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EVALUATING TWO NOVEL HANDWASHING HARDWARE AND SOFTWARE SOLUTIONS IN KYAKA II REFUGEE SETTLEMENT, UGANDA

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The Promotion and Practice Handwashing Kit (PPHWK), a robust, user-friendly handwashing station, and Mum’s Magic Hands (MMH), a creative hygiene promotion strategy, were evaluated in a clustered randomized controlled trial in Kyaka II refugee settlement in Uganda. The trial evaluated whether their provision increased handwashing with soap practice among residents, with a focus on three community intervention arms (PPHWK+MMH, PPHWK only and control) and two school-based intervention arms (PPHWK and control).

The findings suggest that exposure to both the PPHWK and MMH increased hygiene knowledge and handwashing behaviour with soap, and improved health outcomes. Intervention households also preferred the PPHWK over existing handwashing stations, typically a basic bucket with a tap.

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For further information on the issues raised in this paper please email advocacy@oxfaminternational.org

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ABBREVIATIONS

DRC	Democratic Republic of Congo
FGD	Focus group discussion
IDP	Internally displaced person
KII	Key informant interview
MMH	Mum's Magic Hands
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PPHWK	Promotion and Practice Handwashing Kit
RCT	Randomized controlled trial
UNHCR	United Nations High Commissioner for Refugees
WASH	Water, sanitation and hygiene

SUMMARY

Handwashing with soap is widely recognized as a key strategy for reducing the transmission of disease, particularly in emergency contexts, where overcrowding and poor water, sanitation and hygiene (WASH) conditions are common. Combining hygiene promotion with soap provision is accepted as one of the most cost-effective methods for disease prevention; however, this approach has not necessarily translated into a sustained increase in handwashing in emergency contexts. Recent studies have demonstrated the effectiveness of strategies that pair the provision of soap with approaches that use emotional and environmental drivers to increase handwashing with soap practice.

In this study, quantitative and qualitative methods were used to evaluate whether the provision of the Promotion and Practice Handwashing Kit (PPHWK), a user-friendly, robust handwashing station, and Mum's Magic Hands (MMH), a creative hygiene promotion strategy, increased handwashing with soap practice among residents at Kyaka II refugee settlement, Uganda. At the time of the study, the settlement was hosting 62,525 refugees from the Democratic Republic of Congo, displaced due to long-term conflict. A clustered randomized controlled trial, from July to September 2018, included three intervention arms (PPHWK+MMH, PPHWK only and control) and two school-based intervention arms (PPHWK school and control school).

Findings suggest that exposure to both the PPHWK and MMH increased WASH knowledge, influenced change in handwashing behaviour and improved health outcomes. More than 97% of all households in the household survey reported receiving adequate handwashing information since arriving at Kyaka. All households surveyed noted the importance of handwashing before eating. However, those households who received the PPHWK+MMH intervention were significantly more likely to report the importance of handwashing at other critical times: before cooking, before feeding baby and after using the latrine. PPHWK+MMH households were significantly more likely to use soap when handwashing and significantly more likely to report that handwashing with soap was important for the prevention of illness. They were also significantly less likely to report diarrhoea in the previous 14-day period compared with the control group.

Changes in WASH knowledge corresponded with observed handwashing practices. While increases in handwashing with soap practice were noted across groups when compared with baseline, PPHWK+MMH households were observed handwashing with soap in 90.3% of handwashing events assessed, compared with 71.0% of control and 67.5% of PPHWK-only households. It is important to note that no PPHWK-only households were observed engaging in handwashing with soap at baseline. Students at the PPHWK school demonstrated higher rates of handwashing with soap practice throughout the study compared with students at the control school.

Intervention households preferred the PPHWK over existing handwashing stations, typically a basic bucket with tap. More than 40% of all PPHWK+MMH respondents liked almost all of the PPHWK's features, and no feature was disliked by more than 5% of households. The PPHWK was described as attractive and easy to use for persons over the age of five and persons with physical disabilities. Recommendations included printing promotion materials in the local language and providing liquid soap. MMH was also described positively. The content and structure of MMH messaging resonated with mothers, and they reported using MMH training to change handwashing behaviours in their households.

Findings from this study suggest that exposure to both the PPHWK and MMH increased WASH knowledge, increased handwashing behaviour with soap and improved health outcomes. Ensuring the broad provision of low-cost, easy-to-use handwashing technologies with high levels of user acceptability and access to innovative, culturally tailored handwashing promotion strategies may substantially increase handwashing with soap practice in acute emergency settings.

1 INTRODUCTION

Handwashing with soap can disrupt the transmission of pathogens that can cause diarrhoea, a leading cause of morbidity and mortality in refugee settings (Hershey et al., 2011; Peterson et al., 1998; Veerapu et al., 2016; Mahamud et al., 2012). When used consistently, handwashing with soap and water can reduce the risk of diarrhoea by between 31% and 48% (Aiello et al., 2008; Freeman et al., 2014; Curtis and Cairncross, 2003; Cairncross et al., 2010). Current low-cost handwashing solutions available in refugee settings are often poorly constructed and difficult to use, lack adequate drainage and require frequent refilling (Freeman et al., 2014; Curtis and Cairncross, 2003). Further, traditional handwashing promotion strategies, which centre on health beliefs and knowledge as a mechanism for behaviour change, have demonstrated only marginal increases in handwashing with soap practice in these settings (Biran et al., 2012; Phillips et al., 2015). Recent studies have demonstrated the effectiveness of strategies that pair the provision of soap with approaches that use emotional drivers (Biran et al., 2014; Greenland et al., 2016; Greenland et al., 2017) and environmental drivers (Hulland et al., 2013; Jenkins et al., 2013) to increase handwashing with soap.

Standard handwashing promotion strategies are frequently informed by social cognitive models that focus on health beliefs and knowledge as a mechanism for behaviour change (Biran et al., 2014; Rutter and Quine, 2002). In contrast, one study in India tested an intervention based on emotional drivers, including nurture, disgust, affiliation, status and habit, rather than knowledge, to increase handwashing with soap in a rural community (Biran et al., 2014). After the intervention, the proportion of handwashing with soap at key events increased significantly. Others have also noted the potential utility of public health interventions that use emotional drivers (Greenland et al., 2016; Greenland et al., 2017; Curtis et al., 2001). When paired with environmental drivers such as ready access to user-friendly handwashing stations installed near latrines, this approach may demonstrate an even greater increase in handwashing with soap practice.

Handwashing technologies and their characteristics play a potentially important role in enabling or inhibiting regular handwashing at key times (Hulland et al., 2013; Jenkins et al., 2013). Current low-cost handwashing solutions available in refugee settings are often poorly constructed, difficult to use (especially for young children, elderly people and disabled persons), lack adequate drainage and require frequent refilling (Freeman et al., 2014). Poor-quality facilities can inhibit regular handwashing with soap at critical times, including after using the latrine and before feeding young children (Hulland et al., 2013; Jenkins et al., 2013).

The current study, part of an ongoing effort by Oxfam GB to improve handwashing with soap practice in refugee settings, sought to evaluate whether pairing the provision of improved handwashing technologies with effective handwashing promotion strategies increased handwashing with soap practice. A clustered randomized controlled trial (RCT) was conducted to evaluate the effectiveness of the Promotion and Practice Handwashing Kit (PPHWK) and Mum's Magic Hands (MMH) to encourage handwashing with soap practice among newly arriving refugees in Kyaka II refugee settlement, Uganda.

STUDY OBJECTIVE AND DESCRIPTION OF THE INTERVENTION

The purpose of the study was to increase and sustain handwashing with soap practice among all members of a refugee camp population, through the provision of new handwashing stations and tailored handwashing promotion strategies.



Image 1: The Promotion and Practice Handwashing Kit (PPHWK). Credit: Foyeke Tolani

Oxfam, in partnership with a multi-disciplinary team from Dunster House, design specialists from the Royal College of Arts, London, and a behavioural change specialist from The Behavioural Architects UK, has been developing the **Promotion and Practice Handwashing Kit (PPHWK)**, a user-friendly, robust handwashing station that can be easily set up near latrines in the immediate aftermath of a disaster. The kit, which can be installed in about 10–30 minutes, consists of a base structure, a water storage container or tank, a water-conserving water dispenser (the Oxfam Handy Wash Tap), a handwashing tray, provision for drainage and mirrors (Image 1). The PPHWK has been designed specifically to solve existing handwashing hardware problems with the aim of improving handwashing practice at key moments, particularly after defecation. The handwashing kit can be installed quickly and simultaneously with latrine construction.

Mum’s Magic Hands (MMH), a hygiene promotion strategy developed by Oxfam together with Unilever and Lifebuoy, was coupled with the provision of PPHWKs in the camp. Based on formative research in five Asian and African countries (Pakistan, the Philippines, Nepal, Jordan and Uganda), MMH draws on the concepts of nurture and affiliation (Sagan and Tolani, 2016) to motivate mothers to wash their hands at key times, such as before contact with food and after contact with faeces. To accomplish this, MMH focuses on the positive role a mother’s hands can play in her children’s lives and reinforces the fact that the same hands, if not kept clean, can play a role in transmitting diseases. The strategy incorporates storytelling, interactive demonstrations and innovative promotional material (e.g. nudges) to encourage handwashing (Image 2). The intervention runs for eight weeks and includes soap distribution at the household level. (For additional information on MMH and access to training materials, see <https://policy-practice.oxfam.org.uk/our-work/water-sanitation-and-hygiene/mums-magic-hands>).



Image 2: Role model mother and daughter from Mum’s Magic Hands handwashing promotion creative materials

DRC REFUGEE CRISIS AND UGANDA RESPONSE

In December 2017, about 17,000 Congolese individuals arrived in the Kyaka II settlement, in Kyegegwa district in Uganda. Arrivals continued throughout 2018, with approximately 900 per week up until June 2018. The settlement covers a land area of 81.5km² and is divided into nine zones and 26 villages, comprising refugees, asylum seekers and the host population living around the settlement (Danish Refugee Council, 2018).

Oxfam targeted all new arrivals entering the camp from December 2017 to June/July 2018. They received hygiene promotion interventions, access to water, with Oxfam installing four 70m³ rigid water tanks, and access to 150 communal latrines. Handwashing stations in the camp included both tippy taps and Oxfam buckets, a 10-litre plastic bucket with a tap and stand (Image 3). Households in the evaluation either had access to the PPHWK and/or to Oxfam buckets. The PPHWK trial in Uganda was carried out as the second phase of a larger trial, with an earlier trial conducted in Nduta camp in Tanzania in 2017–18 (Oxfam, 2018). Like the first trial, this study sought to test the handwashing kit in an acute emergency context.



Image 3: Existing handwashing kit in Kyaka II refugee settlement. Credit: Betty Ojeyo

2 METHODOLOGY

PILOT TARGETS

In July 2018, there were 62,525 people living in Kyaka II refugee settlement (UNHCR, 2018). Oxfam staff, who had been present since December 2017, were consulted in order to select target zones. Women, men and children living in camp zones 2, 4, 5 and 6 were recruited for participation in the study. The intervention was randomly allocated to villages or schools within each selected zone. New arrivals living temporarily at the reception centre (intervention arm 2 – see below) were also included.

STUDY DESIGN

The research team designed a clustered RCT, assigning treatment arms as follows:

- **Intervention arm 1: PPHWK plus behavioural intervention (PPHWK+MMH)**
 - Tailored WASH training sessions using Oxfam's Mum's Magic Hands programme
 - 18 PPHWK handwashing stations installed, including a nudge message placed on each station consisting of a slogan and visual, drawing on the concept of nurture and affiliation to complement the MMH programme
- **Intervention arm 2: PPHWK only (PPHWK only – reception area)**
 - Standard WASH training session
 - Four PPHWK handwashing stations installed
- **Intervention arm 3: Control**
 - Oxfam standard WASH training sessions
 - Eight existing handwashing stations – mainly 10-litre buckets
- **Intervention arm 4: School**
 - Oxfam standard WASH training sessions
 - Six PPHWK handwashing stations installed
- **Intervention arm 5: School control**
 - Oxfam standard WASH training sessions
 - Six existing handwashing stations – mainly 10-litre buckets.

ASSESSMENT METHODS

Evaluation procedure

A pilot trial was implemented between July and September 2018, including an eight-week evaluation period. Both quantitative and qualitative methods were used. All research methods were modelled from formative handwashing research conducted in Nepal (Sagan and Tolani, 2016), with modifications to suit the context. Data collection began once all intervention arms had access to a handwashing station: Oxfam buckets for control arms and PPHWK for intervention arms.

Household survey

Female heads of household were targeted for the household survey. Only households enrolled in intervention arms 1 and 3 were included, as these households had more stable housing and thus were more likely to be accessible at both baseline and endline. Individuals in intervention arm 2 lived in the reception centre, which only provides temporary housing. Sample size was calculated based on 5% margin of error and 95% confidence level calculated at baseline. Data collected included demographic information, preferred features of handwashing stations, handwashing knowledge and practice, and self-reported diarrhoea in the previous two-week period. Survey data were collected using Mobenzi mobile technology.

Focus group discussions and spidergrams

The research team worked with Oxfam volunteers to identify 10–15 participants in intervention arms 1–3 for female and male focus group discussions (FGDs) at the community level. FGDs were organized by gender. A total of five FGDs were conducted across intervention arms 1–3 at baseline, and a total of 12 at endline. At the school level, teachers helped to identify pupils aged 10–16. Students participated in two FGDs, one for each school-based treatment arm. FGDs were used to assess existing knowledge of handwashing, access to WASH programming, current perceptions and beliefs about handwashing, user experiences with the existing handwashing stations and PPHWK stations, and perceptions of MMH. At endline, a spidergram activity asked FGD participants to score handwashing stations according to ease of use, motivation, attractiveness, durability and maintenance.

Key informant interviews

A series of 20-minute key informant interviews (KIIs) was conducted with representatives of partner organizations and installation staff to collect data on the ease of maintenance and durability of the PPHWK, its ease of use, speed of deployment, ease of installation compared with existing solutions and an overall comparison with existing handwashing stations. Interviews were carried out at places of work. Participants were also asked to complete the spidergram activity described above.

Structured observations

Structured direct observations were collected at baseline and at endline to better measure handwashing with soap practice. Data were collected to assess the number of people (including special populations) using the existing and PPHWK handwashing stations, the number of people engaging in handwashing with soap and the number of users at key times. Observation sessions were conducted from 6am to 9am, when every household member was likely to visit the communal latrine at least once.

Qualitative observations

Handwashing stations in selected villages were observed in one-hour increments, from 8am to 9am. This exercise was completed for each of the three zone-based intervention arms and for both of the study schools. Qualitative observations assessed users' satisfaction, motivation to use the equipment, ease of use, aesthetic appeal and durability of the handwashing stations.

Evaluation objectives

The evaluation sought to assess the efficacy of the PPHWK and of MMH using the qualitative and quantitative indicators, and the methods of data collection listed below.

Quantitative indicators:

- Number of people observed engaging in handwashing with soap at standard and PPHWK handwashing stations (including special populations) – direct observation.
- Increases in knowledge of handwashing with soap at key times (after latrine use, before eating, before cooking, before feeding baby) – household survey.
- Self-reported handwashing with soap or water-only handwashing practice – household survey.
- Diarrheal disease incidence over the trial period, collected during ongoing monitoring at the household level and household surveys during evaluation – household survey.

Qualitative indicators:

- Users' satisfaction, ease of use, aesthetic appeal and durability of the handwashing stations – FGDs and qualitative observations.
- Ease of installation based on feedback on the PPHWK from technical staff compared with tippy taps – KIIs.
- Ease of maintenance and durability based on feedback from the WASH committee and users – FGDs.
- Ease and speed of deployment based on feedback from logisticians and data on the PPHWK kit procurement and deployment process – KIIs.

Data analysis

Household survey data was analysed in R (version 3.4.4) and R Studio (version 1.1.442). Descriptive statistics (e.g. medians, proportions) were calculated for all responses to the household survey, with comparisons by intervention group when relevant. Inferential statistics of endline data were calculated. A significance level of $\alpha=0.05$ was used for all tests in this study. In addition, multivariate logistic regression models controlling for respondent education level and length of time spent in the village were conducted for the following key outcomes of interest: household diarrheal incidence within the past two weeks, observed soap presence, washing with water only (at all, and at key times) and importance of handwashing with soap for preventing diarrhoea and for preventing illness. Frequencies and proportions are reported for structured observation.

Qualitative data were transcribed into English and imported into NVivo (version 11.4.3). All data were coded and organized. Salient themes, paralleling with the indicators noted above, were analysed. Summaries and relevant quotes are reported. Qualitative observation data were reviewed. Salient patterns are described below.

3 FINDINGS

HOUSEHOLD SURVEY

Household demographic information

A total of 236 respondents participated in the household survey across intervention arms 1 and 3. All survey respondents were female heads of household 18 years of age or older. Most respondents were aged 18–59 years in both treatment groups. A large majority of respondents across both groups reported receiving no higher than primary-level education – 97.96% in the PPHWK+MMH group and 91.01% in the control group. Reported levels of education in PPHWK+MMH households were significantly lower than those reported in control households (Table 1). Most respondents reported being either married or single with children and had an average household size of 3–4 persons, with at least two under five years of age. A total of 8.99% of control households and 15.65% of PPHWK+MMH households reported having at least one household member with a disability. Households in the control group had lived in the camp for significantly less time than the PPHWK+MMH group. However, most members in both groups had lived there for at least two months, 96.63% in the control group and 100% in the PPHWK+MMH group.

Table 1: Demographic information of household members surveyed by zone (n=236)

	Intervention group		P-value
	Control n=89	PPHWK+MMH n=147	
Age category*			
Adult (18–59 years of age)	82 (92.13%)	140 (95.24%)	0.4878
Elderly (>59 years of age)	7 (7.87%)	7 (7.87%)	
Observed gender			
Female	89 (100%)	147 (100%)	
Male	0 (0)	0 (0)	
Highest level of education[◇]			0.0016
College	1 (1.12%)	0 (0)	
Secondary	7 (7.87%)	3 (2.04%)	
Primary	25 (28.09%)	22 (14.97%)	
None	56 (62.92%)	122 (82.99%)	
Marital status[◇]			0.2595
Single	11 (12.36%)	15 (10.20%)	
Divorced	1 (1.12%)	0	
Married	38 (42.70%)	65 (44.22%)	
Separated	1 (1.12%)	0 (0%)	
Single parent	19 (21.35%)	44 (29.83%)	
Widowed	19 (21.35%)	23 (15.65%)	
Family size[§]			0.1292
Median (interquartile range)	4 (4)	3 (3)	
Number of children <5 years of age in household[§]			0.0649
Median (interquartile range)	2 (1)	2 (2)	
Person with disability in household*			0.2046
No	81 (91.01%)	124 (84.35%)	
Yes	8 (8.99%)	23 (15.65%)	
Length of time spent in camp[◇]			0.0493
Less than 3 months	12 (13.48%)	16 (10.88%)	
3 to 6 months	59 (66.29%)	115 (78.23%)	
6 months to 1 year	15 (16.85%)	16 (10.88%)	
More than 1 year	3 (3.37%)	0 (0)	
Length of time lived in the village[◇]			<0.0001
2 weeks	2 (2.25%)	0 (0)	
Less than 1 month	1 (1.12%)	0 (0)	
2 months	16 (17.98%)	5 (3.4%)	
More than 2 months	70 (78.65%)	142 (96.6%)	

[§] Kruskal–Wallis rank sum test used.

* Chi-squared test used.

[◇] Fisher's exact test used because at least some cells had expected frequencies of <5.

Feedback on handwashing stations

Households completing the survey were asked to provide feedback on their respective handwashing stations and the features they liked most. Control households using the Oxfam bucket reported liking the bucket (44.94%) and the design (42.0%). Conversely, few control households reported disliking many features: design (3.37%), drainage (0.0%), height (5.62%) and bucket (6.74%). Thirty of 89 (33.7%) control households reported that at least one family member was unable to use the handwashing station; 28 of these were children under five years. Soap was observed in only 51.69% of control households at the time of the household survey.

Table 2: Feedback on existing handwashing stations (buckets), control households (n=89)

Features respondents liked		Features respondents didn't like*	
Design	25 (42%)	Design	3 (3.37%)
Drainage	3 (3.37%)	Drainage	0 (0)
Height	6 (6.74%)	Height	5 (5.62%)
Bucket	40 (44.94%)	Bucket can	6 (6.74%)
		None	77 (86.52%)

* Indicates a category of question that may have responses that add up to more than 100%, as response options are not mutually exclusive.

Among PPHWK+MMH households, more than 40% liked all of the features, with the exception of the nudges, which were liked by 37.41%. The features viewed most favourably included the mirror (91.84%), the tap (85.71%), the tank (76.19%) and the overall design (69.39%). No feature mentioned was disliked by more than 5% of households. A total of 58 of 147 (39.5%) PPHWK+MMH households reported that at least one household member was unable to use the PPHWK handwashing station; all of these were children under five. Soap was noted at all PPHWK handwashing stations at the time of the survey.

Table 3: Feedback on PPHWK stations, (Intervention Households (n=147))

Features respondents liked		Features respondents didn't like*	
Tap	126 (85.71%)	Tap	0
Mirror	135 (91.84%)	Mirror	3 (2.04%)
Design	102 (69.39%)	Design	0
Nudges	55 (37.41%)	Nudges	0
Drainage	66 (44.90%)	Drainage	0
Tray	65 (44.22%)	Tray	1 (0.68%)
Height	60 (40.82%)	Height	2 (1.36%)
Tank	112 (76.19%)	Tank	1 (0.68%)
Frame	74 (50.34%)	Frame	0
Tank cover	97 (65.99%)	Tank cover	7 (4.76%)
None	0 (0)	None	136 (92.52%)

* indicates a category of question that may have responses that add up to more than 100%, as response options are not mutually exclusive.

Handwashing practice knowledge and attitude: handwashing promotion at the camp

The majority of study households reported receiving information on handwashing since arriving at Kyaka II refugee settlement: 99.32% in the PPHWK+MMH group and 97.75% in the control group. Of these, 99.32% of PPHWK+MMH households and 98.85% of control households rated the information they had received as adequate.

Handwashing practice knowledge and attitude: key times for handwashing

Although almost all households in both groups reported the importance of handwashing before eating at endline, PPHWK+MMH households were more likely to report its importance at three of four remaining key time points, including before cooking, before feeding baby and after using the latrine.

Table 4: Important times for handwashing by treatment group at endline

		Control n=60	PPHWK+MMH n=54	P-value
Important times to wash hands				
	Before eating ^f			
	No	1 (1.12%)	1 (0.68%)	1
	Yes	88 (98.88%)	146 (99.23%)	
	Before cooking ^x			
	No	46 (51.69%)	12 (8.16%)	<0.0001*
	Yes	43 (48.31%)	135 (91.84%)	
	Before feeding baby ^x			
	No	71 (79.78)	48 (32.65%)	<0.0001*
	Yes	18 (20.22)	99 (67.35%)	
	After using the latrine ^f			
	No	14 (15.73%)	2 (1.36%)	<0.0001*
	Yes	75 (84.27%)	145 (98.64%)	

^f Fisher's exact test used because at least some cells had expected frequencies of <5.

^x Pearson's Chi-squared test used.

* Statistically significant at alpha=.05.

Handwashing practice knowledge and attitude: handwashing with and without soap

Both crude and adjusted odds ratios were calculated to evaluate differences in reported water-only handwashing for both the control and PPHWK+MMH groups. Control households were more likely to report water-only handwashing than PPHWK+MMH households, at 87.84% and 23.13% respectively. The PPK+MMH households had 0.042 times the odds of engaging in water-only handwashing when compared with the control group. These findings are statistically significant, even after controlling for education and length of time in village.

Table 5: Modelling water-only handwashing

	Treatment group		Crude OR (95% CI)	Adjusted OR (95% CI)*
	Control (n=89)	PPHWK+MMH (n=147)		
No (referent)	11 (12.36%)	113 (76.87%)	1.00	1.00
Yes	78 (87.64%)	34 (23.13%)	0.042 (0.020, 0.089)	0.041 (0.018, 0.092)

* Adjusted model included the following covariates: education, length of time in village.

All households were asked in the survey about the importance of handwashing with soap. PPHWK+MMH households were significantly more likely than control households to report that this was important for the prevention of illness (OR: 8.710). Controlling for education and length of time in the village makes this association even stronger, with an odds ratio of 9.025. While PPHWK+MMH households were also more likely to report that handwashing with soap was important for the prevention of diarrhoea, the difference was not statistically significant.

Table 6: Modelling beliefs about the importance of handwashing with soap for the prevention of illness and diarrhoea

	Treatment group		Crude OR (95% CI)	Adjusted OR (95% CI)*
	Control (n=89)	PPHWK+MMH (n=147)		
Prevent diarrhoea				
No	28 (31.46%)	36 (24.49%)	1.415 (0.789,	1.401 (0.749, 2.618)
Yes	61 (68.54%)	111 (75.51%)	2.538)	1.00
			1.00	
Prevent illness				
No	27 (30.34%)	7 (4.76%)	8.710 (3.600,	9.025 (3.594,
Yes	62 (69.44%)	140 (95.24%)	21.069)	22.660)
			1.00	1.00

* Adjusted model included the following covariates: education, length of time in village.

Diarrhoea recall

Respondents were asked whether anyone in their household had suffered from diarrhoea in the previous 14 days. At baseline, self-reported diarrhoea rates were similar, with 26.9% of control households and 32.2% of PPHWK+MMH households reporting diarrhoea during that time period. However, at endline PPHWK+MMH households were significantly less likely to report diarrhoea than control households, $p = 0.0009$. Further, while reported diarrhoea rates for control households were similar at both baseline and endline, PPK+MMH households reported significantly less diarrhoea at endline when compared to baseline, $p < 0.0001$ (see Table 7).

Table 7: Household diarrheal incidence in past two weeks at baseline and endline

	Treatment group		P-value
	Control	Intervention	
At baseline	n=52	n=149	0.5913
No	38 (73.1%)	101 (67.8%)	
Yes	14 (26.9%)	48 (32.2%)	
At endline	n=89	n=147	0.0009*
No	72 (80.9%)	140 (95.2%)	
Yes	17 (19.1%)	7 (4.8%)	
Difference between baseline and endline within a group	-7.8%	-27.45%	
P-value comparing baseline to endline, within treatment group	0.386	<0.0001*	

^x Pearson's Chi-squared test used.

[†] Two-sample test for equality of proportions with continuity correction.

^{*} Statistically significant at alpha=.05.

PPK+MMH households were significantly less likely than households in the control arm to report any diarrhoea in the previous two-week period (OR: 0.2361). After adjusting for education and length of time in the village, this measure of association became even stronger.

Table 8: Modelling the association between self-reported diarrheal disease within the past two weeks and intervention arm

Treatment group	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)*
PPK+MMH	0.2361 (0.1392, 0.4005)	0.1954 (0.0726, 0.5260)
Control (referent)	1.00	1.00

* Adjusted model included the following covariates: education, length of time in village.

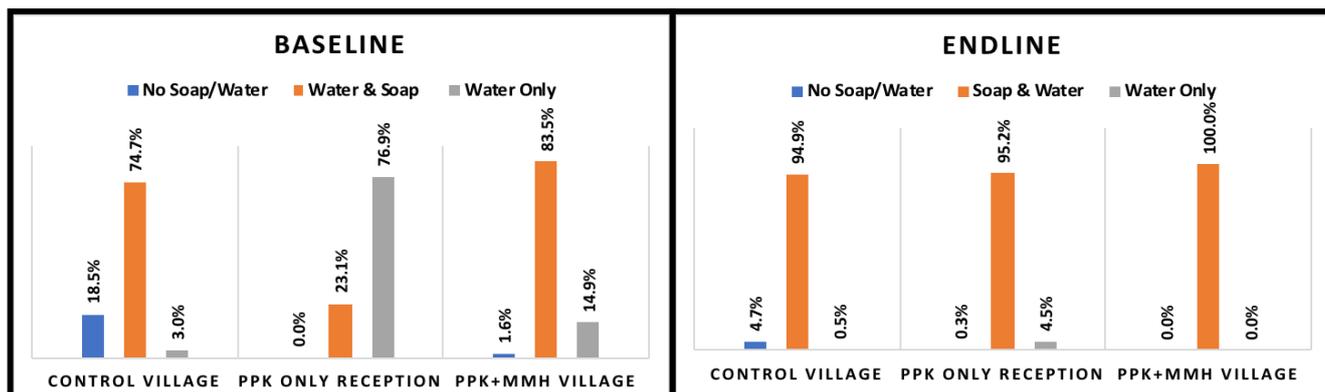
STRUCTURED AND QUALITATIVE OBSERVATIONS

Structured observations

Presence of soap at handwashing stations – latrines

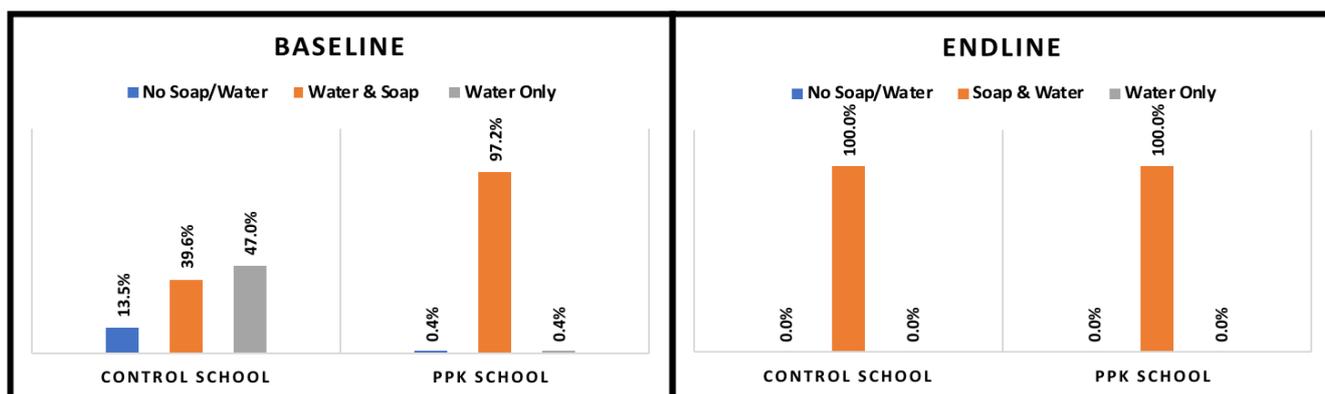
Users' handwashing behaviour after using the latrines was noted. A total of 3,823 structured observations were collected across all intervention arms, 2,548 at baseline and 1,275 at endline. The presence of soap at handwashing facilities increased over the course of the study. At baseline, between 23.1% and 83.5% of users had access to both soap and water at the time of observation. At endline, between 94.9% and 100.0% of users had access to both water and soap.

Figure 1a: Observed water and soap presence in villages and reception, at baseline and endline



A similar pattern was noted for study schools. At baseline, while access to both water and soap was high at the PPHWK school (97.2%), their availability was noted in only 39.6% of observations for students at the control school. At endline, water and soap were present at 100.0% of handwashing stations at both schools.

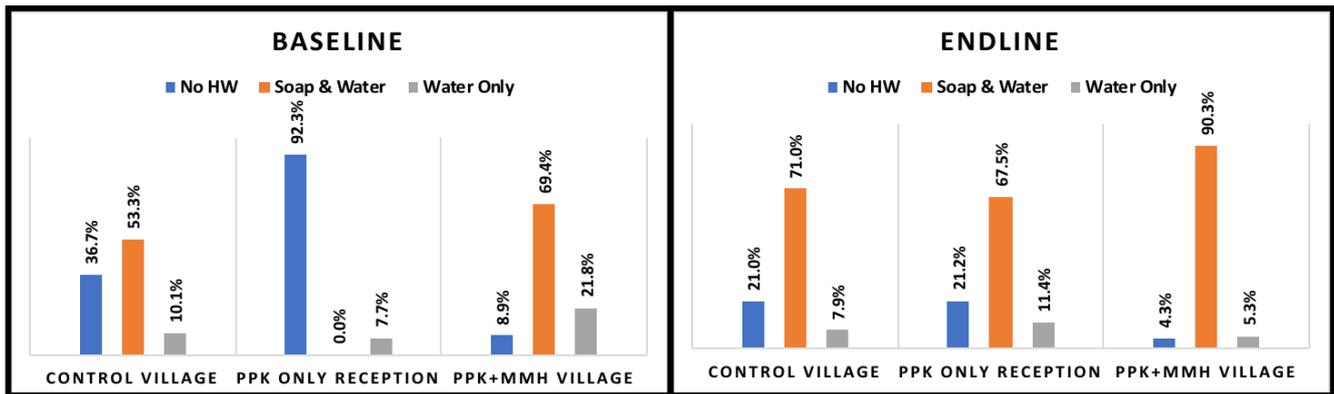
Figure 1b: Observed water and soap presence in schools, at baseline and endline



Structured observations

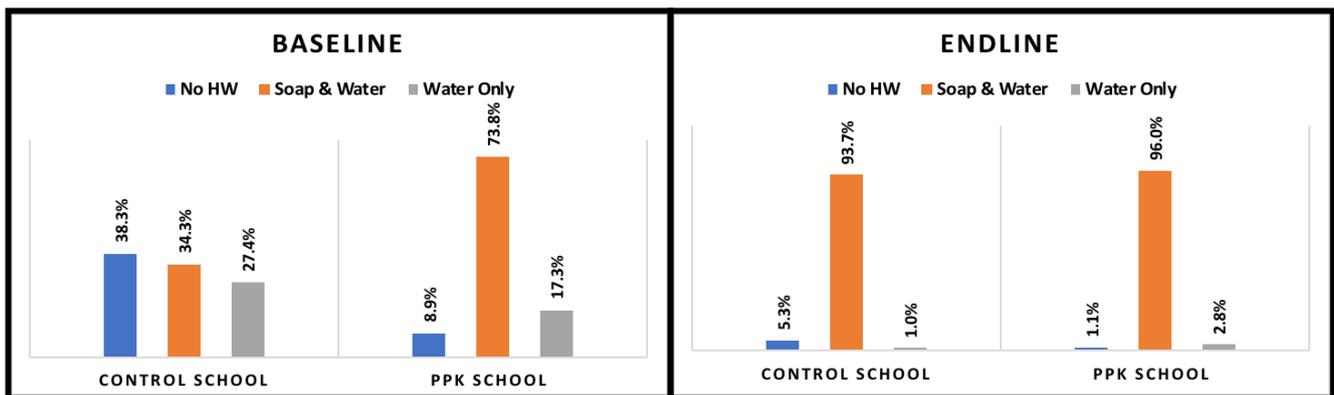
All groups demonstrated an increase in handwashing with soap compared with baseline, from 53.3% to 71.0% in the control group, from 0.0% to 67.5% in the PPHWK-only group, and from 69.4% to 90.3% in the PPHWK+MMH group. PPHWK-only households demonstrated the greatest increase (67.5%) over the course of the study, while PPHWK+MMH households had the highest observed rates of handwashing at both baseline and endline. Further, by the end of the trial, there were fewer individuals in all intervention groups who did not wash their hands.

Figure 2a: Observed handwashing practice in villages and reception, at baseline and endline



Increases in handwashing with soap practice were also observed at study schools. Students at both the control school and the PPHWK school demonstrated higher rates of handwashing with soap at the end of the study, increasing from 34.3% to 93.7% at the control school and from 73.8% to 96.0% at the PPHWK school. Students at the PPHWK school demonstrated higher rates of handwashing with soap practice at both baseline and endline.

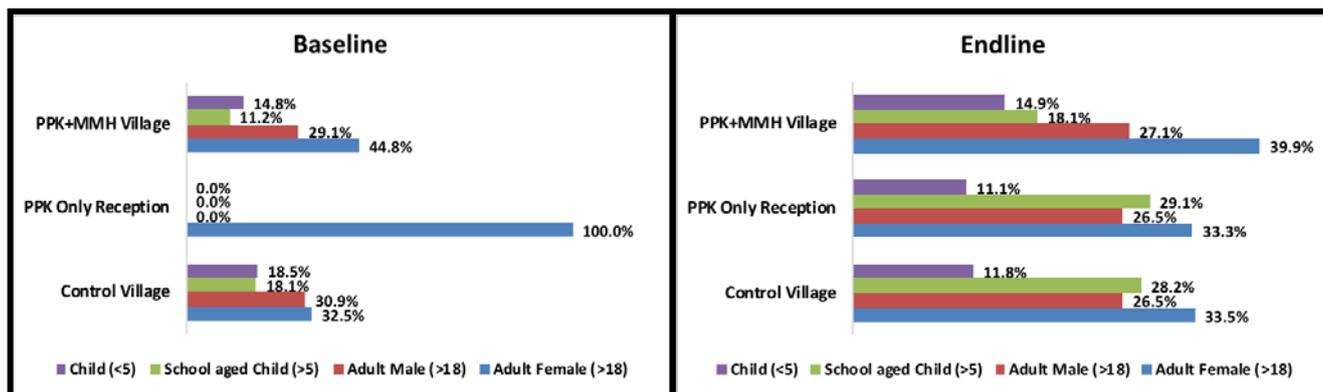
Figure 2b: Observed handwashing practice in schools, at baseline and endline



Structured observations: gender and age

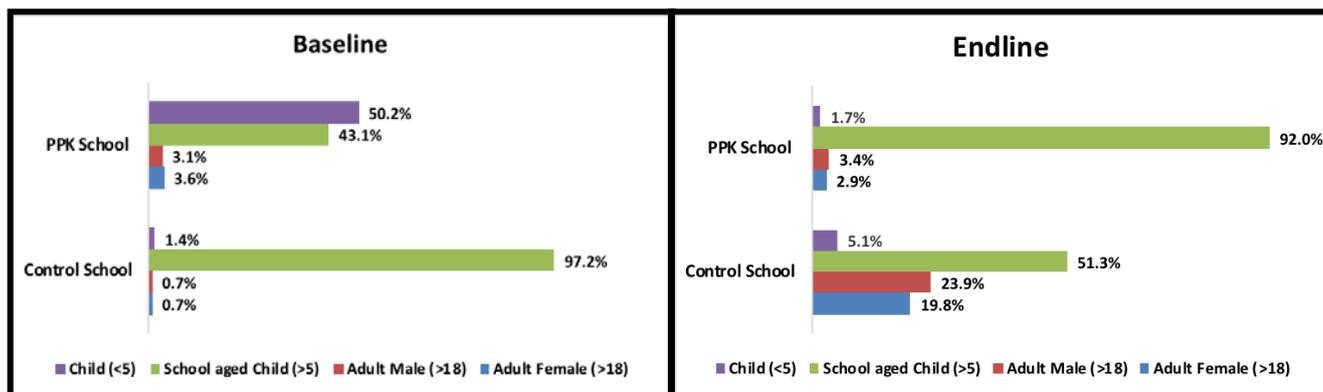
Adult females over 18 years of age were most frequently observed handwashing across all groups at baseline. For the PPHWK-only group, only women were observed handwashing during the observation period. Proportions of handwashing by age and gender at baseline were similar in the PPHWK+MMH group and the control group. At endline, though women were still more likely to engage in handwashing across all groups, the proportion of school-aged children engaging in handwashing increased, from 11.2% to 18.1% in PPHWK+MMH households, from 0.0% to 29.1% in PPHWK-only households, and from 18.1% to 28.2% in control households. The proportion of children under five observed handwashing either remained the same or decreased at endline compared with baseline.

Figure 3a: Observed handwashing practice in villages and reception by gender and age, at baseline and endline



At baseline, children comprised the majority of those observed handwashing at both the PPHWK school and the control school. Adults at the PPHWK school were seen handwashing in less than 4% of observations both at baseline (3.1% males, 3.6% females) and endline (3.4% for males and 2.9% for females). At the control school at endline, while the greatest proportion of those observed handwashing were still children >5 years of age, the proportion of adult males and females increased, collectively representing almost half of handwashing observations at endline.

Figure 3b: Observed handwashing practice in schools by gender and age, at baseline and endline



Qualitative observations

To augment structured observation data, qualitative observations were also conducted. A total of 106 persons were observed, 28 from PPHWK+MMH households, 16 from PPHWK-only households, 13 from control households, 26 from the PPHWK school and 23 from the control school. A diverse group of users included children, elderly persons and one person with a visible physical disability. Age estimates ranged from four to 60 years.

In intervention arm 1 (PPHWK+MMH), no difficulties in using the kit were observed. A total of 27 of 28 users were observed using both soap and water. However, three did not use the proper handwashing technique; all were men estimated at 45–50 years of age. All PPHWKs observed were well maintained, although both mirrors from one of the kits were missing. During the observation period, three women were observed refilling the tank independent of use.

In intervention arm 2 (PPHWK-only), of the 16 users observed only one individual, a young child of around five, had difficulty (with the tap). Six users (37.5%) did not use soap, and in one

instance the user did not wash their hands at all. No soap was observed at two of the kits, whose soap netting had been damaged. All handwashing with water only events were observed at the kits where soap was missing.

In intervention arm 3 (control households), 13 users were observed. Only one user did not engage in handwashing at all. No difficulties in operating the handwashing stations were noted. However, water was observed splashing on six of the 13 users. No parts were broken or missing, and soap was noted during each observation window.

School-based intervention arms were also observed. In intervention arm 4 (PPHWK school), of the 26 users observed three did not engage in handwashing at all and two washed with water only. One user, a young child of around five, was observed struggling to operate the tap. No parts were reported missing, though a spring from one of the taps had been damaged.

In intervention arm 5 (control school), of the 23 users observed seven did not wash their hands at all. Several other users – 11 out of 23 – had water splash on them during use, and some stopped prematurely as a result. No users were observed having difficulties in operating the kit.

FOCUS GROUP DISCUSSIONS

Perceptions of hygiene conditions in Kyaka II refugee settlement

Questions that gauged participants' perspectives on hygiene conditions before and since arriving at the camp were asked at both baseline and endline. Themes were consistent across both time points.

Though many participants reported engaging in some handwashing before coming to the camp, soap use was inconsistent. Residents frequently described washing their hands with water only before arriving at Kyaka. This paralleled descriptions of their neighbours' handwashing practices while at the camp, which were inconsistent at best. Many noted that there were key times when neighbours were more likely to engage in handwashing, including after coming from the garden, after using the latrine and before eating, but soap use varied. One mother observed: 'Most of my neighbours do not wash their hands after latrine use but they do before eating and at times after eating.' A male resident reported: 'My neighbours wash their hands before eating and after garden work but with water only.'

Access to WASH training and the importance of handwashing with soap

At both baseline and endline, participants most frequently suggested that inconsistent soap use during handwashing was related either to a lack of access to soap or to a lack of knowledge about its importance. A young girl observed: 'Some people wash their hands with soap because they know that it helps to kill germs, but some people use water only because they don't know the importance of soap or have no soap to use.' Residents described broad access to handwashing information, mainly from Oxfam and staff at the local health centre. Even with reported inconsistencies in handwashing practice, residents positively described both the WASH training and the role of handwashing as a means to reduce the risk of illness, which was by far the largest motivator for handwashing noted.

Current handwashing stations (buckets)

Control residents described using the 10-litre buckets with taps provided by Oxfam for handwashing. Frequent refilling was noted as a challenge. One male noted: 'Our handwashing facilities are small and communal cleaning is challenging, and frequent refilling on a daily basis is a big task.' A school-aged male offered: 'In our school and community, we use red buckets for handwashing. They are easy to use but the capacity is small and so we refill them every day, we bring them out every morning, take them back inside at the end of the day.' Overall, while the Oxfam bucket was described as easy to use, frequent refilling was cited as a challenge. One young mother shared, 'The handwashing facilities are easy to clean and water refilling is easy too but the challenge is that the kit stores very little water that can not last long in a day.'

Perspectives on the PPHWK

Overwhelmingly, PPHWK users were happy with the kits. PPHWKs were described as attractive and easy to use for persons over the age of five, even those with physical disabilities. Several features were praised, including the water container with cover, the tap and the overall attractiveness of the kit. Highlighting how its appearance encouraged handwashing, one young girl noted: 'It is easy to use by persons over six, it is very accessible in terms of location and attractive to the user and this encourages many to wash their hands after every use of the latrine.' Mirrors also attracted users to the kit. A young male offered, 'That handwashing kit at the communal latrine is beautiful. It helps us wash our hands with soap and what I like on the kit are the mirrors that you're able to look at your face while washing hands to make sure it's clean as well.' The only challenges noted were that the height of the kit limited use for young children, and fears that the kit might be damaged or that parts, most notably the mirrors, might be stolen.

Perspectives on Mum's Magic Hands

Like the PPHWK, MMH was described in a positive fashion. Participants who engaged with the programme characterized it as being different from any other training they had received. One mother said: 'I personally had never heard the MMH messages, which centre on a mother being the pillar of cleanliness in a household through using her magic hands when doing different activities like cooking and breastfeeding.' The content and structure of MMH messaging resonated, and mothers described using the information received to change handwashing behaviours in their households. One said: 'My children can now practise the handwashing steps well, and my husband and I encourage them to continue washing their hands with soap before eating anything.' Mothers described using their hands to care for their households and nurture their children. One noted: 'I personally learned to prevent diseases through washing hands with soap and nurturing my children.' Another said: 'When a child cries, I quiet her/him down using my tender touch as a mother.'

Children who participated in the programme noted the role that their mothers played in changing handwashing practice at home. MMH messages also resonated with them, as evidenced by one young male who recapped the key times for handwashing: 'Yes, I started using soap after knowing the importance, the key times that is: before eating, before cooking and before feeding the baby.' Training and promotion components including the storyboard and household nudges were highlighted as having an impact. When prompted to offer recommendations for the programme, one mother responded: 'It should be extended because of the good news on health and hygiene we have received, which has changed our lives.'

KEY INFORMANT INTERVIEWS

KIIs with representatives of partner organizations

Staff from partner organizations noted that for many new arrivals handwashing was not a priority, but that this was changing because of the wide availability of WASH training and the PPHWK stations. They described clear increases in the number of residents engaging in handwashing, as the PPHWKs were attractive, easy to use and easy to maintain. One noted: 'The kit has caught the attention of all the camp residents because it is unique, makes handwashing more interesting, especially for women and children to view themselves in the mirrors, and water cannot splash on you while washing your hands.' Staff noted that the tap helped to save water but also suggested that the size of the water container could be increased, to reduce the need to refill it multiple times in more highly populated areas such as schools. They also recommended that the messaging posted on the PPHWK be in the local language and that the soap net should be redesigned.

KIIs with installation staff

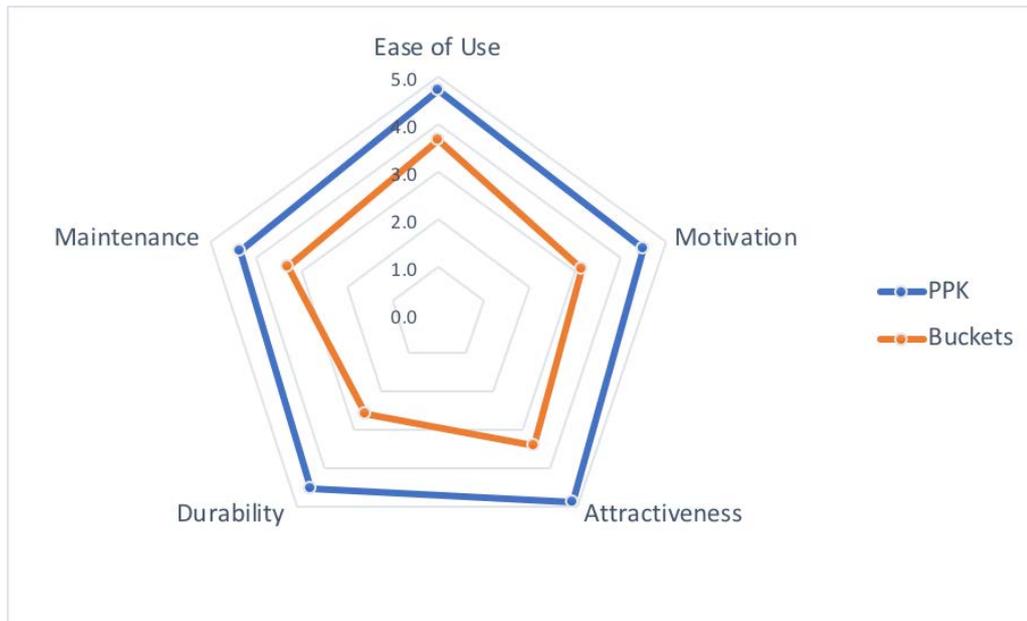
The installation of PPHWKs was reported as being much more challenging and labour-intensive, requiring anything between 10 and 30 minutes. Staff noted the importance of following the installation manual closely. In contrast to the inexpensive and readily available materials needed for tippy taps, staff believed that procurement of PPHWK parts would cost much more. However, once installation had been completed, overall PPHWKs were described as being easy to use, for both children and adults, and attractive. Staff also reported that the design reduced the likelihood of water contamination. PPHWKs were described as being more durable than tippy taps and less susceptible to theft. However, mistakes during prototype manufacturing, such as the misplacement of holes, could make installation more challenging. Recommendations for improving the PPHWK included changing the colour of the lid, as black was thought to absorb heat and increase the likelihood of cracking. Staff also suggested that mirror holes could be pre-drilled to limit cracking during installation, the tap could be adjusted to include a spinner for tightening and the PPHWK could come with liquid soap.

SPIDERGRAMS

PPHWK and Oxfam bucket scores on key aspects

All FGD and KII participants were asked to score both the PPHWK and the Oxfam bucket according to five key aspects: ease of maintenance, durability, motivation, ease of use and aesthetic value. Key aspects could be scored from 1 to 5, with higher scores indicating higher levels of satisfaction. In total 25 spidergrams were created, with several persons in each group contributing to each. Average scores across groups for both type of handwashing station – the PPHWK and the Oxfam bucket – are presented in Figure 4. Average scores for each aspect of the PPHWK considered ranged from 4.3 to 4.8 out of 5, with ease of use and attractiveness averaging 4.8, motivation and durability 4.5 and maintenance 4.3. In comparison, the Oxfam bucket was scored less favourably. Average scores ranged from 2.5 to 3.7, with ease of use scored at 3.7, attractiveness at 3.4, motivation at 3.2, maintenance at 3.3 and durability at 2.5.

Figure 4: User assessment of PPHWK and Oxfam buckets on key aspects



4 DISCUSSION

LIMITATIONS

This study had a number of important limitations. Designed as a short pilot, evaluation data were only collected approximately eight weeks after implementation, thereby limiting the research team's ability to assess the long-term or sustained impact of PPHWK use and MMH training. This is particularly notable given the reported challenges in achieving long-term change in handwashing behaviour (Biran et al., 2012; Phillips et al., 2015). Furthermore, handwashing facilities had not been installed by camp staff in villages prior to the start of the trial. As a result, the trial team had to install the Oxfam buckets in control group areas at the same time as they installed the PPHWKs, which might have affected comparisons between the two. It also limited the ability to compare the tippy tap with the PPHWK in focus group and household survey data, and comparisons of the PPHWK with the tippy tap were limited to installation staff. Additionally, because of the need to install handwashing facilities for control households, structured observations did not begin until one week after the kits were installed. Thus, observed handwashing at baseline could have been influenced across all groups simply by having access to handwashing stations. Lastly, the design of the project limited its ability to attribute increases in handwashing specifically to either component of the intervention, PPHWK or MMH. This may be particularly relevant in situations where resources limit the provision of both. To that end, a cost-benefit analysis of MMH and PPHWK deployment is warranted. To assess the impact of both MMH and PPHWK, in future it would be useful to run a study that includes four zone-based treatment arms: control, MMH only, PPHWK only and PPHWK+MMH.

KEY FINDINGS

There was widespread access to handwashing information at Kyaka II refugee settlement. More than 97% of survey respondents in both the PPHWK+MMH and the control groups, and all adult

FGD participants across all zone-based intervention arms, reported receiving WASH training since arriving at the camp. The information received, primarily from Oxfam and health centre staff, was described as being adequate. WASH training, along with the provision of soap and handwashing facilities, informed participants' characterization of hygiene at the camp as fair and was compared with limited handwashing knowledge and resources before arriving at the camp.

Prior WASH experiences may have also informed participants' views of the existing handwashing stations. While both intervention staff and participants clearly preferred the PPHWK and judged the Oxfam buckets to be less durable, other aspects of the buckets, including ease of use, attractiveness and maintenance, were viewed relatively favourably. Having access to handwashing technology with moderate levels of user acceptability (Hulland et al., 2013; Jenkins et al., 2013) may also have helped to reinforce WASH messaging and thereby inform handwashing behaviours in the control group.

At endline, control households were aware of the importance of handwashing before eating and for diarrhoea prevention. Control households also demonstrated a notable increase in handwashing with soap, compared with the proportion observed doing this at baseline. This was likely to reflect continued exposure to WASH training and the broad availability of handwashing stations. However, PPHWK+MMH households demonstrated significantly greater levels of WASH knowledge, reported significantly less water-only handwashing and were observed engaging in handwashing with soap more consistently. Moreover, PPHWK+MMH households reported significantly less diarrhoea in the previous 14-day period compared with control households. While self-reported data may be subject to poor memory, these findings suggest that exposure to both the PPHWK and MMH increased WASH knowledge, influenced changes in handwashing behaviour and improved health outcomes. This parallels findings from an evaluation of the same intervention at Nduta refugee settlement in Tanzania (Oxfam, 2018).

The efficacy of interventions that use emotional drivers to increase behaviour change has been highlighted elsewhere (Biran et al., 2014; Greenland et al., 2016; Greenland et al., 2017; Curtis et al., 2001). While the current study did not evaluate long-term behaviour change, results not only support the utility of health promotion campaigns based on this approach to influence handwashing with soap practice, but go beyond this to document improvements in related health outcomes. Finding significant decreases in self-reported diarrhoea after an eight-week handwashing trial is notable. More research is warranted.

Participants who engaged in MMH training spoke of the impact that it had on handwashing in their household. Mothers described using knowledge gained through MMH to teach their families about handwashing. Those exposed to the training, directly and indirectly, at times used language from the training to detail their understanding of handwashing practice, e.g. accurately repeating key times for handwashing. Responses highlight the potential efficacy of seeing mothers not simply as the primary receivers of health messaging but also of making them central figures within messaging narratives and materials. Creating health promotion approaches that use emotive drivers and also place characters that the community can identify within the narrative may increase buy-in and therefore result in increased retention of handwashing messaging and long-term shifts in behaviour change. Again, additional studies are warranted.

Observations and FGD data point to a notable additional finding. While all intervention arms demonstrated an increase in handwashing with soap, with PPHWK+MMH demonstrating the highest rates, PPHWK-only households demonstrated an increase in handwashing of approximately 68%. All the families in this treatment arm had been in the camp for only a very short period. Handwashing with soap was not observed among PPHWK-only households at baseline. However, once PPHWKs were installed, rates of handwashing with soap increased

substantially. At the end of the study, PPHWK-only households demonstrated handwashing with soap rates comparable to the control households, all of whom had been at the camp for at least three months. This may suggest that simply exposing camp residents to user-friendly handwashing stations increases handwashing practice, although further research would be desirable.

Overwhelmingly, the PPHWK was widely accepted by both PPHWK+MMH and PPHWK-only households. When asked to detail the features they liked the most during the household survey, more than 75% of PPHWK+MMH households noted the mirror, the tap and the tank. Users largely characterized the kit as easy to use, attractive, easy to maintain and durable, and they suggested that simply having access to it promoted use. Features like the mirrors cultivated sustained interest and were seen as influencing an increase in handwashing with soap.

This was echoed in the KIIs. Staff from partner organizations described the kit as attractive and easy to use, which they believed encouraged increased handwashing with soap practice. Though installation times were longer and some design changes were recommended, including printing promotional materials in the local language and redesigning the soap net, PPHWKs were seen as a great benefit to the community. They were also seen as being less vulnerable to theft. Some changes to improve the installation process were recommended, including efforts to ensure standardization during manufacturing, pre-drilling mirror holes, adjusting the tap to include a spinner and equipping the PPHWK with liquid soap. These considerations should be explored in evaluating the appropriateness of the PPHWK for scale-up and for use in other emergency contexts.

Handwashing technologies and their characteristics play a potentially important role in enabling or inhibiting regular handwashing at key times (Hulland et al., 2013; Jenkins et al., 2013). Poor-quality handwashing facilities can inhibit regular handwashing with soap, including after latrine use and before feeding young children. Conversely, increasing access to user-friendly handwashing technologies with high levels of user acceptability may enable or encourage handwashing with soap practice, as found by studies conducted in Bangladesh and Cambodia (Hulland et al., 2013; Jenkins et al., 2013). Additional research is needed to explore the impact and cost of new technologies and approaches.

5 CONCLUSION

Handwashing with soap is an important strategy for disrupting disease transmission in emergency contexts. Ensuring the broad provision of low-cost, easy-to-use handwashing technologies with high levels of user acceptability and access to creative, culturally tailored handwashing promotion strategies may substantially increase handwashing with soap in these settings. Low-cost technologies that conserve limited resources and which incorporate features that encourage community interest hold particular promise.

While poor-quality handwashing technologies can serve as a disincentive to handwashing practice, the provision of low-cost, high-quality technologies may encourage it. In the current study, use of the PPHWK, which is designed to be user-friendly, robust and easy to set up, increased handwashing with soap practice, as it did when piloted in Nduta camp, Tanzania (Oxfam, 2018).

The impact of new technologies seems to be strengthened when paired with handwashing promotion strategies that use emotional drivers, such as nurture and affiliation, to encourage regular handwashing with soap. While understanding the role of handwashing in reducing diarrhoea and illness is important, framing the information in ways that connect with themes in the lives of communities may have greater impact. Fear of disease is an important motivator for handwashing, and people's determination to protect their families may be equally compelling and may resonate in ways that are much more nuanced in emergency settings. Households that had access to both components of the intervention displayed significantly greater knowledge about key times for handwashing and demonstrated increases in handwashing practices and related health outcomes.

While additional research is warranted to explore costs and feasibility and possibly to attribute the reported benefits more specifically to each component – PPHWK vs MMH – these findings offer important considerations for stakeholders seeking to improve handwashing practice in emergency settings. Significantly improving handwashing with soap practice and related health outcomes in emergency contexts calls for stakeholders to rethink traditional, knowledge-based approaches and to consider the efficacy of new, easy-to-use handwashing facilities and more innovative health promotion strategies based on the behaviours and motivations of camp residents.

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