



Promotion of arsenic-safe drinking water sources in Bangladesh

A case study applying the practical guide *Systematic Behavior Change in Water Sanitation and Hygiene*

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<http://www.eawag.ch/en/departement/ess/empirical-focus/environmental-and-health-psychology-ehpsy/>

Acknowledgement

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Inauen, J., & Mosler, H.-J. (2016). Mechanisms of behavioural maintenance: Long-term effects of theory-based interventions to promote safe water consumption. *Psychology & Health*, 31(2), 166-183. doi:10.1080/08870446.2015.1085985

Case Study: Promotion of arsenic-safe drinking water sources in Bangladesh

Overview

Introduction: Arsenic Contamination in Bangladesh

Approximately half of the world's population relies on groundwater as a drinking water source. Although groundwater can be a safe water source, it can also be affected by geogenic contaminants, such as arsenic. High arsenic concentrations in groundwater have been found to be responsible for health problems summarized under the term arsenicosis, which develops over a period of several years. Symptoms of arsenicosis range from skin disorders to cardiovascular diseases, cancer and the impairment of the neurodevelopment of children. Since there is no cure for arsenicosis to date, the provision of safe water for the prevention of this disease is the vital mitigation approach. The most arsenic-affected country in the world is Bangladesh, where 20 million people are estimated to be at risk of drinking arsenic contaminated water.

Since the recognition of arsenic as a public health threat, the scientific community and governmental as well as non-governmental institutions have made major efforts to understand and mitigate the problem. A variety of low-cost mitigation options have been developed (e.g. arsenic-removing filters, deep tubewells tapping arsenic-free aquifers etc.), and have been implemented. However, what has received only little attention so far is the social dimension of the problem. For instance, many implemented mitigation options are not being maintained by the users and are being abandoned. Also, despite the population's increasing awareness of arsenic contamination, adoption of health preventive measures is going slowly.

Therefore, a research program titled: "Analysis of the social acceptance and use of arsenic mitigation options and evaluation of promotion strategies in rural Bangladesh" was carried out by Eawag. It aimed at gaining understanding of the behavior change processes involved in switching to arsenic-safe drinking water sources, and to promote their use. The project took place between February 2009 and January 2012. The project was part of a transdisciplinary project at Eawag, Water Resource Quality (WRQ), aiming at developing a framework for mitigating geogenic contamination. In Bangladesh, natural scientists of WRQ evaluated the technical viability of different mitigation options in parallel to this project. Close collaboration with organizations involved in arsenic mitigation in Bangladesh was sought. Implementing partners were UNICEF Bangladesh, Christian Commission for Development Bangladesh (CCDB) in Manikganj, and Village Education Resource Center (VERC) in Monoharganj. The aim was to set up a participatory process during the project to ensure that the research team did not miss stakeholders' needs and to guarantee the transfer of research results into practice.

Phase 1: Identify potential behavioral factors

Step 1.1

Define the target behavior

To achieve safe water consumption, users of unsafe wells need to switch to available safe water sources. These are defined as water sources that comply with the drinking water standards of Bangladesh relative to microbial and geogenic contamination. The arsenic drinking water standard of Bangladesh is <50ppb.

Qualitative interviews with experts in arsenic mitigation revealed that there are essentially eight safe water sources available in Bangladesh: safe-tested shallow tube wells, deep tube wells, pond sand filters, community-based arsenic removal, household-based arsenic removal, community-based piped water supply, dug wells, and rainwater harvesting. Additionally, boiling surface water was also considered a safe water source. The target behavior was defined as 100% consumption of drinking water from safe water sources.

Describe all the components of the behavior

We specified the following key actions of safe water consumption as the target behavior: Collect and consume drinking water from an arsenic-safe water source.

Select and describe the target population group

Lots of arsenic mitigation efforts in Bangladesh are targeted towards creating awareness of the problem in the population. For this purpose, millions of shallow tube wells have been tested for arsenic in the past three decades. As alternative water sources, more than 100'000 safe water sources have been installed in affected parts of the country. However, many of these safe water sources are not being used by the people, despite being aware of the problem. We therefore targeted persons in our study who knew that their water source was not arsenic safe, and who had access to at least one safe water alternative. Within the households, our target person was the person responsible for drinking water provision. In Bangladesh, these are predominantly women.

Step 1.2 Collect information on psychosocial and contextual factors that might influence the target behavior

Interviews with 22 stakeholders and 1268 end users were conducted about the eight major safe water options that provide an alternative to contaminated shallow tubewells: piped water supply, deep tubewells, pond sand filters, community arsenic-removal, household arsenic removal, dug wells, well-sharing, and rainwater harvesting. Stakeholders rated different characteristics of each safe water option, such as sustainability, and easy use and maintenance of the options.

Stakeholders mostly preferred rural piped water supplies and deep tubewells, while their least preferred options were dug wells and arsenic removal filters. End users mostly preferred deep tubewells, well-sharing and rural piped water supplies. They least preferred dug wells. End users identified several disadvantages of mitigation options, including long distances, great effort to collect water and difficult social situations. They further demonstrated moderate willingness to pay for a rural piped water supply, deep tubewells and pond sand filters, but lower willingness for other options.

Step 1.3 Allocate psychosocial and contextual factors to the RANAS model

The factors taste, smell, color, and temperature of the safe water were allocated to the attitude factor Feelings. The factors distance, effort and time needed for each option as well as whether they rated it as arsenic safe were allocated to the attitude factor Costs and Benefits. The statements that there might be restrictions for collection and difficult social situations were assigned to the barrier factor.

Phase 2: Measure the psychological factors and determine those steering the target behavior

Step 2.1 Develop a questionnaire to measure behavioral factors and the behavior and a protocol to conduct observations of the behavior

An extensive questionnaire was developed incorporating the previously identified factors mentioned in the qualitative interviews. Exemplary items from the questionnaire used in the Bangladesh study can be found below in Table 1. The full questionnaire is available upon request from the authors.

To assess water consumption, the person responsible for drinking water collection was asked how many containers she/he collected from what water sources on a typical day the previous week. As it turned out that persons only used one water source for collecting drinking water on a particular day, water consumption resulted in a measure of 1 = used arsenic-safe water source or 0 = did not use arsenic-safe water source for drinking.

Table 1: Example items for all psychological factors and answer scales or options.

Psychological factors	Assessment question with answer scales/options
Risk factors	
Health knowledge	<p>This was assessed with a set of 18 ‘yes-no’ questions. The questions were concerned with knowledge of which water sources contained arsenic, whether contaminated water was safe to drink, which medical conditions could be caused by arsenic and tasks for which it was okay to use arsenic contaminated water. Furthermore, respondents were asked whether they knew the location of a safe water option in their village, whether it was safe to drink from a green-colored tubewell, whether arsenic can be removed by boiling and to name water sources that were free from arsenic. Each correct answer was assigned one point.</p> <p>In the end, all points were added to the score and transformed into the standardized value range of 0 to 1.</p>
Vulnerability	<p>Three items were used to assess vulnerability. Participants were asked how high or low the chances were that they or someone in their family would develop arsenicosis, and how high their chances were of developing arsenicosis compared to persons of their sex and age.</p> <p>(- 1 = very low to 1 = very high)</p>
Severity	<p>Participants were asked, ‘Imagine that you contracted arsenicosis, how severely would it impact your life in general/your social life/your economic situation?’</p> <p>(0 = not at all severe to 1 = very severe)</p>
Attitude factors	
Beliefs about costs and benefits	<p>Perceived expenditure of time and effort were measured using two items. For example, ‘Do you think that collecting water from mitigation option is time-consuming?’</p> <p>(0 = not at all time-consuming to 1 = very time-consuming). The scale was inverted so low values reflected low attitudes (i.e. high effort/time) and high values reflected favorable attitudes (i.e. low effort/time).</p>
Feelings	<p>This construct was measured using seven items. Participants were asked, for example, whether they liked collecting water from the safe well, whether they felt ashamed of collecting water from there or whether they liked the water taste</p> <p>(-1 = dislike very much to 1 = like very much)</p>
Normative factors	
Other's Behavior	<p>This was assessed using three items. Participants were asked to name the number of people outside their families or of their village who collected water from the safe water option</p> <p>(0 = almost nobody to 1 = almost everybody)</p>

Other's (Dis)Approval	Two items were used to assess this. People were asked, for example, 'Overall, how much would people who are important to you approve or disapprove of you collecting water from the arsenic-safe water option?'
	(-1 = they [would] disapprove very much to 1 = they [would] approve very much)
Ability factors	
How-to-do Knowledge	This was assessed with a subset of the knowledge questions mentioned under 'health knowledge'.
Confidence in Performance	This was assessed using three items. Participants were asked, for example, how difficult or easy it was to find time to collect water from the arsenic-safe well
	(-1 = very difficult to 1 = very easy)
Confidence in Continuation	Participants answered three questions related to how confident they felt about collecting water from the safe option 'even if they had to walk a long distance/the safe option was broken/they did not feel like collecting water'
	(0 = not at all confident to 1 = very confident)
Confidence in Recovering	Three items assessed people's recovery self-efficacy. People were asked, for example, 'Imagine that you stopped going to collect water from the safe well for several days. How confident are you to start collecting water from the safe option again?'
	(0 = not at all confident to 1 = very confident)
Self-regulation factors	
Action Control	A total of 6 questions assessed this. Participants were asked, for example, 'How much did you pay attention so you do not forget to collect water from the mitigation option?'
	(0 = no attention at all to 1 = much attention)
Barrier planning	This was measured with three items. Participants were asked, for example, 'Have you made a detailed plan of what to do when the arsenic-safe option is broken?'
	(0 = no detailed plan at all to 1 = very detailed plan)
Remembering	As a proxy to measure remembering, respondents were asked an open-ended question: 'How many times did you forget to collect water from the arsenic-safe option in the last week?'
	(0 to number of times)
Commitment	Three items were used to assess this. Participants were asked how important was it for them to collect water from the safe option, how committed they felt to collecting water from the safe well, and how annoyed they felt if they forgot to collect water from there
	(0 = not at all to 1 = very important/committed/annoyed)

In addition, information was captured on socio-demographic factors such as education, age, and household wealth. In order to unambiguously identify households at a later stage of the project, the full name of the respondent and the household's head's name were recorded together with the address and a mobile phone number for contacting the household. No observations were carried out.

Step 2.2

Translate the questionnaire into the local language

The questionnaire was translated from English into Bangla by the local field coordinator, and then back-translated into Bangla by a Professor of the University of Dhaka. We refined the translation during the pretest by discussing it among the team, paying particular attention to use easy-to-understand wording.

Define the sample size and the sample selection procedure

We aimed at interviewing households who knew that their water source was not arsenic safe, and who had access to at least one safe water alternative: 125 households for each safe water option ($N = 875$). Six sub-districts of Bangladesh where the safe water options were installed were selected. Within these study areas, we used the random walk method to randomly select participating households. Of the randomly selected households, we excluded households who did not meet our inclusion criterion of having an unsafe water source.

Schedule the field phase, define the number of data collectors to be employed and supervisors to appoint

The questionnaire took about one hour to administer. To allow for transitioning time between the households, we set the target number of interviews to be five per day per data collector. We recruited a team of 15 data collectors and two field supervisors for the survey.

Employ data collectors

Data collectors were recruited from Dhaka, the Capital of Bangladesh. This had the advantage of finding highly educated and well experienced interviewers. All of them had a university degree and at least some surveying experience.

Organize the data collection

All questionnaires were printed in Dhaka and transported to the field by the supervisors. Prior to departure, we sought permissions and support from the local authorities via the central government, and the heads of the NGOs we worked with. Furthermore, we locally visited the authorities prior to the surveys, informed them about the survey and obtained their support.

Train the data collectors, Pretest of the survey instruments in the field, Revise the survey instruments

During five days, the interviewers were extensively trained to conduct one-hour long interviews. In particular, language was rehearsed to ensure that each interviewer used the same easy-to-understand wording, tailored to the rural participants. For quality control, supervisors were present in the field to answer the interviewers' questions and to check the completeness of the questionnaires.

The training also included general information on the arsenic issue (e.g. about health effects, safe water alternatives). Practice sessions included going through the questionnaire together, filling out the questionnaire items correctly, how to approach households, dealing with difficulties, as well as mock interviews. Two pre-test days were scheduled in areas not part of the study sample but in similar surroundings and conditions. Experiences from the pre-test days were discussed among the team and used to refine the survey instruments.

Conduct the data collection

The first few days of the survey data collectors were allowed to conduct fewer interviews in order to allow for plenty of time to discuss each filled-in questionnaire with the data collectors. Common mistakes and difficulties were discussed in the team, and smaller issues were solved one-on-one. We further closely supervised and supported the data collectors by random checking in person (dropping by the interviews), or by phone.

Step 2.3

Enter, clean, and process the data

After the survey, the data was entered from the paper questionnaire into an excel sheet on a personal computer by local employees. Part of the data (approx. 10%) was double entered in order to cross check the precision of the data entry. This work was closely monitored and double checked by the supervisor.

Divide the sample into doers and non-doers of the target behavior

This additional step was not necessary for this case study, as participants were either collecting water from an arsenic-safe water source or a contaminated water source on a given day. Hence, they were naturally divided into doers (collected safe water) and non-doers (did not collect safe water).

Calculate the mean scores of each psychosocial factor separately for doers and non-doers

Now the mean values for all factors were calculated independently for doers and non-doers. Figure 1 depicts the results from the baseline survey, also indicating differences between the two groups. Larger differences indicate higher potential for intervention.

Compare the mean scores between doers and non-doers to identify the behavior-steering factors

A graphical illustration of results also helps to compare the mean values for the two groups and to interpret the results.

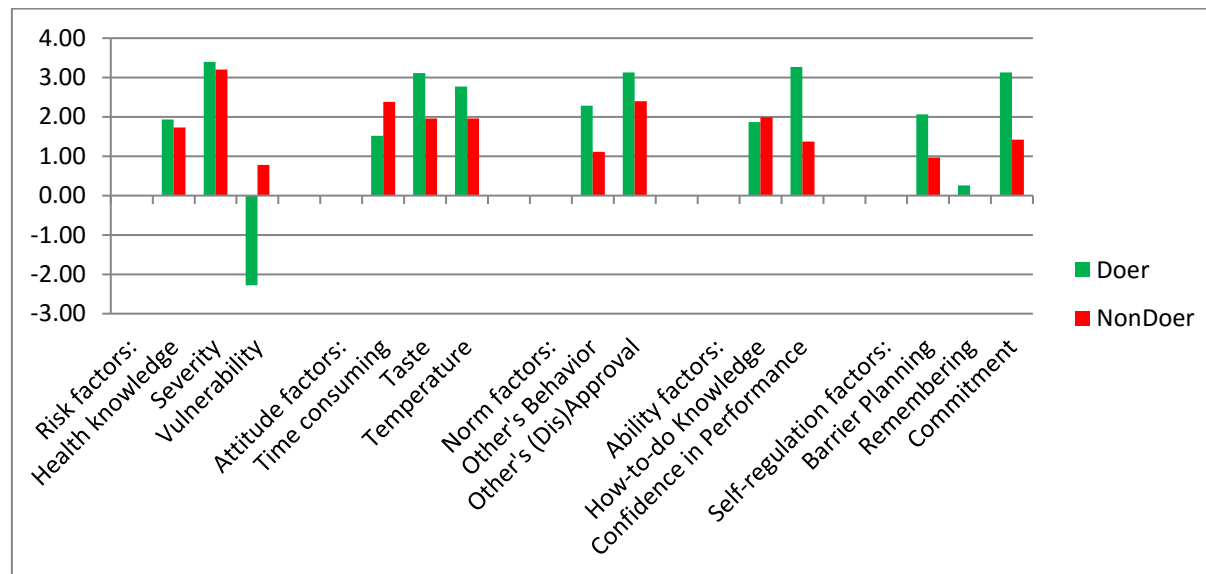


Figure 1: Graphical representation of the baseline results showing means for all factors separately for doers and non-doers for easy comparison.

Large differences between doers and non-doers were found for Commitment, Confidence in Performance, Others' Behavior, and Barrier Planning. We also found large differences for vulnerability. However, they pointed in an unexpected direction: Doers felt less vulnerable than non-doers. Together with qualitative findings from the baseline survey, we were able to understand that this result means that persons who drink water from safe water sources consequently feel less vulnerable (and not that persons who feel less vulnerable consequently consume safe water). This factor was therefore not selected for intervention as it is a consequence of behavior change, in this case, rather than a facilitator.

Phase 3: Select corresponding BCTs and develop appropriate behavior change strategies

3.1 Define BCTs to change behavior steering determinants

Select BCTs that correspond to the psychosocial factors according to the RANAS approach

The following BCTs were chosen based on the results gathered in Step 2. As a basis of the intervention, we provided information about arsenic, health effects, and mitigation to the intervention group and the control group. In the intervention group, we additionally implemented the following BCTs. To increase commitment, we selected BCT 34: Use memory aids and environmental prompts, BCT 26: Prompt specific planning, and BCT 10: Prompt public commitment. Prompts are not only reminders of behavior, but they are also assumed to strengthen commitment. Specific planning includes plans that link situations with actions. To enhance Others' Behavior, the public commitment intervention was selected as these interventions are frequently and popularly applied in Bangladesh. More details on the specific design and implementation can be found in Step 3.2.

A) Information about health risks (BCT 1: Present facts) and about how to avoid these (BCT 15: Provide instruction)

The information contains what arsenic is and where it comes from. Then, how arsenic enters the body and what kind of health symptoms it causes. After that it is explained which tubewells should be used (the green painted ones), which ones should not be used (the red painted ones, and the ones with no paint).

B) Memory aid at water collection container (BCT 34: Use memory aids and environmental prompts)

This memory aid is fixed at the place where the water collection container is situated; it should support people in remembering to go to the green arsenic-safe tubewell and not to use the red tubewell containing arsenic-contaminated water for drinking and cooking.

C) Tag at contaminated water source (BCT 34: Use memory aids and environmental prompts)

A tag was developed to support people in remembering that they should not use water from arsenic-contaminated (red) shallow tubewells for drinking and cooking. Also the tag shows for what purposes the water from red tubewells may be used. The tag is shown to the participant, its meaning explained and then attached to the red shallow tubewell that the participant is currently using for drinking or cooking.

D) Specific behavior planning (BCT 26: Prompt specific planning)

For specific behavior planning participants are asked to specify, when (which situation), where (which safe option), how much water (number of vessels), and for which purpose (drinking, cooking, or both) they will collect water. In the end, participants are asked to read the agreement out loud and sign it.

E) Pledging session (BCT 10: Prompt public commitment) for promising to use arsenic free water

The pledging session is a meeting with the persons responsible for drinking water collection of a village. Each meeting contains an informational session with posters, as well as a pledging part. For the pledging, every one of the participants is asked to put up their hands if they commit to collecting only arsenic-safe water for drinking and/or cooking. Participants who committed are then asked to get up and tell their detailed plans of when, where, and how much water they will collect from the safe water option (i.e. their specific behavior plan) to the people present. Note that participants were prepared for and invited to the meetings by the promoters.

3.2 Develop and design behavior change strategies

Combine one or several BCTs with suitable communication channels to form a behavior change strategy & Design behavior change strategies

All interventions were delivered by health promoters of a local nongovernment organization, CCDB (Christian Commission for Development in Bangladesh). They each received a remuneration for their services during this one-month intervention. The five female promoters (18 to 25 years old) lived in the study areas and were trained to correctly provide the interventions. At each visit, promoters obtained fully informed consent. Thereafter, promoters conducted the intervention session, which lasted from 20 to 60 minutes depending on the intervention condition (each BCT required approx. 20 minutes). Participants in the public commitment condition were also invited to join the commitment session held in their village two weeks after the promoter's visit. Note that all materials were designed so they could also be understood by illiterate participants.

A) Information on arsenic, arsenicosis and arsenic-safe drinking water options (BCT 1: Present facts and BCT 15: Provide instruction).

This element of the intervention was the control condition and the basis of the three theory-based intervention arms. The promoters explained the following content to the participants by demonstrating a booklet with pictograms and photographs. First, promoters informed participants about arsenic in shallow tubewell water. Second, it was explained that arsenic can have adverse health effects, and these effects were described. Finally, participants were told where arsenic-safe water can be found in their communities (green-marked shallow tubewells), and in general (all major arsenic-safe water sources available in Bangladesh).

B) and C) Memory aids (BCT 34)

A set of two reminders was developed—a poster and a tag. The poster was designed to remind participants in the key situation (just before their drinking water was finished) to collect their water from the safe option. It depicted an almost empty *kalosh* (local vessel for water collection, (pl. *kolshi*)) and a woman who goes to collect water from a green-marked tubewell instead of a red-marked one, which was crossed out. The tag was developed to remind participants not to collect drinking water from the red-marked tubewell. It contained pictograms showing the purposes for which the water should not be used: drinking directly, boiling and then drinking or cooking. Furthermore, the tag displayed the purposes for which the water can be used (e.g. bathing, washing dishes). Promoters first explained the contents of the poster and then installed it at the place within the household where participants kept their *kolshi*. Thereafter, promoters explained the contents of the tag and installed it at the arsenic-contaminated tubewells, which the participants reported to use.



Figure 2: Left: Memory aid at water collection container, designed to remind household members to collect their water for drinking from a safe source just before their drinking water is finished. The poster should be placed next to the drinking water container. Right: Tag at contaminated water source, designed to remind household members not to collect drinking water from here. (BCT 34: Memory aid)

D) Specific behavior planning (BCT 26)

This behavior change technique consists of specific plans for where, when, and how to perform a behavior. It is a special challenge to conduct these interventions for people with low literacy who are not used to living by the clock. We therefore used pictograms with typical tasks during the day for the 'when' part of the plans (e.g. sunrise, breakfast, bathing, etc.). First, promoters asked participants how many times a day they would have to collect water at their neighbor's arsenic-safe tubewell. Then participants were asked to specify a situation before or after which it would be best for them to

collect water (e.g. before preparing lunch). Then, participants named a specific neighbor’s green-marked tubewell from where they committed to collecting their drinking water. Subsequently, they specified how many vessels they would collect each time they went and for which purpose. In the end, participants were asked to repeat the plan out loud after the promoter, to sign the planning form by thumbprint and to keep it safe.

Commitment contract of

Jennifer
(Participant name)


 Every day after / before (getting up / breakfast /.....)

and after / before  and after / before 

I am going to walk to *Mubarak*'s tubewell
 (name of green tubewell owner)

and I am going to collect 
 (number of kolshi)

for  and 
 (drinking / cooking / drinking and cooking)

Signature

Figure 3: Specific behavior plan for participants depicting when, where, how much water they would collect (BCT 26: Specific Behavior Planning).

E) Pledging session (BCT 10: Prompt public commitment)

Participants in this condition were invited by the promoter to join the public commitment session that was held in their respective villages approximately one week after the promoter visit. The sessions were part informational and part commitment. First, using posters, a team of two promoters and the

supervisor again explained the information about arsenic, arsenicosis and arsenic-safe drinking water to the group of participants. Thereafter, participants were asked to commit themselves to only drink arsenic-safe water from now on. The participants who committed were asked to read their implementation intentions to the group. At the end of the two-hour session tea and biscuits were offered.



Figure 4: Picture of a public pledging session where women raise their hands in order to show their commitment to only drink water from arsenic-safe sources (BCT 10: Prompt public Commitment).

Phase 4: Implement and evaluate the behavior change strategy

4.1 Design a Before-After-Control (BAC) protocol

Assign the strategies to project communities or project groups

In this case study 16 villages were compiled to four areas and were allocated to one of the three intervention strategies (app. 100 households each (or to the information-only strategy (app. 50 households)).

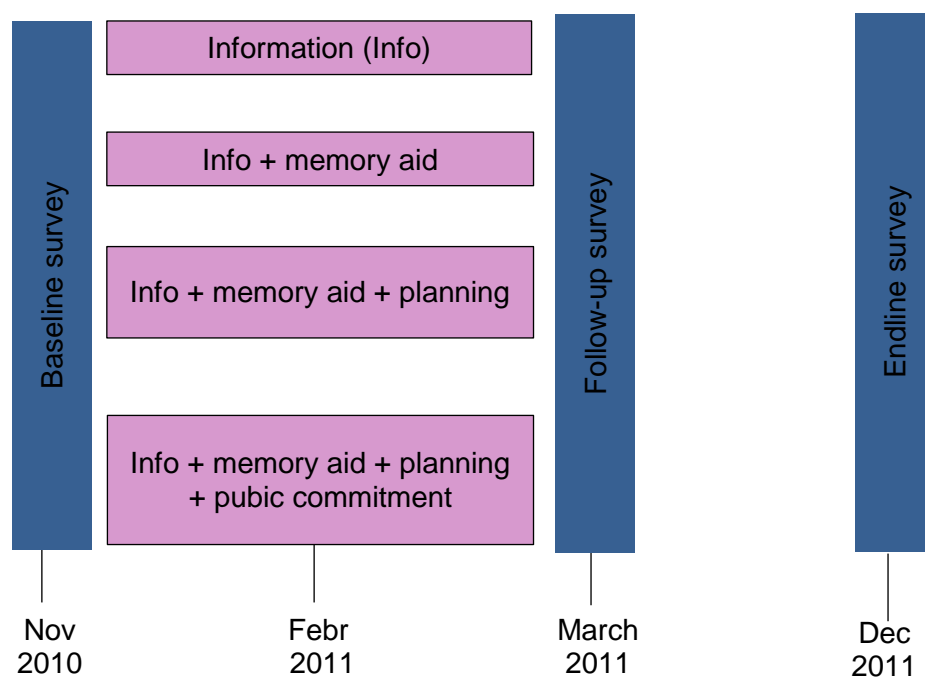


Figure 5: Study design showing the separation of the whole sample into four different arms after the baseline survey, each receiving a different set or combination of behavior change strategies, while the first group serves as a control receiving information only. Later, all households of the different intervention arms were surveyed again to compare the effects on behavior change between the different groups. The endline survey allows to investigate long-term effects of the campaign.

4.2 Implement behavior change strategies

Plan the implementation of the strategies

To convey the informational and reminder messages, a graphic designer was involved. She simplified the messages to easily and culturally tailored pictograms. We pre-tested the understandability of the materials near the study areas.

Train promoters in implementing the strategies

A team of local promoters was recruited and trained to deliver the interventions to the households. The promoters had previously been working for our local partners, and hence had experience in talking to the local population. The training lasted three days and comprised of theoretical parts and practice sessions.

Monitoring the implementation

The fidelity of intervention delivery was monitored by a field supervisor. Every day of the implementation phase, he centrally gathered the promoters and distributed the intervention materials to them, together with reporting sheets where the promoters would fill in, which materials they delivered to which households. The supervisor checked these forms at the end of each day, and gathered the remaining materials. Also, he contacted the promoters randomly during the day and asked if they needed his support.

A) Information about health risks (BCT 1: Present facts) and about how to avoid these (BCT15: Provide instruction): Instructions for Promoters

Promoter, please explain the following to the participant when showing page 1 of this booklet:

- Arsenic is a chemical found in some tubewells in your area.
- This poses a potential threat to your health and to the health of your children.
- Today, I would like to inform you about arsenic, its health effects and how you can avoid these health effects. Please ask me any questions you may have during and after this session.
- In Bangladesh, arsenic occurs in shallow groundwater.
- Arsenic is a poisonous chemical that is endangering human health.
- Arsenic is not visible, it is transparent. It has neither taste nor smell.
- In your area, some of the shallow tubewells are contaminated with arsenic, and some of the tubewells are free from arsenic.
- Tubewells that have been tested for arsenic and found contaminated are sometimes painted red.
- Tubewells that have been tested for arsenic and found arsenic-free are sometimes painted green.

- Tubewells that are without coloring: These are either untested or the colors have worn off. It is not sure whether they are contaminated with arsenic or not.
- Arsenic enters the human body in the following ways:
 1. Arsenic can enter the body by drinking water from contaminated tubewells (= red tubewells).
 2. Arsenic can enter the body by eating food that was cooked with arsenic-contaminated water.
 3. Arsenic cannot be removed by boiling: Arsenic can enter the body by drinking pre-boiled arsenic-contaminated water.
 4. Arsenic cannot be removed by common household filters: Arsenic can enter the body by drinking arsenic-contaminated water that was filtered with common household filters.
- If arsenic-contaminated water is consumed, severe health effects may occur to you and your family members, including your children.
- Note that you do not know whether untested tubewells are contaminated or not. They are therefore not safe to use.
- The disease developed by chronic consumption of arsenic is named “arsenicosis”.
- Arsenicosis develops over a period of several years when drinking or cooking with water from contaminated tubewells
- It may be that you do not notice any health effects for a long period, although arsenic is slowly affecting your body.
- There are several symptoms of arsenicosis. Some are visible on your body, some are invisible.
- The symptoms include:
 - Skin diseases: dark spots and white spots on the skin, hardening of the skin.
 - Cardiovascular diseases (e.g. heart problems)
 - Gangrene
 - Problems with children’s brain development
 - Cancers of skin, lung, kidney and bladder
- Ultimately, arsenicosis may end in death
- Unfortunately, there is no cure for arsenicosis. However, I will explain to you now, how you can avoid developing this disease.
- To avoid developing arsenicosis and prevent you and your family from suffering its health effects, stop using water from contaminated or untested tubewells for drinking or cooking.
- Do not drink the water from untested or contaminated tubewells!
- Do not eat food that was cooked with water from untested or contaminated tubewells!

- Do not drink pre-boiled water from untested or contaminated tubewells!
- Do not drink contaminated or untested water that was filtered with common household filters!

- In the following, I would like to talk to you about water sources that are safe from arsenic.
- You can use these water sources for drinking and for cooking.
- Arsenic-safe tubewells:
 1. In your neighborhood, some shallow tubewells are free from arsenic. You can recognize them by their green color.
 2. In your village, some tubewells are deep tubewells. They are installed for community use and usually have a caretaker. These are free from arsenic because they go to deeper groundwater that is free from arsenic.
- Finally, I would like to point out some activities that you can use the water from the arsenic-contaminated tubewell for:
 1. Washing hands, face and body
 2. Toilet purposes
 3. Bathing your animals
 4. Washing dishes
 5. Washing clothes
- **To summarize:**
 1. Arsenic-contaminated water is found in red tubewells and may be found in untested tubewells.
 2. Drinking and/or cooking with arsenic-contaminated water is dangerous to your health and the health of your family.
 3. To avoid arsenicosis, do not drink or cook with arsenic contaminated water.
 4. Go collect water at an arsenic-safe water source, e.g. a neighbor's arsenic-safe tubewell or a deep tubewell.
- Thank you for listening! I will be happy to answer any of your questions.

B) Memory aid at water collection container (BCT 34: Use memory aids and environmental prompts)

Description

We designed a memory aid to support people in remembering to go to the arsenic-safe tubewell and not to use arsenic-contaminated water for drinking and cooking.

Procedure

1. Please show the memory aid to the participant.
2. Explain to her its meaning:
 - o “For drinking and cooking (*point to the person*)
 - o do not use the water from the red tubewell
 - o but instead, take your kalosh (*point to kalosh*)
 - tubewell (*point to green tubewell*)!”
3. Ask the participant where she usually stores water for drinking.
4. Tell the participant that you would like to give the kalosh (or other vessel used for collecting drinking water).
5. If she agrees, attach the Prompt on the wall just above the kalosh (or other vessel used for collecting drinking water) by using glue or string.
6. Next step: show the Tag to the participant. --> **See instructions for Tag!**



drinking a glass of water),
(point to the crossed-out red tubewell),
and go to collect water at your neighbor’s green

the kalosh or another vessel she uses to collect

her this poster and hang it up on the wall just above

C) Tag at water source (BCT 34: Use memory aids and environmental prompts)

Description

We designed a Tag to support people in remembering that they should not use water from arsenic-contaminated (red) shallow tubewells for drinking and cooking. Also, the Tag shows, for what purposes the water from red tubewells may be used. You will show the Tag to the participant, explain its meaning and then attach it to the red shallow tubewell that the participant is currently using for drinking or cooking.



Procedure

1. Please show the Tag to the participant.
2. Explain to her its meaning:
 - a) Arsenic-contaminated tubewells are sometimes painted red (*point to red part of the Tag*).
 - b) It is bad for your health to drink arsenic-contaminated water.
 - c) Please do not use this water for: drinking; cooking; boiling and then drinking; filtering with common household filter and then drinking.
 - d) (*Now point to green part of Tag*): There are some activities, however, for which it is safe to use the water from the red tubewell for. These are: washing hands, face, and body, toilet purposes, bathing the animals.

D) Specific behavior planning (BCT 26: Prompt specific planning)

Description

For specific behavior planning participants are asked to specify, when (which situation), where (which safe option), how much water (number of vessels), and for which purpose (drinking, cooking, or both) they will collect water from. In the end, participants are asked to read the agreement out loud and sign it.

Procedure

1. Take two empty implementation forms and a set of picture stickers.
2. Explain to the participant about implementation intention:

- “Sometimes it is helpful to make a specific plan, when, where, water.
- We would like it if you could specify, when, where, how much collect water in the future.
- This is a kind of a commitment you make with yourself. It is agree?”

3. If the participant agrees, ask the following questions and fill the respective sticker pictures to the form:

a) When will you collect water from your neighbor’s arsenic-

→ This can be a time of the day (e.g. morning, midday,

before breakfast etc.).

→ Attach the respective picture sticker in the places indicated

→ If the participant goes to collect water more than once per the day for each time she goes to collect water!

b) What is the name of the owner of the neighbor’s arsenic-

→ Write the name in the space indicated on the form.

c) How many vessels will you collect from your neighbor’s arsenic-safe tubewell each time you go to collect water?

→ Attach as many stickers of vessels to the form as indicated by the participant.

d) For what purpose will you collect drinking water from your neighbor’s arsenic-safe tubewell?

→ Indicate whether participant will collect water for drinking or cooking or for both purposes by attaching a glass and/or a cooking stove picture sticker to the form.

4. Read the completed implementation intention to the participant and ask her to repeat it. Then ask the participant to sign it by signature or by thumb print.

5. Documentation: Copy the filled-in plannin form to the second empty form by writing down, when, whose tubewell, how many vessels, for what purposes did the participant commit herself to collect water.

6. Ask the participant to keep the implementation intention somewhere safe.

7. Thank participant for her time and answer any remaining questions.

Commitment contract of

Jennifer
(Participant name)

Every day after / before  (getting up / breakfast /.....)

and after / before  and after / before 

I am going to walk to *Mubarak*'s tubewell
(name of green tubewell owner)

and I am going to collect  
(number of kolschi)

for  and 
(drinking / cooking / drinking and cooking)

Signature

how much water, and for which purpose to collect

water, and for which purposes you are going to

not intended for anybody else to see. Do you

in the answers into the planning form by attaching

safe tubewell?

afternoon etc.) or a situation (e.g. after cooking,

on the form.

day, you need to ask her for a time or situation in

safe tubewell you will collect your water from?

E) Pledging session (BCT 10: Prompt public commitment) for promising to use arsenic free water

Description

The pledging session is a meeting with the persons responsible for drinking water collection of a village. Each meeting contains an informational session with posters, as well as a pledging part. For the pledging, every one of the participants is asked to put up their hands if they commit to collecting only arsenic-safe water for drinking and/or cooking. Participants who committed are then asked to get up and tell their detailed plans of when, where, and how much water they will collect from the safe water option (i.e. their implementation intentions) to the people present.

Note that participants were prepared for and invited to the meetings by the promoters.

Promoters informed participants of the date and time of the pledging session and have asked them to bring their implementation intentions to the meeting (they filled this in during the promoter household visit).

Staff requirements

- 2 promoters

Materials

- 8 community meeting posters on arsenic, arsenicosis, and arsenic-safe water sources
- Address list
- Tea and biscuits

Duration

- App. 1.5 - 2 hours (depending on group size)

Procedure

1. All participants gather at the location of the meeting. These will be approximately 20-30 people, depending on the village. Ask the people to sit in a circle, so everybody can see you.
2. Request all people to identify themselves:
 - a) List present participants.
 - b) Try to contact missing participants by mobile phone and ask them to join.
 - c) Kindly ask people who are not invited to leave (except children).
 - d) Check whether participants brought their implementation intentions. If they don't have it with them, ask them to go back home to bring it, if possible. If not possible (e.g. because too far), ask them to try to remember their implementation intention.
3. Introduction: Welcome all participants to the meeting, thank them for coming and introduce yourselves as promoters of Eawag.



4. Information session on arsenic, arsenicosis and arsenic-safe water sources:

- a) Duration: app. 30 minutes.
- b) Conduct the information session by means of the posters.
- c) One of you will walk around the circle of people and demonstrate the posters while the other one of you is explaining.
- d) Important: Make sure that all participants can clearly hear you and see the posters!
- e) Answer remaining questions of participants regarding arsenic, arsenicosis or arsenic-safe water options.

5. Public commitment:

- a) Duration: app. 45 minutes.
 - b) Ask the group of participants to commit themselves **to collect only drinking water from their neighbors' arsenic-free tubewell (Shivalay) / water from the deep tubewell (Monoharganj)**.
 - c) Request the people who commit themselves to clearly raise their hands.
 - d) Ask each committed participant to **read/tell their implementation intention** aloud to the group: when, where, how much water, for which purpose they are going to collect water from now on.
6. Offer tea and biscuits to all participants.
7. Closing: Thank all participants for coming and committing themselves and close the meeting.

4.3. Develop follow-up questionnaire and conduct survey

Develop a follow-up questionnaire and observation protocol & Conduct follow-up survey

The questionnaire developed in Phase 2 was applied again, asking for the water consumption behavior and the RANAS factors. Additional questions asked participants about the interventions they received as a behavior change strategy check.

Behavior change strategy check

A) Information about health risks

- Have you been visited, approximately 1-2 months ago, by a promoter or a health worker (not an interviewer) who talked about arsenic, arsenicosis and arsenic-safe drinking water sources? (Interviewer show pictures of promoters!)
- When did the promoter/health worker visit your house? / / (day/ month/ year)
- Did the promoter/health worker talk positively or negatively about arsenic-safe water?
- How convincing was the promoter/health worker?
- How much did you like or dislike the promoter/health worker?
- After that conversation did you think more positively, more negatively or the same about using the neighbor's arsenic-free tubewell / the deep tubewell?
- During the visit, what did the promoter tell you or do? (don't read these items!)
 - She explained about arsenic, arsenicosis and arsenic-safe drinking water
 - She gave me a poster to put on the wall
 - She installed a sign board on the contaminated tubewell
 - She filled in a form with me about when, where, how much, and for what purpose to collect water at the arsenic-safe tubewell / the deep tubewell
 - Other:
- Did the promoter/health worker show you a booklet and explain to you about arsenic, arsenicosis and arsenic-safe water?

B) Memory aid at water collection container

- Did the promoter/health worker install a poster inside your house? (*show the poster*)
- Did you ever remove the poster or did it break?
- How much does the poster help you in going to collect water from your neighbor's tubewell / the deep tubewell?

- How many of your neighbors and other people in the community have this poster?
- How much do you like it or find it disturbing having the poster inside your house?
- How pretty or ugly do you find the design of the poster?
- What about the poster do you particularly like or dislike it? Any suggestions for improvement?
- **Interviewer, please observe and mark:**
 - Is the poster still hanging?
 - Is the poster hanging near the place where the people keep the kalosh (or other vessel for collecting drinking water)?

C) Tag at water source

- Did the promoter/health worker install a tag on the contaminated tubewell you are using (or you were using at the time)? (show the picture of the tag)
- Did you ever remove the tag or did it break?
- How much does the tag help you in going to collect water from your neighbor's tubewell / the deep tubewell?
- How many of your neighbors tubewell and other people's tubewells in the community have this tag?
- How much do you like it or find it disturbing having this tag on the contaminated tubewell?
- How pretty or ugly do you find the design of the tag?
- What about the tag do you particularly like or dislike it? Any suggestions for improvement?
- *Interviewer, please observe and mark:*
 - Is the tag still installed on the contaminated tubewell?
 - Is the tag broken?
 - Is the tag still readable?

D) Specific behavior planning:

- *Did the promoter/health worker fill in a form / contract with yourself with you that specifies when, where, how much and for what purpose you will collect water? (show the example form!)*
- Do you still have the form? Please show it to me.
- How much does this contract with yourself help you in going to collect water from your neighbor's tubewell / the deep tubewell?
- How many of your neighbors and other people in the community have this form?
- How much did you like it or find it disturbing to make this contract with yourself?

- How pretty or ugly do you find the design of the form and the pictures?
- What about the form do you particularly like or dislike? Any suggestions for improvement?

E) Pledging session

- Did the promoter give you an invitation letter to attend a community meetign regarding arsenic, arsenicosis, and arsenic-safe drinking water in the last month?
- Did you attend a community meetign regarding arsenic, arsenicosis, and arsenic-safe drinking water in the last month?
- Did the promoters/health workers talk positively or negatively about arsenic-safe water during the meeting?
- Did you talk positively or negatively during the meeting?
- How convincing were the promoters/health workers?
- How much did you like or dislike the community meeting?
- After the meeting, did you think more positively, more negatively or the same about using the neighbor's arsenic-free tubewell / the deep tubewell
- What happened during the community meeting? (*don't read these items!*)
- The promoters explained about arsenic, arsenicosis, and arsenic-safe water by showing big posters
- We (or some of us) put up our hands to commit to collecting water from the neighbor's green tubewell / the deep tubewell
- Those committed to collecting arsenic-safe water read to the group, one by one, when, where, how much and what purpose they will collect water from the neighbor's arsenic-free tubewell / the deep tubewell
- How much did the meeting help you in going to collect water from your neighbor's tubewell / the deep tubewell?
- How many of attendees committed to collecting water from the neighbor's arsenic-safe tubewell / the green tubewell during the meeting?
- How many of attendees committed to collecting water from the neighbor's arsenic-safe tubewell / the green tubewell during the meeting?

4.4 Estimate efficacy and efficiency of the behavior change strategies

Enter, clean and process the data

Calculate mean scores at baseline and at follow-up separately for the control and the intervention group(s)

Calculate change scores from baseline to follow-up separately for the control and the intervention group(s)

Compare change scores between control and intervention group(s)

Calculation of efficiency

To calculate the efficiency in behavior change of the strategies in the case study we simply have to compare the number of households which use arsenic safe wells before with the number after the interventions. As we selected only households which did not use safe wells before (at T1 in the figure below) we only have to count how many of our intervention households use these wells after the intervention. From the figure below we see that information alone (the standard intervention) yielded only 12% new users of arsenic safe wells, the addition of tags and prompts 29%, further planning 41%, and adding to all of these interventions public commitment accumulated to 65% of new users of arsenic safe wells.

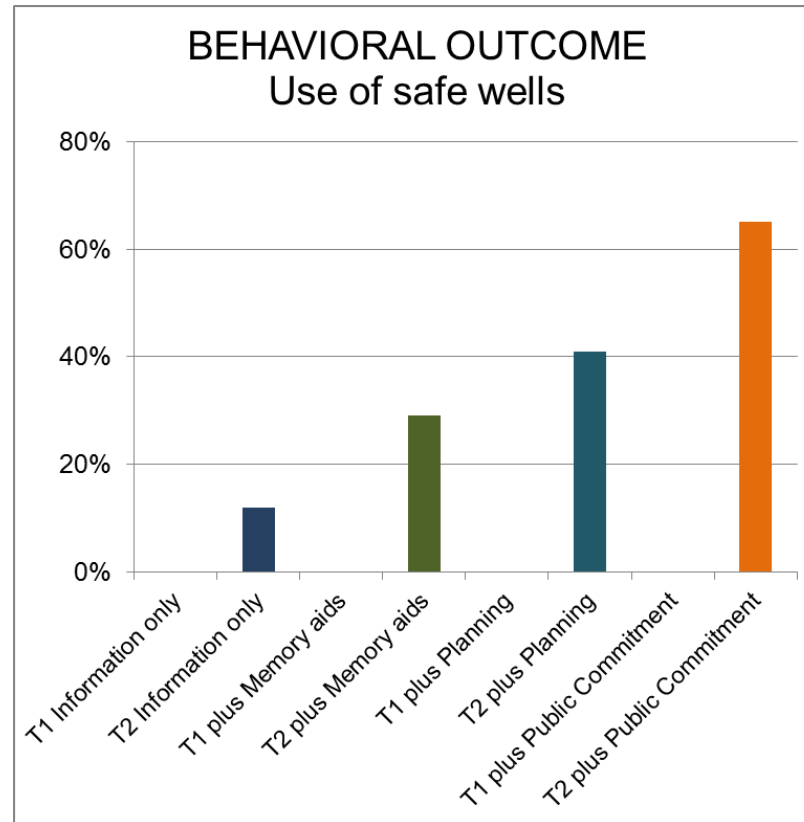


Figure 6: Results for behavior outcome: Percentage use of safe wells is depicted for all four intervention arms both prior (T1 - baseline) and after (T2 - follow-up) the implementation of interventions.

To determine, how effective the interventions were in changing behavioral factors we have to compare the differences between the intervention groups before and after the interventions. Mainly the difference between the information only group compared to the other groups is of interest. If the change in a factor is significantly bigger for an intervention group than the change in the control group (information only) then we can say that this factor changed due to the intervention.

In the figure below we compare the change in the behavioral factors before (T1) to after (T2) the intervention between the groups. If we look particularly at the differential change between the information only group and the group which got all BCTs (plus public commitment) then it is evident that this

group changed more in commitment, barrier planning, confidence in recovering and continuation, and in others' (dis)approval. With the exception of barrier planning all these factors were targeted (see case study in step 2.3), therefore we can conclude that our interventions changed what we wanted to be changed.

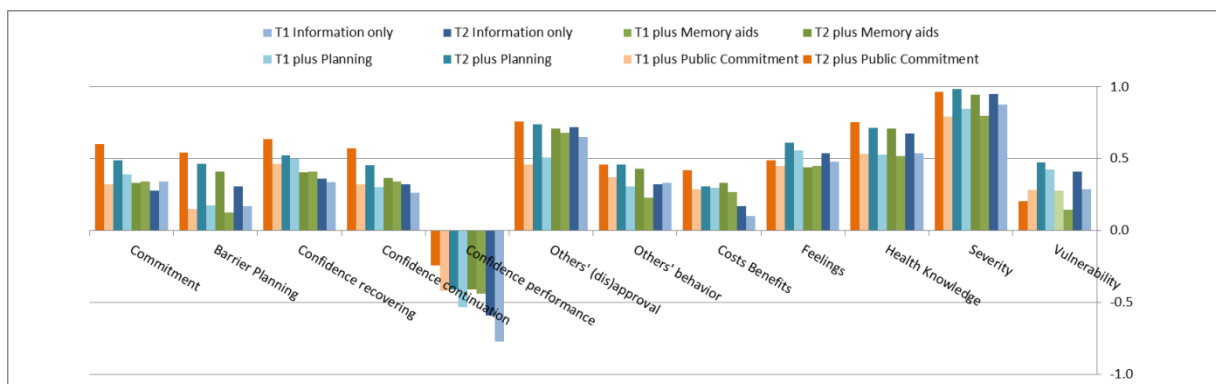


Figure 7: Results for changes in psychological factors. Scores for all four intervention arms at both surveys (T1 - baseline and T2 - follow-up) are depicted. Again, the scale has been standardized so that "1" represents the maximum increase possible, "0" represents no change, and "-1" represents maximum decrease.

Calculation of efficacy

In this case study the implementation costs of the different behavior change strategies were compared. All costs were included: design of material, the material itself, costs of promoter visits, and of group meetings. In the table below the costs for each strategy are listed first in Bangladeshi Taka (BDT) then in USD. The behavior change effects are equal to the ones depicted in the figure about behavioral outcome, meaning that they are the percentages of new users of safe wells. Then the ratio between the simplest strategy (information only) and any strategy comprising additional BCTs (Information plus) is calculated. For example the behavior change effects for Information only are 0.12 (12% of new users) for Info + Memory aids + Planning + Public commitment they are 0.65 (65% of new users). 0.65 divided by 0.12 results in an effectiveness ratio of 5.4. The cost ratio is calculated by dividing the costs in USD of any strategy plus by the costs of Information only (e.g. 3.0 divided by 0.8 results in 3.7). From the table it can be depicted that the strategy Info + Memory aids + Planning + Public commitment is 3-4 times more expensive than the Information only strategy but 5-6 times more effective.

	BDT	USD	Behavior change effects	Effectiveness ratio	Cost ratio of standard intervention
Information only	60.0	0.8	0.12	-	-
Info + Memory aids	135.0	2.1	0.29	2.4	2.1
Info + Memory aids + Planning	145.0	2.3	0.41	3.4	2.2
Info + Memory aids + Planning + Public commitment	195.0	3.0	0.65	5.4	3.7

References

For further information and details please refer to the following publications:

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