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**ACCESS TO SANITATION AND SAFE WATER:
GLOBAL PARTNERSHIPS AND LOCAL ACTIONS**

**Measuring behavioural outcomes when promoting
household water treatment and storage**

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This document discusses the advantages and disadvantages of three indicators to measure behavioural outcomes associated with household water treatment and storage: volume of sales, volume of liters of water treated, and percent of households practicing effective water management. It suggests that the last indicator may be the most adequate for capturing technologies available for household water treatment. The measures proposed to capture the indicator are more effective than self-reports, as they are based on spot-checks or simple water quality tests when water is treated with a chlorine solution. Yet, collecting data on psycho-social determinants of practices will be useful to program managers. Modifications to the questions to capture treatment practices using solar disinfection are also suggested. The document ends with additional input provided by participants from an e-conference organized to discuss the paper.

Introduction

Household water treatment and safe storage (HWTS) interventions can change water quality, thus reducing morbidity and mortality associated with diarrheal disease. There are different conceptual and programmatic dimensions to point-of-use (POU) water treatment; for example: performance of water treatment and storage systems; water quality; financial targets; coverage; behavioural outcomes; and health impact.

These dimensions provide useful information for stakeholders and can be assessed once acceptable indicators and tools to collect data are developed. The WHO-sponsored International Household Network to Promote Household Water Treatment and Safe Storage constituted an Implementation Working Group tasked to define the indicators and develop the needed tools. This document responds to that group's mandate and focuses on the behavioural outcomes dimension. It has been drafted by the USAID-funded Hygiene Improvement Project (HIP), which promotes at-scale changes in three key hygiene practices: hand washing, safe storage and treatment of water, and safe disposal of feces. A table of indicators proposed by Susan Murcott (2005), a HWTS Network member, for the different dimensions is available on HIP's website at hip.watsan.net

Report objectives and structure

The document was written for a HIP-sponsored e-conference held January 22-26, 2007, on which indicators can best measure the impact of efforts to promote household water treatment and storage practices. It takes into account the larger concerns of program implementers interested in behaviour change interventions, including the HWTS Network. It also focuses on the needs of USAID to have valid HWTS indicators for interventions implemented by different types of USAID grantees and partners, including data collection efforts to generate trends such as Demographic and Health Surveys.

The behavioural outcome measures HIP's discussion focused on were:

- 1) the number of liters of water treated; and
- 2) the percentage of households practicing effective household water management, defined as:
 - presence of chlorine residual in a household drinking water storage container;
 - presence of a covered ceramic water filter in an accessible spot in the kitchen, with filter in place and water in the lower container; and/or
 - presence of multiple bottles for solar disinfection (SODIS) exposed to full sunlight.

Conference participants commented on whether indicators to measure HWTS interventions must include measures of behavioural determinants as well as behavioural outcomes; and offered ways to refine the two

indicators listed above. Key conclusions from the e-conference discussion are included at the end of this paper.

Background

The evidence base for water disinfection and safe storage

Despite the progress made to date towards achieving the Millennium Development Goal in the water and sanitation sector, 1.1 billion people worldwide still lack access to improved water supplies (WHO/UNICEF, 2006). In settings where there is no access to improved water sources, HWTS options offer an alternative to reduce diarrheal disease, even though improvements in water quality by itself will not completely interrupt the spread of disease. Household interventions can be more effective in preventing diarrheal disease than interventions at the water source (Clasen et al., 2006).

Water disinfection and storage options

For Baffrey (2005) “... a pristine water source can become microbially contaminated by improper transport, storage and use practices in the home.” Thus, the option to treat water immediately before intended use may be more effective than treating at the source in preventing diarrheal disease. To increase effectiveness, water treatment should be implemented in conjunction with safe water storage, meaning the use of protected containers that restrict physical access prior to actual use. Water specialists may consequently speak of household water treatment and safe storage technologies.

There are three treatment interventions to improve the microbial quality of water, offered alone or in combination: physical removal of pathogens (through filtration, adsorption or sedimentation); chemical treatment of water to kill or deactivate pathogens usually with chlorine either as a solution, in tablets or using a combined flocculent with timed release chlorine; and disinfection by heat (boiling) or ultraviolet radiation using solar disinfection (SODIS) or an artificial lamp (Clasen et al., 2006; Baffrey, 2005).

Water storage recommendation include: 1) plastic containers with a narrow mouth, lid, and a spigot (CARE/CDC, no date); 2) ceramic filters: raw water poured into a covered top container sitting on top of bottom container where treated water is collected; spigot attached to bottom container, with top and bottom containers may of steel, plastic or clay (Baffrey, 2005); and 3) in the absence of containers with a spigot, use of 10-30 liter containers with narrow mouth, tight fighting lid, and handles for easy lifting and carrying and preferably mounted on stable base to prevent overturning (HIP, 2005).

Guiding concepts and associated indicators

The following sections offer choices that program managers and donors can use to track behavioural outcomes of HWTS interventions. Options presented can facilitate aggregation across program sites. The presentation starts with a conceptual discussion and presents criteria that can be used to select indicators.

Behavioural determinants

Typology and process of influence

Communication permits exposure to promotional messages; those messages affect behavioural determinants and these, in turn, affect practices (Hornik, 2002). Communication activities may be instructional, directive, nondirective and public communication activities. Any of them can have an impact on behavioural determinants external to the individual (named environmental factors) as well as on determinants internal to the individual (including, skills, knowledge, psychosocial factors and intentions to perform a given behaviour). It is important to recognize that communication activities will affect individuals directly and indirectly through social norms on the one hand and institutional changes on the other. Institutional changes may create a favourable environment that may in turn facilitate the adoption of practices by individuals. Participants in HIP's e-conference suggested that programs in the field follow the same model “where program activities lead to change in behavioural determinants which in turn impact behaviour” (Shekhar, 2007). By the same token, as more and more individuals engage in a given promoted practice, the perception of social norms may change, thus helping to motivate others to follow the social trend (Kincaid et al., 2005). Based on these principles, the evaluation of the effectiveness of a communication intervention will have to take into account: exposure measures; measures of changes in the behavioural determinants (to understand if the communication activities have been effective in changing behaviour); and the extent to which individuals have adopted promoted practices.

Capturing incremental change to better target promotional efforts

Conceptually, we can distinguish complete adoption from incremental change. A communications program may promote different hygiene practices. In the case of HWTS, they may be related to both water treatment and water storage. Complete adoption would imply adopting all promoted practices: water treatment practices as well as water storage practices. Incremental change may be defined as partial adoption. Individuals may adopt one set of practices and not the other, or adopt some component(s) of one practice but not the complete behaviours associated with water treatment or safe storage.

Even though water treatment and water storage should be adopted as a package, it is possible that communication interventions may effect partial adoption or incremental changes. An evaluation of these interventions should be able to capture either one, even if program implementers argue that partial adoption is incorrect. It is crucial to determine how much change an intervention is generating, and explore what factors facilitate and hinder the adoption of the full model. If elements of the full model are more difficult to adopt, future communications interventions need to focus on “hard-to-change” components.

Sustainability

Behaviour change must be sustainable. Two issues related to sustainability merit consideration: intervention as well as behaviour sustainability. If interventions are designed to specifically sustain promotional efforts, by integrating them to normal ongoing promotional efforts implemented by participating partners, for example, evaluations of these interventions must capture the impact that they have in sustaining practices.

Indicators to measure behavioural determinants

The following are examples of generic indicators that would be useful in evaluating behaviour change (BC) communication interventions. These are borrowed from other programmatic areas in the health sector and adapted to the water and sanitation sector (Bertrand et al., 2002). They include both measures of exposure as well as measures of the psychosocial factors discussed above.

Percent of target audience (e.g., child caretakers) who:

- 1) recall hearing or seeing a specific message;
- 2) know a product (e.g., a given chlorine solution) or a practice (e.g., solar disinfection);
- 3) perceive a risk in a given behaviour (e.g., leaving turbid water untreated);
- 4) are confident that they can correctly perform a practice;
- 5) believe that the practice has a positive consequence (e.g., effective removal of water content that can make people sick); and
- 6) believe that a significant person (spouse, friends, relative) approves of the practice.

Behaviours**Definition of behaviour**

Given that behaviours are overt actions, in the context of this paper it is important to distinguish between actions to treat water for drinking at the household level from actions to store it. This definition may lead programs to focus on either of these behaviours or on both. Focusing on treatment would imply promoting treatment options and making products for water treatment available. On the other hand, focusing on water storage would also imply making products for appropriate storage available. Shekhar (2007) indicated, for example, that PSI’s POU promotional efforts worldwide may focus on water treatment and not necessarily on water storage, indicating the difficulties they have faced on scaling up efforts to introduce safer water storage vessels in Nigeria, Uganda and Nigeria at the 24 sites where they operate.

Program and evaluation focus: One or more behaviours

Evaluations must reflect program content. A BC intervention may address different behaviours associated with household water management such as: transport, treatment, and storage. If a promotional effort addressed only transport, the evaluation should address just transport. If it addressed any combination of the three, such as treatment and storage, it should address both elements.

Classification of “Users” of HWTS

A classification of users of HWTS can be developed based on different criteria, including: a time dimension for level of use, the level of compliance with technical recommendations, and the consistency with which the practices are performed.

- The time dimension for the **level of use** would be broken down into groups of “**ever,**” “**current,**” “**irregular,**” and “**sustained**” users. The “ever” users are users that have performed the practice at one point but have abandoned it. “Current” users are those who perform the practice at the point of measurement. “Irregular” users would be those that perform the practice on and off. “Sustained” users would be those users who have performed the practice consistently over a given period of time. Murcott (2006b) proposed that a period of one year be considered to determine the level of use.
- The **level of compliance** with technical recommendations may allow us to speak of **partial vs. full users** as well as **correct vs. incorrect users**. Because HWTS includes more than one practice, it could be possible that users have adopted one component (e.g., water treatment) and not the other (e.g., water storage). Partial users have adopted just one component of the system, and full users have adopted both. Correctness may be associated with different aspects of each component.
- The **level of consistency** with which the practice is performed may allow us to speak of **inconsistent vs. consistent users**. An inconsistent user would be one who performs the practice sometimes, but not all of the time. A regular user would be one who performs the practice all of the time.

Program implementers and funders would most likely be interested in both current and correct users. The challenge for evaluators then would be how to measure correct use at one point in time. The method of how one might do this will be discussed below.

Murcott (2006b) suggests using data collected on use to construct rates such as: rate of adoption and rate of sustained use. The rate of adoption would be calculated dividing the number of households using HTWS after one month by the number of households targeted. As indicated earlier, the rate of sustained use would be calculated dividing the number of households using HWTS after one year by the number of targeted households.

Measures of behaviours

Criteria for choosing indicators

Indicator selection should be based on certain criteria: validity, reliability, ease of collection, and whether they are economical and practical to use. That is, **valid** measurements reflect true reality; **reliable** measures provide the same conclusions over time; **easy to obtain** data can be gathered quickly or may already be collected; **economical indicators** should not consume resources that can be used for implementation; and **practical indicators** can help make programmatic decisions. Only the first two, validity and reliability, will be discussed below, given the self explanatory nature of the other three.

Validity: Objective measures are preferable to subjective ones, and are considered to be more valid. In that sense, measures based on observations are preferred to measures that rely on self reports. “Respondents will distort answers in ways that will make them look better or will avoid making them look bad.” Inaccuracies from self reports may also occur because answers may put respondents at risk, or even because accurate answers may not be the way that respondents want to think about themselves (Fowler, 1995).

Reliability: Behaviours are circumstantial and may change from day to day. How do we know what we observe one day is what normally happens in a household? Webb et al. (2006) observed via spot checks whether households covered water storage containers in 588 rural Guatemalan households over 36 months. One of conclusions from this study is that “indicators of hygiene practices assessed by spot checks are subject to substantial day-to-day variations within households over long periods of time.”

On the other hand, Cousens et al. (1996) observed 200 mothers in Burkina Faso three times at weekly intervals. The attention focused on the events of child defecation in the compound’s yard, including the way caretakers cleaned children after defecation, and hand washing by the caretaker after leaving a latrine. There are three study conclusions that are related to variability of behaviour over time. One is that child defecation in the yard increased from 5% to 16% ($p=.01$) from the first to the last observation. The second is that the proportion of occasions when the child’s bottom was observed to be washed declined over the course of the three observations from 95% to 85% ($p=.01$). And finally, hand washing after leaving the latrine declined over the course of the three observations from 35% to 22% ($p=.05$). These declines suggest the possibility that variations may be due to the presence of the observer. Nevertheless, the variations may also be due to the fact that individuals do not necessarily perform the same behaviours systematically over time. Consequently, observer reactivity and behaviour repeatability may be factors affecting the findings.

Three alternatives for measuring behaviours

Volume of sales

Some of the HWTS technologies proposed are products that can be used for treating a certain number of liters of water. As such, consumers would have to buy them frequently in order to systematically use them to treat drinking water. Chlorine solutions and flocculent-disinfectants are examples of these products. In a search for easy-to-obtain data to measure behavioural outcomes, **volume of sales** represents a viable alternative and represents Alternative Indicator 1.

This indicator meets some of the criteria mentioned above. Volume of sales is information easy to obtain, and also economical. Distributors of the products would generally keep sales records and may be willing to share them with program managers and donors. Although reliable, they may not necessarily be valid, particularly if consumers have used the products incorrectly, either as a result of under dosage or over dosage. An important limitation of this method is that it is only applicable to product-based technologies and not applicable to technologies such as SODIS or boiling.

Number of liters of water treated

Volume of sales can be used, however, to obtain another figure: **the number of liters of water treated**. This indicator would be Alternative Indicator 2. This indicator is yet another indirect measure of behavioural outcomes. Such a figure is an attractive indicator as it may allow the evaluator to combine the result of practices across HWST options, and in so doing, permit comparisons across sites and projects implemented through different implementing agencies.

Although “number of liters of water treated” is a practical measure, it is a limited one. The only water treatment technology that would lend itself easily to providing the needed information for such an indicator would be chlorination. If one bottle of sodium hypochlorite solution can be used to treat, for example, 10 liters of water, then obtaining the number of liters of water treated can be calculated by multiplying the volume of sales by 10. Calculating the number of liters of water treated for the other water treatment technologies would require more laborious work including at least: 1) determining the number of liters of drinking water consumed daily by a typical household in a given population; and 2) multiplying it by the number of households using a water treatment technology. There are three important limitations with this indicator: 1) it measures quantity as opposed to quality; 2) it ignores water storage; and 3) it does not address the extent to which the practice may be performed correctly. Consequently, the results may be invalid, albeit reliable and easy to obtain.

% of households practicing effective household water management

This indicator proposes to collect objective information including a chlorine residual test if chlorine products are used thus addressing reliability and validity. It also proposes to conduct spot checks of equipment/supplies used to treat water, including whether the technology is under use at the time of the home visit, as well as characteristics of household water storage vessels.

Rainey (2005) proposes that the indicator be defined by the following elements, applicable depending on the technology used:

- the presence of chlorine residual in household drinking water storage container;
- the presence of a covered ceramic water filter in an accessible spot in the kitchen, with filter in place and water in the lower container;
- the presence of multiple SODIS bottles exposed to full sunlight;
- the presence of a water storage vessel covered or closed with a solid cap or lid; and
- the presence of a water storage vessel with a narrow mouth and/or a tap for removing water from the container.

This indicator takes into account both the water treatment as well as the water storage aspects of HWTS, and requires no self reports. The indicator also makes it possible to look at different water treatment technologies available to households (Murcott, 2007). Allowing for the use of different technologies to be detected is appropriate since households may use more than one treatment technology in one single day as has been demonstrated by field research in Bolivia (Mosler, 2007).

E-conference participants with experience in implementing SODIS programs worldwide have suggested, however, that it may not be also possible to observe bottles exposed to the sun even among families that use solar disinfection because ‘typically they do not expose water bottles every day’ (Saladin, 2007). As a result,

it would be more appropriate to see if families have water in bottles available for consumption.

Furthermore, the indicator also excludes boiling and it relies on spot checks, which may not be completely reliable, since, as pointed out, practices may vary from day to day.

The fact that boiled water may be re-contaminated due to how it is stored may not be sufficient cause for eliminating boiling as a practice to be included in the indicator. An evaluation would need to know if improper storage of boiled water, or any treated water for that matter, is occurring as it offers a challenge for behaviour change strategists to go back to the drawing board to decide how to focus the intervention or promote the right storage practices. Lantagne (2006) suggested that adding boiling as one element of the indicator would simply require following the boiling chain to the end and ask: Have you boiled water? Did you do it today? Where is the boiled water? (And determine from the observation.)

Key e-conference findings

The key points that emerged from the e-conference discussions were:

- Water treatment and storage may be important regardless of the services available to households. Different indicators should track household water treatment and household water storage.
- Behaviour determinants as well as contact with information sources may be programmatic indicators and could be used to monitor rather than to evaluate behavioural outcome of interventions. However, POU promotional efforts may focus on clarifying that safe storage does not mean safe water and that clean water does not mean safe water. If so, measures to determine whether the target audience clearly understand these distinctions must be developed and used.
- Measures of perceived benefits may help families to continue practicing the desired treatment and storage practices over time. Perceived benefits may include both health and non-health aspects.
- The behavioural determinants that can help modify POU practices may vary from context to context and must be studied each time an intervention is implemented. The behavioural determinants specific to a given context must be assessed through monitoring activities.
- Measure water quality and not only water quantity. Number of liters of water treated is a measure of quantity but does not tell program managers whether the quality of the water treated is acceptable for drinking. The chlorine residual test suggested by the third indicator proposed in the conference paper overcomes that limitation and makes it, consequently, more valid.
- Three aspects of HWTS must be taken into account to construct an indicator: recontamination of water from protected sources when transporting it; handling and storage of water at the household once treated at the household; and the use of treated water by vulnerable populations. The connection between effective water management may prove no relationship to diarrheal disease if it ignores who is consuming the treated and stored water.
- Experts should suggest what correct storage options are and these recommendations should be incorporated into the definition of the indicator and the measurement of that indicator.
- If agreement is reached in this regard, eliminating boiling from the mix of technologies tracked may not make sense.
- A comprehensive indicator that includes different technologies for treatment would be “% of households that drink treated water.” An alternative would be “% of households that do not drink raw water.” In the case of the first indicator one would expect increases, and in the case of the second one would expect decreases.
- This indicator also offers the advantage of incorporating technologies as well as household consumption of properly treated water by different household members on a regular basis

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