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Integrating Water Treatment into Antenatal Care: Impact on Use of Maternal Health Services and Household Water Treatment by Mothers—Rural Uganda, 2013

Almea Matanock,* Tara Anderson, Tracy Ayers, Lilian Likicho, Richard Wamimbi, Xin Lu, Thomas Emeetai, Celia Kakande, Miriam Mutabazi, and Robert Quick

Epidemic Intelligence Service, Centers for Disease Control and Prevention, Atlanta, Georgia; Division of Foodborne, Waterborne, and Environmental Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia; Management Sciences for Health, STRIDES for Family Health, Kampala, Uganda; World Vision International, Kampala, Uganda

Abstract. To increase maternal health service use and household water treatment (HWT), free water treatment kits were provided at first antenatal care (ANC) visits and free water treatment sachet refills were provided at follow-up ANC visits, delivery, and postnatal visits in 46 health facilities in rural Uganda. We evaluated the impact by surveying 226 women in the initiative (intervention group) and 207 women who received ANC before the initiative began (comparison group). There was no differences in the percentages of intervention and comparison group women with ≥ 4 ANC visits; however, a higher percentage of intervention group women reported treating their drinking water (31.7% versus 19.7%, $P = 0.01$), and had free chlorine residual in stored water (13.5% versus 3.4%, $P = 0.02$) than comparison group women. The intervention did not appear to motivate increased maternal health service use, but demonstrated improvements in HWT.

INTRODUCTION

In Uganda, many maternal, neonatal, and child mortality indicators have improved, but have not met 2015 Millennium Development Goal targets.[1] In fact, the maternal mortality ratio in Uganda increased from 296.3 per 100,000 live births in 1990 to 324.9 in 2013.[2] Although 95% of women had at least one antenatal care (ANC) visit, only 46% of women living in rural Uganda had the recommended minimum of four ANC visits and only 52% delivered in a health facility.[3]

Infant mortality (54/1,000 live births) and under-five mortality (90/1,000 live births) in 2011 in Uganda were also above the Millennium Development Goal targets.[1,3] Diarrheal diseases accounted for 9% of deaths and were the third most common cause of under-five mortality after removing causes of neonatal mortality.[4]

Household water treatment (HWT) has been shown to decrease diarrheal disease risk.[5–7] HWT is especially important in rural settings where limited access to improved water sources† necessitates the collection, transportation, and storage of water.[8] In rural Uganda, only 71% of households had access to improved water sources in 2012.[9]

Previous studies have shown that integrating water treatment products and soap into ANC can be effective in increasing uptake of HWT practices,[10,11] and helping to maintain these behaviors over time.[10,12,13] Possible reasons for this effectiveness include broad coverage (> 90% of pregnant women in developing countries have ≥ 1 ANC visit), maternal openness to interventions during pregnancy, trust in health providers, and increased perception of HWT value due to the distribution of free products.[13]

Water for Health initiative. Using this model of integrated services, STRIDES for Family Health, a nongovernmental organization working in partnership with the Ugandan Ministry of Health, implemented the Water for Health initiative in January 2013 in 46 health facilities (HFs) in six rural districts (Bugiri, Kasese, Kumi, Mayuge, Nakasongola, and Sembabule) of Uganda. These locations were targeted because of low use of maternal health services and limited access to safe water. The Water for Health initiative provided several incentives to motivate use of maternal health services. These included "water treatment kits" (two 10-L buckets with lids; 30 sachets of Procter and Gamble Purifier of Water (Cincinnati, OH), a flocculant-disinfectant product referred to hereafter as sachets,[14,15] a stirring stick, a filtering cloth for flocculant removal, and soap; Figure 1) at the first ANC visit or first maternal health contact with a Water for Health HF; 30 sachet refills at subsequent ANC visits; 45 sachet refills at delivery; and 180 sachet refills at postnatal (PN) visits. In November 2013, we conducted an evaluation to determine the impact of Water for Health on the use of maternal health services and HWT.

METHODS

Evaluation design. The evaluation included three components: 1) a cross-sectional household survey of an intervention group of women exposed to the Water for Health intervention in 2013 and a comparison group who received ANC in 2012, 2) abstraction of data from 2012 and 2013 ANC and maternity registries, and 3) a health-care provider survey.

Evaluation population. The 46 HF where Water for Health was implemented ranged from level II with catchment areas of 5,000 people to district hospitals with catchment areas of 500,000. All women who received ANC in these HF in 2012 and all women who received ANC and the water treatment kit in the same HFs in 2013 were eligible to participate.

Sample size calculation. We based our sample size calculation on sachet use, a principal objective of the implementing organization and the donor. To determine the cross-sectional survey sample size, we assumed that the comparison group would have a 5% usage of sachets, which were available in shops in Uganda before the study began, and that the intervention group would report an increase in sachet use to 15%. To assure an adequate sample size, the estimated

*Address correspondence to Almea Matanock, Epidemic Intelligence Service, Centers for Disease Control and Prevention, 1600 Clifton Road, MS A-38, Atlanta, GA 30329-4018. E-mail: xdf2@cdc.gov

†Improved water sources defined by WHO/UNICEF Joint Monitoring Programme include piped water, borehole, protected well or spring, and rainwater. Although improved water sources are more likely to provide water that is microbiologically safe, this is not necessarily true. In addition, contamination may occur during collection, storage, and use.

FIGURE 1. Contents of the Water for Health initiative water treatment kit.

baseline use of sachets was higher than typically seen[16] and the expected increase in use of free product was modest. A sample of 150 women in each group would provide 90% power to detect the difference in sachet use at an $\alpha = 0.05$. We chose to include all HFs in the evaluation for several reasons. First, increasing the number of HFs enrolled would reduce the impact of a single HF on results and provide analytical options should some facilities provide influential or distinct results. Second, we minimized the potential impact of the design effect on the variance estimates by maximizing the number of HFs enrolled and selecting a smaller sample of women from each facility. Finally, we aimed for as many HFs as available so that HF variance could be statistically addressed, if needed. To ensure that women from each HF were adequately represented in the sample, a minimum of six women per HF was selected, which resulted in a substantial increase in sample size.

Survey enrollment. We stratified our sample across the 37 eligible HFs and aimed to enroll six intervention and six comparison group women per HF, with one exception of a large hospital in which we targeted 10 intervention and 10 comparison group women for enrollment. Eligible women were selected for interview by random number generation from lists of women whose first ANC visit was recorded in ANC registries in March–April of 2012 for the comparison group and March–April of 2013 for the intervention group. This time frame was chosen to ensure that intervention group women had ample time for four ANC visits and would have delivered before the November 2013 evaluation. This was the primary sampling procedure, but because not all women identified by the registry could be located in a village (a common problem in rural Uganda) we used an alternate enrollment procedure in an attempt to reach the desired sample size. In this case, village health teams generated a list of women who attended at least one ANC visit, and delivered between 1 and 2 years previously (for the comparison group) or delivered less than 3 months previously (for the intervention group). Women were randomly selected, using a random number generator, from the list developed by the village health teams. For both primary and alternate enrollment selection methods, women selected for the comparison group were excluded if they were pregnant and received ANC in 2013.

Cross-sectional survey. Trained research assistants fluent in two or more local languages used a standardized questionnaire to interview women about demographic and socioeconomic characteristics, pregnancy history, use of maternal health services, HWT practices, knowledge about sachets, and receipt and use of water treatment kits and sachet refills. Observations of data recorded in the maternal passport (a document maintained at home by the women, and updated by health-care providers at each visit to a maternal health clinic) and of home environmental characteristics were also made. Stored drinking water was tested for free chlorine residual using the N,N-diethyl-*p*-phenylenediamine colorimetric method (LaMotte Co., Chestertown, MD) as an objective measure of HWT.

ANC and maternity registry data abstraction. Data abstracted from ANC and maternity registries included monthly totals for first ANC, ≥ 4 ANC, total ANC visits, HF deliveries, PN visits for 2012 and 2013, and, for 2013 only, the number of water treatment kits and sachet refills distributed. The outcomes of ≥ 4 ANC, HF deliveries, and PN visits were divided by first ANC, a proxy for the total number of women since > 95% of women attend at least one ANC visit, to further compare across years.

Health-care provider survey. To improve our understanding of the Water for Health implementation process, we interviewed one health-care provider from each HF in March 2014.

Data analysis. Data from the cross-sectional survey were entered into a Microsoft Access 2010 (Microsoft Corp., Redmond, WA) database, whereas registry data and health provider survey data were managed in Microsoft Excel (Redmond, WA); analysis was done using SAS version 9.3 (SAS Institute, Cary, NC). We tested the hypothesis that exposure to an offer of free water treatment kits and sachet refills at HF-based maternal health services would increase the percentages of mothers with ≥ 4 ANC visits, HF deliveries, PN visits, reported HWT, and confirmed HWT (positive chlorine residuals in stored household drinking water). Intervention and comparison group data were compared using Rao-Scott χ^2 test, adjusting for any potential correlation within HF respondents. The design effect ranged from 0.01 to 1.62 with all but one being < 1.00. We report when the design effect exceeded 1.00 indicating some correlation. We report design-adjusted χ^2 results to describe associations, as the intent and study were not powered for describing effect sizes and performing multivariable modeling.

Ethical review. The protocol was approved by Institutional Review Boards at the Joint Clinical Research Center in Uganda and CDC (protocol 6482). Informed consent was obtained from all mothers.

RESULTS

Health facilities. Although 46 HFs implemented the Water for Health initiative, nine (19.6%) lacked adequate registry data to enable selection of a sample of women for the cross-sectional survey and were excluded. Of 37 included HFs, 17 (46%) were level II, 16 (43.2%) were level III, two (5.4%) were level IV, and two (5.4%) were district hospitals.

Cross-sectional survey. *Enrollment.* We enrolled six women from each of 36 HFs that had similar average numbers of

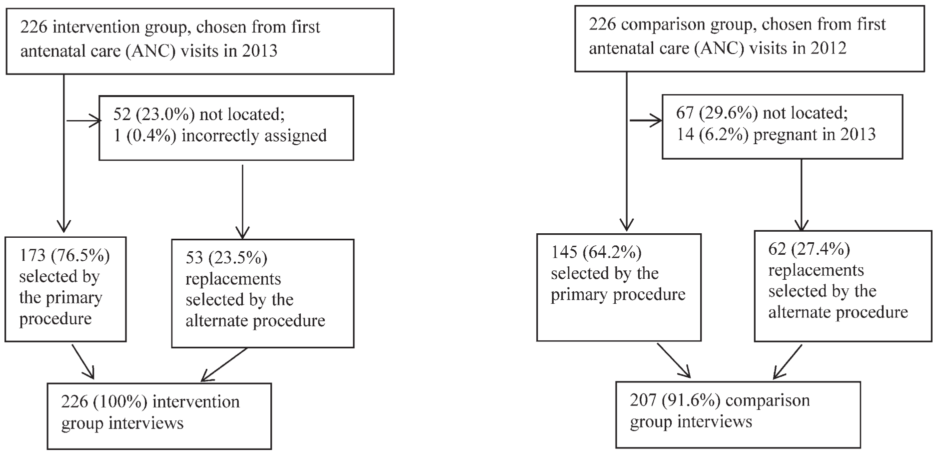

FIGURE 2. Enrollment flow chart, cross-sectional survey, Water for Health initiative evaluation, Uganda, 2013.

first ANC patients per month, and a weighted sample of 10 from one district hospital, for a total of 226 in each group (Figure 2). Of 226 women randomly selected for the intervention group, 52 (23.0%) could not be located and 1 (0.4%) was incorrectly assigned (Figure 2). We enrolled 53 replacements using the alternate selection procedure. Of 226 women selected for the comparison group, 67 (29.6%) could not be located and 14 (6.2%) were pregnant in 2013 and excluded. We were able to locate and enroll 62 replacements using the alternate selection procedure, for a total of 207 women. We found no statistically significant differences in primary outcomes of interest between women selected by primary and alternate procedures.

Demographics. The median age of mothers was 25 years (range = 16–46) in the intervention group and 27 years (range = 15–44) in the comparison group; median gravidity and parity were four in both groups (Table 1). Approximately 90% of women in both groups were married or cohabitating with a partner and over 36% had completed primary or higher level education. The median family size in both groups was five (range = 1–15) with a median of two (range = 0–7) children under 5 years old.

Maternal health service use. There were no significant differences between intervention and comparison group women in the reported percentages with ≥ 4 ANC visits (68.2% versus 66.5%), or attending PN visits (38.3% versus 39.6%) (Table 2). However, fewer women in the intervention group reported delivering their last child at a HF (67.8% versus 74.3%, $P < 0.01$). Only level III and IV HFs, and district hospitals are equipped to routinely provide delivery services. However, deliveries do also occur at level II HFs. The median number of months between initiation of ANC and delivery was similar between mothers in the intervention group (4.21 months, range = 0.03–7.76) and comparison group (3.75 months, range = 0.46–8.88).

TABLE 1
Demographic characteristics of women surveyed, evaluation of Water for Health initiative, 2013

	Intervention (N = 226)	Comparison (N = 207)
	Median (range)	Median (range)
Mother's age*	25 (16–46)	27 (15–44)
Gravidity	4 (1–14)	4 (1–12)
Parity	4 (0–13)	4 (1–11)
	n (%)	*n* (%)
Married or cohabiting with a partner	202 (89.4)	187 (90.3)
Completed primary school or higher	84 (37.2)	75 (36.2)

*Statistically significant difference of $P = 0.03$.

At the time of interview, 160 (70.8%) of 226 intervention group women and 130 (62.8%) of 207 comparison group women had their maternal passport, the maternal health record, available. There were no significant differences in the percentages of intervention and comparison group women with ≥ 4 ANC visits (43.4% versus 38.7%), HF deliveries (36.1% versus 39.1%), or PN visits (9.0% versus 4.7%) recorded in passports (Table 2). The majority of reported results agreed with results recorded in the maternal passport for both the intervention and comparison groups (concordant reported and recorded ANC visit [67.6% versus 64.9%], HF deliveries [66.0% versus 63.8%], and PN visits [68.9% versus 69.5%]). However, when recorded and reported results were discordant, women tended to report receiving more maternal health services than were recorded in the maternal passport.

Water source, storage, and treatment. Improved water sources, primarily boreholes or wells, were used by 122 (54.0%) of 226 intervention women and 113 (55.1%) of 207 comparison women (Table 3). Water was reportedly stored at home by 222 (98.2%) of 226 intervention households and 200 (96.6%) of 207 comparison households. Overall, a significantly higher percentage of intervention than comparison group women reported treating their water (83.6% versus 64.6%, $P < 0.01$), having treated water at home (31.7% versus 19.7%, $P = 0.01$), and using sachets to treat their water (43.8% versus 9.2%, $P < 0.01$). More comparison group women reported boiling their water (37.7% comparison group versus 30.5% intervention group, $P < 0.01$). Of women who had water stored at home that could be tested at the time of interview (72.1% in the intervention group and 71.5% in the comparison group), a higher percentage in the intervention than comparison group had detectable free chlorine residual in stored water (13.5% versus 3.4%, $P = 0.02$). Fewer than 7% of women who had heard of sachets in either group reported knowing where to buy the product.

Water treatment kits and sachet refills received. Of 226 intervention group women, 222 (98.2%) received the water treatment kit and 101 (45.5%) received sachet refills at subsequent

Table 2
Maternal health service use among women surveyed, evaluation of Water for Health initiative, 2013

	Intervention (N = 226)* n (%)	Comparison (N = 207)* n (%)	P value
≥ 4 antenatal care (ANC) visits	145/219 (66.2)	135/197 (68.5)	0.18
Last delivery at a health facility (HF)	145/214 (67.8)*	153/206 (74.3)	< 0.01
Postnatal (PN) visits	82/214 (38.3)*	82/207 (39.6)	0.87
Passport available	160/226 (70.8)	130/207 (62.8)	0.30
≥ 4 ANC visits	66/152 (43.4)	48/124 (38.7)	0.35
Last delivery at a HF	56/155 (36.1)	50/128 (39.1)	0.13
PN visits	14/155 (9.0)	6/128 (4.7)	0.20

*> 10 missing.

ANC, delivery, or PN visits. Over the course of ANC, delivery, and PN service use, survey respondents who received sachet refills reported receiving a median of two (range = 1–5) 30-day sachet refills. Compared with women who received no refills, women who received sachet refills were more likely to attend PN visits (49.5% versus 30.2%, P < 0.01) have an improved water source (64.4% versus 44.6%, P < 0.01), and report that they used sachets (54.5% versus 35.5%, P = 0.02), but were less likely to report boiling their water (15.8% versus 43.8%, P < 0.01); there were no differences in age, marital status, education, and confirmed water treatment between the two groups. The most common reasons reported by intervention group women for not using sachets at the time of the interview included their high cost and unavailability for sale, which would have precluded sachet use after the conclusion of free distribution at the end of the study, and the unpleasant smell or taste of treated water. It was also noted by a few that the product was time consuming to use or that it is used only for turbid water.

ANC and maternity registry data. Compared with 2012, in 2013 there was a 47.7% increase in the number of first ANC visits, 78.9% more ≥ 4 ANC visits, 29.9% more HF deliveries, and 72.2% more PN visits (Table 4). There was also an increase in the ratio of women with ≥ 4 ANC to first ANC visits by 21.8% and PN to first ANC visits by 17.6%, but the ratio of HF deliveries to first ANC visits decreased by 11.8%. A total of 19,586 water treatment kits were distributed at the 37 HF from January to December 2013. Of these, 16,913 (86.4%) were distributed at ANC visits and the remaining 2,673 either at delivery or PN visits. A total of 582,077 sachet refills were also distributed, representing approximately 19,402 30-day refills. There was relatively little missing registry data for ANC visits (< 8% for 2012 and 2013), 23.9% of delivery and 57% of PN visit data outcomes were missing. Level II HFs, where deliveries are not routinely performed or may not be recorded, accounted for 86.0% of missing deliveries in 2012 and 87.6% in 2013.

Health-care provider survey. Providers at 36 (97.3%) of 37 HFs were interviewed about the Water for Health initiative. Of 36 respondents, 13 (36.1%) attended the Water for Health training and 32 (88.9%) reported that one or more colleagues attended the training. Of 36 respondents, 28 (77.8%) knew that the water treatment kit should be given at the first ANC visit, three (8.3%) knew that sachet refills should be given at delivery, and six (16.7%) knew that sachet refills should be given at the PN visit. Of 36 respondents, 35 (97.2%) reported water treatment kit stock-outs during the project and seven (19.4%) reported sachet stock-outs. Pregnant women from outside the HF catchment area were reported to have visited the clinic to receive water treatment kits by 32 (88.9%) respondents and to have received sachet refills by 23 (63.9%) respondents.

DISCUSSION

Results of this evaluation seem contradictory. In contrast to three previous studies of similar interventions[11] (K. O'Connor and J. Routh, personal communication), we found no apparent differences in the percentage of mothers with ≥ 4 ANC visits between the intervention and the comparison groups in either self-reported survey findings or maternal passports. A decrease in HF deliveries was self-reported in survey data, but not observed in the recorded maternal health passport record. Registry data showed increases in the number of first ANC visits, ≥ 4 ANC visits, HF deliveries, and PN visits from the preintervention period in 2012 to the postintervention period in 2013. Despite the increase in the number of HF deliveries, the ratio of HF deliveries to first ANC visits decreased from 2012 to 2013.

Table 3
Water handling, hygiene, and sanitation practices among women surveyed, evaluation of Water for Health initiative, 2013

	Intervention (N = 226)* n (%)	Comparison (N = 207)* n (%)	P value
Improved water source†	122/226 (54.0)	113/205 (55.1)	0.85
Reported storing water at home	222/226 (98.2)	200/207 (96.6)	< 0.01
Reported that they treat drinking water	189/226 (83.6)	133/206 (64.6)	< 0.01
Reported use of sachets	99/226 (43.8)	19/207 (9.2)	< 0.01
Reported boiling water	69/226 (30.5)	78/207 (37.7)	< 0.01
Report that drinking water at home was treated	71/224 (31.7)	40/203 (19.7)	0.01§
Positive chlorine water test	22/163 (13.5)	5/148 (3.4)	0.02
Hand washing soap present at home	172/223 (77.1)	167/206 (81.1)	0.50
Improved latrine ‡	33/225 (14.7)	27/204 (13.2)	0.45

*> 10 missing.
†Improved: tap in house, public tap, protected borehole/well, protected spring, bottled water, rain water, or tank vs. unimproved: river, lake, dam, pond, open well, or open spring.
‡Improved: improved latrines with concrete floor, ventilation, roof, door vs. unimproved: no facility, shared, pits, and traditional latrines.
§Design effect > 1.00.

TABLE 4

Number of antenatal care (ANC) visits, health facility (HF) deliveries, and postnatal (PN) visits recorded in the ANC and maternity registries of 37 HF* included in the Water for Health initiative evaluation, January–December 2012 and 2013

Outcome of interest	2012	2013	Percent change from 2012 value
First ANC visits	16,781	24,746	47.7%
≥ 4 ANC visits	4,296	7,687	78.9%
Total ANC visits	38,586	57,767	49.7%
≥ 4 ANC visits/first ANC visits	25.6%	31.1%	21.4%
HF deliveries	4,672	6,073	29.9%
HF deliveries/first ANC visits	27.8%	24.5%	−11.8%
PN visits	1,818	3,131	72.2%
PN visits/first ANC visits	10.8%	12.7%	17.6%

*Seventeen of the included 37 health facilities are health facility level II, where deliveries are not routinely expected to be performed.

There are several possible explanations for why this intervention did not impact maternal health service use. First, survey data suggested there was discordant demand for the water treatment kits and sachet refills. Among women interviewed, 98.2% received water treatment kits and were therefore eligible to receive sachet refills at their additional ANC visits, delivery, and the PN visit. Over 65% of women reported attending ≥ 4 ANC visits and delivering in a HF, which would have made them eligible to receive at least four sachet refills. However, only 45.5% received any sachet refills and among them the median number of refills received was two. Survey findings illuminated several possible reasons for low demand for sachet refills. These included poor availability in the community, bad smell or taste, time-consuming nature of the water treatment procedure, and participants saving sachets for the dry season when water is more turbid. Low demand for and use of sachets has been observed in other studies.[16–19] ANC and maternity registry data corroborated survey findings by showing that approximately equal numbers of water treatment kits and sachet refills were distributed instead of the programmed four sachet refills per water treatment kit.

Second, the provider survey suggested that the timing and quantity of sachets used for refill distribution were not well understood by program implementers, distribution practices were not uniform, and sachet stock-outs occurred in some HFs. It seems unlikely that these programmatic problems fully explain the magnitude of the discrepancy between expected and observed sachet refill distribution. We did not determine a reason for why HF deliveries might have decreased among the intervention group women in the health-care provider survey.

Third, the 47.7% increase in first ANC visits from 2012 to 2013 observed in the registry data very likely resulted from women outside project catchment areas traveling to the project HFs to receive the free kits. This large increase in first ANC visits would not have been possible if services were used only by women living in the catchment areas of project HFs.[3] Because nearly all pregnant women in Uganda have at least one ANC visit, the number of first ANC visits can only reasonably vary by a few percentage points between years within the same catchment area. The projected increase in the number of pregnant women in Uganda from 2012 to 2013 was less than 1%. Women traveling to Water for Health HFs from outside the catchment areas to receive free kits could also explain the increases in the number of ≥ 4 ANC, HF deliveries, and PN visits in the registry data (although the increase in HF deliveries was not proportional to the increase in first ANC visits, resulting in the decrease in the ratio of HF deliveries to first ANC visits from 2012 to 2013). The provider survey corroborated these explanations and suggested high demand for the water treatment kits. The presence of two 10-L buckets in each kit was a high-value incentive that likely motivated women to travel outside of their usual clinic catchment area for ANC.

Fourth, the incentive structure of the Water for Health initiative had water treatment kits being distributed at the first ANC visit. However, 2,673 water treatment kits were given to women at delivery or PN visits. We have no specific information about the recipients at these visits to determine if these visits were truly first visits in the initiative (e.g., they were given a kit to "catch-up") or if they were women from outside the catchment area.

Results of this evaluation did show a statistically significant, modestly higher percentage of intervention group women with reported and confirmed HWT than comparison group women. These findings are consistent with at least three other studies of HWT integration with ANC (J. Routh, personal communication).[11,12] Although modest, this increase in HWT indicated that, at least among some project participants, the water treatment kits and sachet refills were used, suggesting that some mothers understood the need for, and were more adherent to, recommendations for water treatment. In fact, women who received refills were more likely than those who did not receive refills to report treating their water and using improved water sources, which suggests possible greater adherence to recommended home water management. These women were also more likely to report attending a PN visit, the least used of maternal health services, which could be an indicator of adherence to recommended maternal health-care. However, the sachets did not seem readily available for purchase in the community, a barrier to sustained use. Other research suggests that the prevalence of HWT could be increased if women were given greater choice in interventions to decide which one best serves their needs.[20] Supply-side interventions, such as the one offered in this project, can result in discordance with local needs and a consequent lack of acceptance.[21]

Limitations. This study had several important limitations. First, because the evaluation was designed nearly a year after the program was implemented, no baseline data were collected. Second, the comparison group received ANC in the same HFs and was from the same communities as the intervention group, but had been pregnant in 2012, the year before the Water for Health initiative started. Consequently, the comparison group had some exposure to the water treatment product, possibly biasing the results towards the null. Third, sachet use may have been inflated in the intervention group because of courtesy bias. This limitation was mitigated by making surprise visits to households and testing stored water for free chlorine residual, an objective measure of HWT. Objective water testing data were weakened by 30% missing data in both intervention and comparison group households that had no water stored at the time of water testing. It is not known whether the absence of water to test biased confirmed treatment findings because we could not assess whether these data were missing at random. However, in the two groups, water-handling practices and the proportion of households lacking stored water available for testing were similar. Fourth, it was possible that water treatment programs of which we were unaware could have influenced HWT results, but it is unlikely that other programs would have targeted the identical group of villages as this intervention. Fifth, recall bias regarding maternal health service use could have been greater in the comparison group. This possibility was unlikely because a review of maternal passport data found no difference in service use outcomes between the two study groups, suggesting that poor recall did not bias study findings. Sixth, because we selected intervention group women from the ANC registries, we likely overestimated water treatment kit coverage because most registered women had received kits. Although this procedure excluded women who did not seek ANC, this group represents < 5% of pregnant women. Seventh, women selected from both the intervention and comparison groups could not be located. This resulted from registry data that were incomplete, difficult to read, or had inaccurate personal identifiers. The impact of this problem on study results cannot fully be determined and we did not account for the two sampling methods in our analysis, but a comparison of women selected by the primary and alternate methods did not reveal differences in the primary outcomes of interest. Finally, because the evaluation included a convenience sample of HF that participated in the Water for Health initiative, results are not generalizable.

CONCLUSIONS

The Water for Health initiative did not appear to increase the percentage of pregnant women among the target population with ≥ 4 ANC visits, HF deliveries, or PN visits, likely because of low demand for the follow-up incentive, that is, the sachet refills. Inconsistent implementation of sachet refill distribution could also have contributed to this result. There did appear to be high demand for the water treatment kits which likely contributed to a dramatic increase in first ANC visits, potentially including visits from women outside of the target population, from 2012 to 2013. There was a modest increase in confirmed HWT among intervention group women, which suggested that some women recognized the need for water treatment and took advantage of the incentives. To improve outcomes in programs like Water for Health, we recommend implementers provide more consistent training for health-care providers, consider regular refresher trainings to help improve program implementation, and assess consumer demand for different products before selecting water treatment technologies as incentives.

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Authors' addresses: Almea Matanock, Tara Anderson, Tracy Ayers, Xin Lu, and Robert Quick, Centers for Disease Control and Prevention, Division of Foodborne, Waterborne, and Environmental Diseases, Atlanta, GA, E-mails: xdf2@cdc.gov, TCAnderson1@cdc.gov, eyk6@cdc.gov, lx.alzn@gmail.com, and rxq1@cdc.gov. Lilian Likicho, Thomas Emeetai, Celia Kakande, and Miriam Mutabazi, Management Sciences for Health, STRIDES for Family Health, Kampala, Uganda, E-mails: lilianlikicho@hotmail.com, thomas.emeetai@gmail.com, ctkakande@yahoo.com, and mimmutabazi@gmail.com. Richard Wamimbi, World Vision International, Kampala, Uganda, E-mail: richardwamimbi@yahoo.co.uk.

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