those shown at the top of the table for the following variables due to value of other variables or unanswered survey questions/missing values.

Table 7 presents the presence of water observed in the HWS in relation to the size of the reservoir tank. Obviously, the frequency of refill of the 20 litres will be more often than the 100 litres, but the burden differs between 20 litres and 100 litres – more frequently, difficult to fill 100 litres if it is manual, rather than pumped etc.

TABLE 6: PRESENCE OF WATER FOR HANDWASHING VS VOLUME OF THE HANDWASHING STATION

Presence of water for handwashing vs volume of the HWS	n (%)	Volume of the HWS		
	Total	**20 liter**	**60 liter**	**100 liter**
No water	22 (7.0%)	5 (11.1%)	4 (8.5%)	13 (5.8%)
There is very little water in the tank	54 (17.1%)	20 (44.4%)	14 (29.8%)	20 (8.9%)
The water level is slightly below half	110 (34.8%)	12 (26.7%)	16 (34.0%)	82 (36.6%)
Water level is over half of the tank	99 (31.3%)	7 (15.6%)	12 (25.5%)	80 (35.7%)
The tank is at full capacity	31 (9.8%)	1 (2.2%)	1 (2.1%)	29 (12.9%)

8.2.2 Use of handwashing stations

From the direct observations, the handwashing stations were used by people across different age groups, with 88.6% (365) adults observed washing their hands aged between ages 18 and 59 years, and preschools children and the elderly users were the least users, at 1% (4) and 1.9% (8) respectively (table 9).

Of the 411 persons observed, 96.6% (397) washed their hands independently with no assistance, while 3.4% (14) received some form of assistance while washing like opening and closing of tap and dispensing of soap. In the instances where assistance was offered, it was mainly by the caretaker (71.4 %.) In 96.7% and 95.6% of the stations, users dispensed soap and opened and closed taps by themselves respectively (table 9).

On use of soap and proper handwashing, 84.7% (348) of observed users used soap while washing their hands with about half (49.4%) of the users following the correct technique of washing hands disaggregated by gender and age as below (table 8). Finally, the findings from the users' survey indicated that, 60.2% (183) of the respondents recalled to never have missed using soap in their hand washing instances.

TABLE 7: DISAGGREGATION OF DEMONSTRATION OF PROPER HANDWASHING TECHNIQUES

Person using the station	Total	Washed hands properly[1]
Older Adult (>60yrs)	8 (1.9%)	3 (1.5%)
Adult Male (18-59yrs)	238 (57.9%)	110 (54.2%)
Adult Female (18-59yrs)	127 (30.9%)	67 (33.0%)
School age child (5-18yrs)	34 (8.3%)	22 (10.8%)
Pre-school child (<5yrs)	4 (1.0%)	1 (0.5%)

[1] Proper handwashing is the act of cleaning one's hands with soap and running water for at least 20 seconds

TABLE 8: OBSERVED USE OF HANDWASHING STATIONS

Variable	All HWS	HWS with unpaid caretaker	HWS with paid caretaker	p-value
Number of users	411	249 (60.6%)	162 (39.4%)	
Person using HWS (n=411)				
Older Adult (>60yrs)	8 (1.9%)	4 (1.6%)	4 (2.5%)	<0.001
Adult Male (18-59yrs)	238 (57.9%)	161 (64.7%)	77 (47.5%)	
Adult Female (18-59yrs)	127 (30.9%)	75 (30.1%)	52 (32.1%)	
School age child (5-18yrs)	34 (8.3%)	9 (3.6%)	25 (15.4%)	
Pre-school child (<5yrs)	4 (1.0%)	0	4 (2.5%)	
Person used the station independently (n=411)	397 (96.6%)	243 (97.6%)	154 (95.1%)	0.167
Who assisted persons who did not use the facility independently (n=14)				
Caretaker	10 (71.4%)	3 (50.0%)	7 (87.5%)	0.124
Someone else	4 (28.6%)	3 (50.0%)	1 (12.5%)	
Used soap to wash hands (n=411)	348 (84.7%)	203 (81.5%)	145 (89.5%)	0.028
Washed hands using proper technique (n=411)	203 (49.4%)	99 (39.8%)	104 (64.2%)	<0.001
How often have you found that there was no soap (n=304)				
Never	183(60.2%)	119(56.9%)	64(67.4%)	0.426
Once	26(8.6%)	20(9.6%)	6(6.3%)	
Sometimes this happens	68(22.4%)	49(23.4%)	19(20.0%)	
This happens often	25(8.2%)	19(9.1%)	6(6.3%)	
Always	2(0.7%)	2(1.0%)	0	

* The 30 minute structured observation period varied between handwashing facilities. It was conducted between the hours of 8.00 am and 5.00 pm.

To further cue and/or inspire proper handwashing practices and the practicing of other key desired COVID-19 preventive measures, IEC posters were observed on 45.6% of the hand washing stations, with varying messages that included proper handwashing steps, and information on COVID-19 preventive measures. The findings also presents that 56.5% felt that the educative information displayed on the handwashing station was clear and easy to read. Furthermore, estimations of people present around the handwashing stations at the time of visit were done as a proxy indicator of right/strategic location of the handwashing station and indicated that up to 10 people were spotted around 62% of the handwashing points (table 10).

TABLE 9: IEC MATERIAL ON HWS

Variable	n	%
Information material glued on HWF (n=316)		
Yes	144	45.6
No	172	54.4
Information HWS is clear and easy to read (n=352)		
Yes	199	56.5
No	153	43.5
Estimated people around HWS (n=316)		
0-10	120	38
11—20	87	27.5
21-50	65	20.6
51-100	29	9.2
More than 100	15	4.7

8.2.3 Access to handwashing stations

The ability and ease for the different user-population cohorts to access the various deployed HWS varied. From the analysis (table 11), the study established that 49.1% of the installed HWS could not be physically accessed by a person on a wheelchair, while only 15.8% could be physically accessed by this group but could not use them mainly due to inappropriate height. As well, 23.1% of children users and 23.7% elderly people experienced access challenges. However male and female adults above the age of 18 forming 57.9% and 30.9% of users easily accessed and used the installed handwashing stations with no notable challenges.

TABLE 10: ACCESS TO HANDWASHING STATIONS

Accessibility (n=316)	n	%
Accessibility of the HWS		
Easily accessible (visible and no obstuction) to everyone in the vicinity of the facility	246	77.8
Only accessible to those in the immediate vicinity	70	22.2
Accessible for a person using a wheelchair		
Yes	111	35.1
Can physically access the station, but could not use it	50	15.8
Can potentially physically use the station (reach tap etc.), but could not physically access it due to the ground being uneven or muddy	46	14.6
No	109	34.5

Accessible for children	243	76.9
Accessible for elderly	241	76.3

8.2.4. Operation and Maintenance of HWS

Out of the total 304 caretakers interviewed, 82.6% were caretakers to which HWS were originally allocated to, whereas 17.4% were secondary i.e., assigned by original caretaker to operate and maintain the HWS. About half of the caretaker respondents (52.0%) reported to have received a form of training or sensitization on maintenance of their handwashing stations. Training was more commonly received by paid caretakers than by unpaid caretakers (71.6% vs 43.1%, *P<0.001)* (Table 12).

Majority of the caretakers (79.6%) visited the handwashing stations multiple times in a day to check on a number of issues. The commonly checked variables were water levels (95.4%) and soap levels (85.5%).

From the survey findings, 84.2% of the caretakers repored that water to refill the tank was readily available when needed, and that the tanks were mainly refilled when below half the tank in 85.5% of the HWS. The caretakers also reported that soap was replenished by both care takers (89.1%) and other individuals (10.9%) to facilitate continuous handwashing. Of these, both caretakers and other individuals, 80.3% reported to replace the soap when at low levels i.e., just before running out, and 16.4% replacing when the soap completely ran out. Majority of the caretakers (66.4%) reported that at no instance were they unable to replace soap because of unavailability. On cleaning of the HWS, a similarly integral component in maintenance of the handwashing stations, 83.9% of the caretakers did the cleaning whereas other individuals cleaned 15.8% of the HWS (Table 12).

Some potential setbacks from the caretaker survey findings included the cumbersomeness in refilling water with 44.7% alluding to find refiling cumbersome and inability to refill water in one or several instances reported by 28% of caretakers. Of the 304 caretakers who were interviewed, 49.7% and 47.4% reported to have a system that notified them when soap and water respectively ran out (Table 12).

TABLE 11: OPERATION AND MAINTENANCE OF THE HANDWASHING STATIONS

Characteristics	All HWS, n = 304	HWS with unpaid caretaker n=209	HWS with paid caretaker N=95	p-value
Caretaker was located, n (%)*	304 (96.2%)	209 (95.9%)	95 (96.9%)	0.646
Caretaker is the original caretaker, n (%)	251(82.6%)	165(78.9%)	86(90.5%)	0.014
Received training on HWS maintenance, n (%)	158(52.0%)	90(43.1%)	68(71.6%)	<0.001
How often does the caretaker visit the HWS, n (%)				
Multiple times a day	242(79.6%)	160(76.6%)	82(86.3%)	0.189
At least once a day	50(16.4%)	41(19.6%)	9(9.5%)	
At least twice a week	10(3.3%)	6(2.9%)	4(4.2%)	
Less than once a week	1(0.3%)	1(0.5%)	0	
Whenever I am notified that there is a problem	1(0.3%)	1(0.5%)	0	
What they check when visit HWS, n (%)				
Water levels	290 (95.4%)	198(94.7%)	92(96.8%)	0.417
Soap levels	260 (85.5%)	174(83.3%)	86(90.5%)	0.095
Cleanliness	193 (63.5%)	121(57%)	72(75.8%)	0.003
Tap is working properly	133 (43.8%)	89(42.6%)	44(46.3%)	0.543
Tap is not leaking	85 (28%)	54(25.8%)	31(32.6%)	0.221
Other	25 (8.2%)	14(6.7%)	11(11.6%)	0.151
Draining water basin is full	7 (2.3%)	5(2.4%)	2(2.1%)	0.877
Who replaces soap?, n (%)				
Caretaker	271(89.1%)	180(86.1%)	91(95.8%)	0.012
Other individuals	33(10.9%)	29(13.9%)	4(4.2%)	
When is soap replaced?, n (%)				
When it reaches a low level/preset level	244 (80.3%)	161 (77.0%)	83 (87.4%)	0.036
When there is no soap at the station	50 (16.4%)	42 (20.1%)	8 (8.4%)	
Other	10 (3.3%)	6 (2.9%)	4 (4.2%)	
There is a system in place to notify when there is no soap, n (%)	144 (47.4%)	103 (49.3%)	41 (43.2%)	0.322
Is it cumbersome to source water to refill the tank?, n (%)				
Yes	136(44.7%)	87(41.6%)	49(51.6%)	0.106
No	168(55.3%)	122(58.4%)	46(48.4%)	
Who replenishes water?, n (%)				
Caretaker	256(84.2%)	174(83.3%)	82(86.3%)	0.497
Other individuals e.g., neighbors	48(15.8%)	35(16.7%)	13(13.7%)	
Water is replinshed when, n (%)				
It reaches a low level / preset level	260(85.5%)	174(83.3%)	86(90.5%)	0.215
There is no water in the tank	36(11.8%)	28(13.4%)	8(8.4%)	
Other	8(2.6%)	7(3.3%)	1(1.1%)	

Characteristics	All HWS, n = 304	HWS with unpaid caretaker n=209	HWS with paid caretaker N=95	p-value
System to notify when there is no water, n (%)	151(49.7%)	99(47.4%)	52(54.7%)	0.234
Unable to refil water because it was unavailable				
Yes	85(28.0%)	48(23.0%)	37(38.9%)	0.004
No	219(72.0%)	161(77.0%)	58(61.1%)	
HWS is cleaned by, n (%)				
Caretaker	255 (83.9%)	168 (80.4%)	87 (91.6%)	0.045
Other individual	48 (15.8%)	40 (19.1%)	8 (8.4%)	
No one	1 (0.3%)	1 (0.5%)	0	

*Percentages were estimated from slightly higher denominators that take into account all 316 HWS that were observed

8.3 Barriers to effective use of handwashing stations

The study investigated on a number of factors considered to affect access to HWS and effective handwashing practices. The intermediate barriers established were on availability of handwashing stations, availability of hand hygiene commodities like soap and water, design features of the stations, their location/placement, hygiene behaviours, and motivation levels of caretakers.

8.3.1 Availability of handwashing commodities

Despite availability of water and soap in majority of the stations i.e., 93% (294) and 88.9% (281) respectively, about 7% (22) had no water at the time of visit and lack of readily available soap was observed in 9.2% of the HWS. From the analysis of the caretaker interviews, 33.6% (102) and 28% (85) of caretakers noted that they were unable to replace soap and water respectively at least at one point in time due to various reasons (stock levels, intermittency of water supply, costs). The respondents highlight the following barriers:

"There is a water problem and that why when Corona started, there were several NGOs that were supplying water in the area. Now that they are no longer supplying water, there is a big water shortage" (FGD-MSA-R5)

"....but water gets lost in town frequently. You find sometimes it is unavailable. There are times you find it depleted. Now you know you won't go round looking for water because it's a town, and

it is huge. So you may wonder where you will find it. You just wait until the time it comes back on. When it comes back on then we had arranged how we will be fetching so you come and put water." (FGD-EMB-R5)

Further, with 16.4% of caretakers citing to replace soap when it was completely out at the HWS, as opposed to 80.3% who replaces when it hit low levels, potentially indicates possibilities of lack of soap at certain times to facilitate at the HWS.

"The problem comes in with soap…you find now soap is usually not there. When you just place it, it does not last because there are many people. Even if you decide to buy it yourself, it won't last. By 11 am, it is usually depleted. Sometimes we just wash our hands like that." (FGD-EMB-R9)

"Again soap is a problem. You know in town, there are many people. Even if you place 5 litres, it won't last. It gets depleted. Then you prefer to just wash your hands. God will help you because if you say you will buy daily, you see that you can't." (FGD-EMB-R5)

Lack of a system to monitor water usage and running out in 50.3% of the stations and the cumbersome nature cited among almost half (44.6%) of caretakers in refilling water also inferred a potential lack of water to facilitate washing of hands in some instances. Qualitative analysis from the key informant interviews affirms these potential barriers with one of the respondents stating *"Sometimes even getting water is a problem because water here is seasonal. It comes maybe on Monday and Tuesday then Wednesday, Thursday and Friday it doesn't come until Saturday. So, if people misuse it, we have to go long distance to get for it." (KII, MBS)*

8.3.2 Barriers due to status and design of HWS

a. Height

In 8.3% of the stations (table 12), an average user had to bend over completely in order to wash hands; an indicator of inappropriate height & positioning and/or HWS design. One of the partners involved in procurement and distributed of the HWS stated that, *'a handwashing station should comply with some form of universal standards. Where these standards are around height, if they are too low, usually, the average adult has a problem bending over too far, and that causes a disincentive*." (KII PTN1)

b. Status of the taps

From the analysis, only 2.5% of the taps for the handwashing visited were faulty and completely not working with other 5.4% taps being faulty with leaks but working and 92.1% taps – the majority – working without leaks. Findings from the user survey cited difficulties in operating the tap in 6.1% of the stations with 2.2% of taps not working at all. Further analysis of spot checks indicated that 10.4% of HWS taps were difficult to open or close despite eventually opening and closing. In some instances, (4.1%) HWS caretakers opened and closed taps for users.

c. Drainage system of the HWS

Waste water from 20.3% (64) of HWS drained directly to the ground with 20.3% (120) of the users interviewed reporting to have watched out for water splashing to their feet whilst washing hands. The improper drainage was cited as a challenge by respondents, *"….in most like mine the challenge users experience when washing hands is water splashes on them. Personally, I have improvised by placing a bucket there, which has at least helped" (IDI, NBO).*

d. Perceived cleanliness of the HWS and soap

Some respondents reported that their access and use of a HWS was influenced by the observed neatness of the sites around the HWS or the 'cleanliness' of the bar soap because they feared contamination and subsequent risk of COVID-19.

"There are places the soap is too dirty it even turning black, yet it was a white bar soap. It is touched by many people and nobody bothers to wash it, so when you see it, you don't even want to touch it… I have never washed my hands with dirty soap. I'd rather wash with water only. So many people ouch the soap." (FGD-MSA-R4)

"You can go to a handwashing station you won't use it if the bucket or the soap is dirty. So I won't use it." (FGD-KWL-R2)

"Some handwashing stations are very dirty so one is forced to choose the one that is clean." (FGD-HB-R8)

8.3.3 Information, Education & Communication (IEC) materials

Even with the availability of the handwashing equipment and commodities, lack of clear information on proper handwashing techniques was a potential barrier to proper handwashing with 56.3% of HWS lacking guiding instructions. From use analysis, 50.6% of users did not follow the basic WHO-recommended procedure when washing hands. Both users and staff

implementing the HWS communicated that the IEC materials were not appropriately contextualized, were too wordy, not durable (faded in the sunlight, or fell off due to being wet), or were not fixed at the right height to read whilst at the HWS.

8.3.4 Operation & maintenance management model

Due to the urgency of the response to the pandemic, a clear operation and maintenance model was absent from the outset. However, eventually two types were identified – paid vs unpaid caretakers.

Paid care takers were set up for HWS provided by SHOFCO (and Rotary distributed ones, which relied on care takers mobilized by SHOFCO on their behalf) on the basis that they will be required to be on 'standby' throughout the day to be next or near to the HWS to ensure optimum operation and maintainance, and also based on their high traffic locations, previous incentivized engagement with communities.

Unpaid care takers were set up on the premise that their mobilization, identity would initiate responsibility to respond to the daily upkeep and functionality of the HWS. Some were community members assigned, whilst others owned a business and were allocated the responsibility of the operation and maintence of the HWS, which was located outside/near to their shop.

Yet, the unpaid caretakers posed a barrier to access and utilization of the HWS as they could sometimes 'abandon' the HWS as they had to go about 'other' daily activities leaving the handwashing station unattended.

"The attitude of the owner of these containers. some put you off by telling you that it is not a public facility and that you should go wash somewhere else." (FGD-HB-R3).

"You know you cannot stand there and keep dictating to someone. Customers they are different. So if you stand there and keep telling someone wash your hands well, it can make you lose your customers. You have to keep quiet. You just appreciate the way someone will wash their hands." (IDI-EMB).

"And some customers refuse to wash their hands. They just look at you. And they are adults, you cannot force them to wash their hands." (FGD-EMB-R1))

"It is that now the customer has come, they don't want to wash their hands. You tell them to wash their hands. They tell you there is no Corona. Will you believe that there is Corona? When

someone dies of Corona, then.....Now you know you have to force them to wash their hands. Like I can't sell to them if they have not washed their hands." FGD-EMB-R8).

Some respondents were demotivated by the placement of the HWS, especially those in shops as they felt undue pressure of buying from the shops beyond using the HWS, while others identified the attitude of the caretakers as a potential barrier.

*"Some people do not allow you wash your hands before you buy. After you buy that is when they give you the permission to wash your hands." (*FGD-HB-R9*).*

"There is a particular shopping center where you are told, do not wash your hands if you're not going to buy anything here. And they tell you outright when you just are about touch the tap. You're only allowed to wash your hands if you state that you are going to buy something in the shop. Otherwise, if you are a passerby then you are not allowed." (FGD-MSA-R6).

"At first when Corona started, it was at every shop. You could wash your hands-free in any station, but now if you go to the Mummies Choice and you are not getting a meal you cannot use the facilities. It is private if you are not buying no! no! no!." (FGD-KWL-R5).

These narratives from the communities/users hightlights the opportunities and challenges of the different good intentions of the different operation and maintenance models.

TABLE 12: SUMMARY OF BARRIERS TO EFFECTIVE USE OF HANDWASHING STATIONS

Summary of barriers to effective use of HWS	n	%
Unable to refill water because it was unavailable (n=304)	85	28.0
Unable to replace soap because it was unavailable (n=304)	102	33.6
Appearance of the bar soap (n=81)		
Soap looks dirty	41	50.6
Soap looks clean	40	49.4
Posture while washing hands (n=578)		
I had to bend over completely	48	8.3
I had to lean forward slightly	388	67.1
I could use it in standing position	142	24.6
Drainage system of the HWS (n=316)		
The water drains into a washbasin	252	79.7
The water drains directly onto the ground	64	20.3

Summary of barriers to effective use of HWS	n	%
Checked whether water splashed on the feet (n=578)	120	20.8
The tap opens and closes easily (n=315)	275	87.3
Clear instruction on how to wash hands available in the form of a poster (n=316)	138	43.7

8.4 Ways to improve functionality, user experience of HWS

During the study, existing gaps in relation to the physical attributes of the handwashing stations and various suggestions that can improve the users experiences and promote sustainability of frequent practicing of proper handwashing were identified. Throughout the study, the most commonly suggested gaps and measures were: the need to improve the supply of soap in the HWS, increasing the number and distribution of HWS in various areas, improve the HWS structural design and targeted IEC materials on hand hygiene practices.

8.4.1 Improving ease of dispensing water & soap (contact free)

Suggested measures to improve the ease of dispensing water and soap by the respondents were:

- Changing the tap and soap dispensing system into a foot pedal
- Use of technology and/or rudimentary techniques to calculate/predict use per person and therefore help determine filling rates each day in an effective and efficient manner
- Provide containers to collect waste water to avoid splashing onto feet and ensuring that the height accommodates people living with disabilities, the elderly and children.

This was echoed through the qualitative data. One partner working in rural areas stated that

"*The one important thing that you need to bear in mind is that to fight Corona you need to minimize contact as much as possible, therefore you will want to get a handwashing station whereby you have limited touchpoints. For example, a foot pedal, when you press it water and soap come out*." *(KII-PTN3).* This was reiterated by another partner working with special population groups, *"One I think the design of the handwashing facility would have been that which reduces the level of point of contact between the user and the facility itself…" (KII-PTN1).*

8.4.2 Improving daily operation and maintenance, including replenishment of consumables

Availability and the 'cost' of water especially in the low-income urban locations was identified as a gap, and challenge. In addition to this, the 'one' responsible for the payment for the continuous

re-filling of the HWS is a key issue, especially post-pandemic since most of this was on volunteer basis. One partner stated that,*, "Water was very expensive. When a water tanker comes you will find so many people struggling to get water, sometimes we buy from other vendors and some would charge a lot of money as high as Ksh.20... I still stress water is a challenge." (KII-PTN5).* One strategy could have been establishing clear linkages with water services providers for the supply of water for filling of the public HWS.

The 'high' cost of soap could be a gap that was identified as most depended on donations. Using a market-based approach was identified as a measure to reduce the cost of ensuring availability of and maintaining the supply of handwashing commodities, such as soap*. "The cost of the materials that were used in the production of the liquid soap could be subsidized or zero tax materials so that people can make liquid soaps at home" (KII-PTN5).*

The success of public HWS necessitates shared responsibilities and strategies for commununity ownership to ensure continuous operation and management of the HWSs, including ensuring availability and use of the handwashing commodities. One partner targeting the youth said, *"Can we get the communities around these handwashing stations to own and take care of these handwashing stations…? We want to empower these people so that they can find these things (handwashing stations) on their own… We want to communicate to them the importance of this thing (handwashing station) so they can find them themselves" (KII-PTN4).*

During the study, two distinctive types of management - paid caretakers vs non-paid caretakers, were identified. Even though the clarity of the day to day responsibilities and motivation of the caretakers is hazy (paid or not paid), it is clear that the HWSs must have a caretaker. There is need to also document and develop a toolkit for caretakers and public HWS to address the challenges and opportunities of the NBCC collaboration. Yet, when asked about management of the HWS one of the paid caretakers mentioned that it was not a difficult and that it was the only job that they had. *"It's not hard...So it is up to you to commit yourself to your work so that you manage your work well. If I was not managing this station well, I would have been removed by now. Yes but I have stuck to that one job." They continued to say "...I agreed because right now I have no other job. So I saw it is important instead of staying like that." (IDI-NBI).*

8.4.3 Increase number and distribution of handwashing stations, with coordination efforts

The number of HWS provided were inadequate and could not cover all areas and existing need. This was due to limited resources as it was not practical to provide enough HWS throughout the

country. In addition, HWS were distributed only in regions where the partners had presence, hence some areas that might have been in need did not receive the stations. Having an integrated approach by partners working in the same area was identified as a way to avoid duplication of activities. One partner working in one of the urban informal settlements stated that, *"There is a duplication of interventions in the country because you find different partners doing the same thing, for example, when SHOFCO supplies water to a given area and NMS also supplies water in the same areas although there are other areas with similar needs. There is a need for an integrated approach and synergy like a consortium" (KII-PTN5)*.

8.4.4 Behavior centered communication

A major gap identified in the information materials on the HWS was that the communication approach was not heavily behavior centered. Several respondents identified that the IEC materials were too wordy and did not follow the principles of designing health promotion material (e.g., pre tested, and localized), and hence needed to be simple, succinct and with more illustrations. For instance, one respondent found the materials to be, *"too bulky and too wordy but not catchy. It's not straight to the point. It's too much information lanting to that surface… the information was too much… and the message disappears along the way … too wordy because you just need people to wash their hands…. It should have been very straight to the point. well they would have used some imagery in terms of just photos" (KII-PTN6).* Another partner reiterated the same: *"The information should be user friendly in design so that people could be involved"* and further suggested involvement of special population groups such as people living with disabilities. *"…we need to do more when it comes to behavior change communication in the community. We need to up our game and start thinking about how to be more receptive in terms of language and participation in developing communication. We also need to target people with disabilities." (KII-PTN1).* Finally, there was a suggestion that the IEC materials needed to be more visual and also in a range of local dialect to allow for proper communication: *"I think that the only limitation whether it was done in English or Kiswahili, I think illiterate people were not able to get most of the information on the stickers. We received a lot of batches, but there is one that was good, it had images on handwashing. My thought is that we should avoid being wordy and use explanation imagery." (KII-PTN3). "…I think we could have them in different languages; Kiswahili, Luo, Kikuyu translation, and target people with disability." (KII-PTN 1).*

9 Discussion

In response to our research questions, the following discussion will present analysis of our findings across functionality, the users, accessibility, operation and maintenance, barriers, and enablers, which have encouraged effective hand hygiene and use of the HWS.

Functionality

93.4% of the handwashing stations were functional with 6.6% noted to have defects

A good percentage (93.4%) of HWS found to be functional with minimal breakages, mainly as a result of proper management and simplicity of the HWS, whereas those which had defects were mostly due poor management and design failure. For the HWS where the care taker had to keep emptying the waste water, it is highly like to be a tedious and unsustainable while those which were draining directly to the ground had the risk of splashing to the user, hence discouraging its use.

92% of the HWS taps were working with no leaks, 5.4% were working with notable leakages and 2.5% were dysfunctional. This is an indication that majority of the taps were of good quality. The taps with leakages were mostly the ones that were deployed during the Phase I but were later replaced with improved versions. In addition,

97% of containers had water and 88.9% had soap available for use (25% bar soap, 61.7% liquid soap and 1.6% soapy water)

Water was present in 97% of the containers with 88.9% of them having soap indicates that the HWS were functional for potential use, and provided with the key agents for handwashing – soap and water.

99.7% were opened and closed using hands and 0.3% using a foot pedal. 10.4% of those opened by hands experienced difficulties in opening and closing taps while washing hands

Those who experience difficulties in opening and closing taps was mostly due to the type of fittings use for the HWS in the deployment Phase I, as well as the frequency of use and the handwashing behavior practiced.

Use

On soap utilization, 84.7% (348) of observed users used soap washing their hands with about half (49.4%) demonstrating the correct technique

It was evident that majority of the users wash their hands with soap while the few who do not use soap could be attributed to some stations running out of soap without replacement.

Users behaved differently while using HWS with 58% of them focusing on proper handwashing techniques while a significant number 20.8% were distracted by chatting with others or the external environment, unreadable small writings with many words to read to fit into 20 seconds and water splashing on their feet. These findings show a clear indication that more efforts are still needed in terms adopting clear handwashing nudges and IEC materials supported with appropriate infrastructure for full behavior change to be realized.

Furthermore, the findings that 30.5% of the users clearly understood the messaging coupled with 45% of the handwashing stations had IEC materials on key COVID-19 preventive measures, illustrate that the use of nudges/IEC posters in HWS could yield more results. However, more work is still needed to be done on messaging to ensure all users understand clearly the messages on the nudges/IEC posters and are in multiple languages, engaging, colourful, keep people interested and are visual diagrams instead of written text.

Only 1.9% presented difficulty in locating through direct observation, a possible indication of limited use.

Some of the HWS presented difficulty in locating them as they has been placed in locations where they were not easily visible to many, as they were obscured, hidden or placed inside premises, hence a possible indication of its limited use. This concurs with a study by (Nakanwagi, 2019) which found out that use of HWS is determine by its strategic location. Clear visibility, unobstructed and easy access, and a minimal effort requirement can serve as a simple visual cue that a hand-washing environment is ready and has a positive impact on Hand Washing Compliance. (Eric W. Ford, 2014)

Accessibility

Adult, children and elderly users. 96.6% washed independently, 3.4% receiving some form of support while washing like opening and closing of tap and dispensing of soap. Assistance offered was mainly by the care taker (71.4 %).

It was noted that those who experience challenges in accessing HWS were mainly children, the elderly and people with a disability. This could be attributed to inconvenient heights of the HWS and unfavorable terrains of points of installation, which hinder access and consequently usage.

According to the sanitation hub, one of the ways to ensure accessibility includes; ensuring the tap is high enough so that taller users to not have to stoop too much, but low enough for the shortest users. If there is a large height difference between users, a step/seat could be stored near the facility for shorter users to stand on or taller users to sit on. The height of the soap should be chosen based on similar considerations. (Coultas, 2020)

Operation & maintenance

Care takers are a key and necessary attribute, given their role it ensuring HWS are functional by ensuring there is water and soap (bar or liquid soap), the presence of IEC poster/nudges, drainage in function, and general upkeep and care of the HWS.

Some of the care takers were paid (SHOFCO), whilst most others were genuine volunteers – unpaid care takers. In any public setting, one must understand the motivations, expectations of the proposed management models, to ensure roles and responsibilities are understood both for the short and long term. Care takers of HWS, which were associated with their business had both successes (responsibility, care and provision of soap and water) and challenges (pressure for users to buy something from the care takers business), which need to be contexualised in every case.

Findings present that 53% of the respondent care takers were not the original care takers, coupled with that of 48% respondent caretakers having received no form of training or sensitization on maintenance of their HWS. This indicates that there could be information gaps on maintenance of HWS and therefore there is need for regular checks and refresher trainings on caretakers for full maintenance of the HWS. Such trainings or checks will help address on the issues regarding replacement of soap and water, the cleanliness of the HWS and pressures on users to buy from businesses, to facilitate effective and efficient handwashing and hand hygiene.

Barriers to effective use and ways they can be improved and sustained

Availability of handwashing commodities: Soap and water constitute the key ingredient for proper handwashing. Lack of either or both has a significant effect to the whole handwashing experience and may discourage people from washing their hands.

Availability of handwashing commodities were influenced by different factors such as: proximity to the water points for refill purposes, provision or lack thereof of soap by partners, volume of the users among others. Care takers cited difficulties in refilling soap and water in different occasions with 33.6% (102) stating that they were unable to replenish soap at the HWS, and unable to refill water. Similar to our findings, a study conducted in Ghana identified that barriers to maintaining bar soap at a handwashing station include fear of theft and reluctance to share costs and maintenance duties among people using a common water source. Finding a safe and appropriate place to store soap was a problem as there were concerns that it might be stolen or wasted leading to the practice of intentionally hiding soap in inaccessible places. (Scott B., 2007)

Out of the 545 (94%) respondents who found soap at the handwashing station, only 3.5% had an issue with the status of the soap; they preferred not to use the bar soap citing that it had been in contact with many other people.

Height: The height of the HWS directly affected the posture while washing hands. Placement of the handwashing station directly affects the handwashing experience. Users should be comfortable while washing their hands – they should not bend over too much or stretch too high. Phase I HWS did not have a stand, and users had to stoop over to use it. Standard HWS are designed for the average sized adult. Therefore, children, the elderly and people with disabilities must be provided with assistance while using them. In future when designing and installing HWS the different heights of users, and ease of their use must be considered from the outset. Consult with users, modifiy and consult again until an appropriate design is made.

Status of taps: Faulty taps affect the user's experience as well as the care takers. In the case of taps that are difficult to open, users may despair from washing their hands and in these instances the care taker may have to open for the users. For leaking taps, due to water loss, it would call for constant refilling of the HWS by the care taker, which is cumbersome. Already, nearly half of the care takers engaged felt that refilling water was labour intensive.

In some instances, (4.1%) care takers opened and closed taps for users (1.9%) this could have been an indication of faulty taps, or was a way the care taker ensured proper usage of the taps.

Drainage system of the HWS: Waste water management is paramount in enhancing the user experience. Users may tend to shy away from using stations where they have to worry about water splashing on their feet. More so, run off water may cause the surrounding environment to be unpleasant due to instances of water accumulation or mud if the station is placed on soil

(coupled with ineffective drainage). This could be an indication that the HWS was not equippred with a bucket to collect waste water or the water was intended to drain directly to the ground.

10 Conclusion

This rapid assessment demonstrated that the HWS distributed were functional, visible and accessible and contributed to modest improvements in access to HWS in public settings especially in the context of COVID-19. The findings of the study largely indicated that most of the users washed their hands independently with soap and water but some improvements, e.g. heights of the tap and terrains of installation points, need to be made. The findings of the study recommended the following - improving ease of dispensing water & soap (contact free); improving daily operation and maintenance, including replenishment of consumables; and increasing the numbers and distribution of handwashing stations, with proper coordination**.** There are however gaps and barriers related to access by 'all persons' and effective use, especially using soap. The principal barriers were the constant supply of handwashing commodities (soap and water) especially in the urban informal settlements and poor coordination of activities among various actors causing duplication of interventions in certain areas while others receive little or no intervention. In addition, behavior change communication for hand hygiene interventions need to be deliberate, progressive and focused on specific motives that promote hand hygiene.

11 Recommendations

1. Engage staff an users in practicing handwashing with soap and water to determine the average quantity of water used per handwash in each local context. This demonstration will inform the size of tank of the HWS, the regularity of refilling with water and replenishment of the soap agent.
2. The caretakers manning the HWS require a basic training on behavior change communication with emphasis on handwashing.
3. While mapping out areas to distribute, it would be important to further map the various vulnerable groups so as to provide customized handwashing stations to accommodate various groups of people.
4. Handwashing stations must factor in the drainage of waste water.
5. Replace the taps operated by hands with those operated by foot pedal or automatic sensor taps.

6. The designs and placement of the handwashing stations should be appropriate for all users, including adults, elderly, less abled and children.
7. Establish clear roles, responsibilities and expectations for the caretakers for the short and long term.
8. Consider having tanks with larger volumes for high traffic areas to cater for the demand of users, and to mitigate the cumbersome task of regularly refilling the tank with water.
9. Ensure that the HWS are secured and located appropriately to provide ease of access and usage throughout the day and night.
10. Future studies to:
    a. Increase observation time to get the real picture especially in the rural areas. Better estimates can be obtained from long-term direct observation.
    b. Compare those who washed their hands vis a vis those who did not to assess whether accessibility to a handwashing station promoted or contributed to increase in effective or consistent hygiene practices among communities in the context of COVID-19.
    c. Study to further investigate appropriate operation and maintenance models for ownership and sustainability.

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