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Point-of-Use Water Treatment Studies and Reports Published from January – July 2007

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Below are citations, by primary author, to 29 studies and reports published from January through July 2007. Links are provided to the full-text if available. If you have additional studies to add to this 2007 bibliography, please email them to dcampbell@usaid.gov.

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1. Arnold BF, Colford JM. **Treating water with chlorine at point-of-use to improve water quality and reduce child diarrhea in developing countries: a systematic review and meta-analysis.** *Am J Trop Med Hyg.* 2007 Feb; 76(2): 354-64.

We conducted a systematic review of all studies that measured diarrheal health impacts in children and the impact on water quality of point-of-use chlorine drinking water treatment. Twenty-one relevant studies were identified from > 856 screened abstracts. Data were extracted and combined using meta-analysis to provide summary estimates of the intervention effect. The intervention reduced the risk of child diarrhea (pooled relative risk: 0.71, 0.58-0.87) and it reduced the risk of stored water contamination with *Escherichia coli* (pooled relative risk: 0.20, 0.13-0.30). A major finding from this review is that nearly all trials on this topic have been short (median length was 30 weeks). Although not statistically significant, we observed an attenuation of the intervention's reduction of child diarrhea in longer trials. Future studies with multi-year follow-up are required to assess the long-term acceptability and sustainability of health impacts shown by the shorter trials identified in this review.

2. Banerjee A., Deborah A. McFarland, Ritu Singh and Robert Quick. **Cost and financial sustainability of a household-based water treatment and storage intervention in Zambia.** *Journal of Water and Health Vol 5 No 3 pp 385-394 2007.*

Providing safe water to >1 billion people in need is a major challenge. To address this need, the Safe Water System (SWS) - household water treatment with dilute bleach, safe water storage, and behavior change - has been implemented in >20 countries. To assess the potential sustainability of the SWS, we analyzed costs in Zambia of "Clorin" brand product sold in bottles sufficient for a month of water treatment at a price of \$0.09. We analyzed production, marketing, distribution, and overhead costs of Clorin before and after sales reached nationwide scale, and analyzed Clorin sales revenue. The average cost per bottle of Clorin production, marketing and distribution at start-up in 1999 was \$1.88 but decreased by 82% to \$0.33 in 2003, when >1.7 million bottles were sold. The financial loss per bottle decreased from \$1.72 in 1999 to \$0.24 in 2003. Net program costs in 2003 were \$428,984, or only \$0.04 per person-month of protection. A sensitivity analysis showed that if the bottle price increased to \$0.18, the project would be self-sustaining at maximum capacity. This analysis demonstrated that efficiencies in the SWS supply chain can be achieved through social marketing. Even with a subsidy, overall program costs per beneficiary are low.

3. Brown J., Sobsey M. and S Proum. **Use of Ceramic Water Filters in Cambodia.** Water Sanitation Program (WSP), 2007. Available on the [WSP website](#) after September 1, 2007. Hard copies can be requested from WSP Cambodia at wspeap@worldbank.org.

This study randomly selected and visited approximately 25% of the 2000 households that originally received the filters in 13 villages and in three provinces as long as 4 years ago. These households comprised a sample spanning variability in geography and demographics, time

since implementation (0 to 44 months before the study), water sources, implementation method, and filter producer. Households still using the filter (and matched control households, never using the filter) were followed for 3 additional visits that included collection of water samples and health data to determine the impacts of the filters on water quality in the home and associated levels of diarrheal disease.

4. Clasen T, Menon S. **Microbiological performance of common water treatment devices for household use in India.** *Int J Environ Health Res.* 2007 Apr; 17(2):83-93.

Diarrhoea and other diseases associated with unsafe drinking water are a leading cause of mortality and morbidity worldwide and in India. Household-based water treatment has been shown to be an effective means of reducing this disease burden. Numerous such devices are manufactured and sold all over the world. We tested the microbiological performance of a leading brand of each of three common types of water treatment devices designed for household use in India: a ceramic candle gravity filter, an iodine resin gravity filter and an iodine resin faucet mounted filter. The ceramic candle filter and the iodine resin faucet filter reduced bacteria by more than 4 logs. However, the reduction of the MS2 phage (surrogate for viruses) and 3 micron microspheres (surrogate for protozoan cysts) in these devices was lower than log 3.4 and log 2.6, respectively. There were also high levels of residual iodide (and in some cases, iodine) in treated water from the iodine-based devices. While household water treatment could play an important role in India, standards are necessary so that consumers can ensure that the devices they purchase and use in the home are effective and safe.

5. Clasen, T, Wolf-Peter Schmidt, Tamer Rabie, Ian Roberts, and Sandy Cairncross. [Interventions to improve water quality for preventing diarrhoea: systematic review and meta-analysis](#), (pdf, full-text). *BMJ*, 12 Mar 2007.

Interventions to improve water quality are generally effective for preventing diarrhoea in all ages and in under 5s. Significant heterogeneity among the trials suggests that the level of effectiveness may depend on a variety of conditions that research to date cannot fully explain.

6. Clasen, T., Cairncross S., Haller L, Bartram J. and Damian Walker. **Cost effectiveness of water quality interventions for preventing diarrhoeal disease in developing countries.** *Journal of Water and Health Vol 5 No 4 pp 599-608 2007.*

Using effectiveness data from a recent systematic review and cost data from programme implementers and World Health Organization (WHO) databases, we conducted a cost-effectiveness analysis to compare non-piped in source- (dug well, borehole and communal stand post) and four types of household- (chlorination, filtration, solar disinfection, flocculation/disinfection) based interventions to improve the microbial quality of water for preventing diarrhoeal disease. Results are reported for two WHO epidemiological sub-regions, Afr-E (sub-Saharan African countries with very high adult and child mortality) and Sear-D (South East Asian countries with high adult and child mortality) at 50% intervention coverage. Measured against international benchmarks, source- and household-based interventions were generally cost effective or highly cost effective even before the estimated saving in health costs that would offset the cost of implementation. Household-based chlorination was the most cost-effective where resources are limited; household filtration yields additional health gains at higher budget levels. Flocculation/disinfection was strongly dominated by all other interventions; solar disinfection was weakly dominated by chlorination. In addition to cost-effectiveness, choices among water quality interventions must be guided by local conditions, user preferences, potential for cost recovery from beneficiaries and other factors.

7. Crump JA, Mendoza CE, Priest JW, Glass RI, Monroe SS, Dauphin LA, Bibb WF, Lopez MB, Alvarez M, Mintz ED, Luby SP. **Comparing Serologic Response against Enteric Pathogens with Reported Diarrhea to Assess the Impact of Improved Household Drinking Water Quality.** *Am J Trop Med Hyg.* 2007 Jul; 77(1):136-141.

We evaluated enteric infection serology as an alternative outcome measure to diarrhea prevalence in a randomized controlled trial of household-based drinking water treatment; 492 households were randomly assigned to 5 household-based water treatment interventions or control. Individuals were followed weekly over 52 weeks to measure diarrhea prevalence. Study subjects of age ≤ 6 months and < 24 months had blood drawn at entry and exit from the study or age cohort. Serologic assays for *Cryptosporidium parvum*, *Giardia intestinalis*, enterotoxigenic *Escherichia coli* (ETEC), and Norovirus were done. Of 343 subjects eligible for the study, the proportions of subjects experiencing serologic responses were 56% for Norovirus, 24% for *C. parvum*, 10% for ETEC, and 16% for *G. intestinalis*. Serologic response was associated with increased diarrhea prevalence only for *G. intestinalis* ($P = 0.0134$). Serologic response to the antigens tested for *G. intestinalis* but not for Norovirus, *C. parvum*, and ETEC may be a useful health-effect measure. Larger intervention studies that yield a more marked effect on diarrheal disease, use additional and improved serologic assays, and that collect serum samples at more frequent intervals are needed.

8. Dejung S., Fuentes I, et al. **Effect of solar water disinfection (SODIS) on model microorganisms under improved and field SODIS conditions.** *Journal of Water Supply: Research and Technology* 56(4) pp 245-256 2007.

SODIS is a solar water disinfection process which works by exposing untreated water to the sun in plastic bottles. Field experiments were carried out in Cochabamba, Bolivia, to obtain standard UV-A (320–405 nm) dose values required to inactivate non-spore forming bacteria, spores of *Bacillus subtilis*, and wild type coliphages. Inactivation kinetics for non-spore forming bacteria are similar under SODIS conditions, exhibiting dose values ranging between 15 and 30Whm²² for 1 log₁₀ (90%) inactivation, 45 to 90Whm²² for 3 log₁₀ (99.9%), and 90 to 180Whm²² for 6 log₁₀ (99.9999%) inactivation. *Pseudomonas aeruginosa* was found to be the most resistant and *Salmonella typhi*, the most sensitive of the non-sporulating organisms studied here. Phages and spores serve as model organisms for viruses and parasite cysts. A UV-A dose of 85 to 210Whm²² accumulated during one to two days was enough to inactivate 1 log₁₀ (90%) of these strong biological structures. The process of SODIS depended mainly on the radiation dose [Whm²²] an organism was exposed to. An irradiation intensity exceeding some 12Wm²² did not increase the inactivation constant. A synergistic effect of water temperatures below 50°C was not observed. Data plotting from various experiments on a single graph proved to be a reliable alternative method for analysis. Inactivation rates determined by this method were revealed to be within the same range as individual analysis.

9. Disease Control Priorities Project. [Water, sanitation and hygiene: simple, effective solutions save lives.](#) (pdf, full-text). May 2007.

Promoting hand-washing with soap is particularly cost-effective. The intervention is both very affordable (approximately US\$1 per capita or US\$3.35 per DALY gained)* and can generate excellent results - up to a 43 percent reduction in diarrhea morbidity and a 48 percent reduction in life-threatening cases of diarrhea. Oral-rehydration therapy, the principal other measure to prevent diarrhea mortality, costs an estimated US\$23 per DALY gained. The intervention is most effective when it is the sole behavior change promoted - combining with other interventions can dilute the message and make recipients less compliant.

10. Eisenberg JN, Scott JC, Porco T. **Integrating Public Health Control Strategies: Balancing Water Sanitation and Hygiene Interventions to Reduce Diarrheal Disease Burden.** *Am J Public Health.* 2007 Jan 3.

Objectives. Although the burden of diarrheal disease resulting from inadequate water quality, sanitation practices, and hygiene remains high, there is little understanding of the integration of these environmental control strategies. We tested a modeling framework designed to capture the interdependent transmission pathways of enteric pathogens. *Methods.* We developed a household-level stochastic model accounting for 5 different transmission pathways. We estimated disease preventable through water treatment by comparing 2 scenarios: all households fully exposed to contaminated drinking water and all households receiving the water quality intervention.

Results. We found that the benefits of a water quality intervention depend on sanitation and hygiene conditions. When sanitation conditions are poor, water quality improvements may have minimal impact regardless of amount of water contamination. If each transmission pathway alone is sufficient to maintain diarrheal disease, single-pathway interventions will have minimal benefit, and ultimately an intervention will be successful only if all sufficient pathways are eliminated. However, when 1 pathway is critical to maintaining the disease, public health efforts should focus on this critical pathway.

Conclusions. Our findings provide guidance in understanding how to best reduce and eliminate diarrheal disease through integrated control strategies.

11. Foran, M. [An Analysis of the Time to Disinfection and the Source Water and Environmental Challenges to Implementing a Solar Disinfection Technology \(SolAgua\)](#). (pdf, full-text). Massachusetts Institute of Technology/Water and Sanitation, 2007.

This thesis investigated the potential of SolAgua, a solar water bag, to remove microbial contamination over a period of four hours and the role of environmental variables such as sunny versus cloudy conditions and source water conditions. The potential of SolAgua to remove microbial contamination was testing the current recommendation of exposing SolAgua to a minimum of two hours and a maximum of four hours to solar radiation.

12. Gaafar. MR. **Effect of solar disinfection on viability of intestinal protozoa in drinking water.** *J Egypt Soc Parasitol.* 2007 Apr; 37(1): 65-86.

The effect of solar disinfection on the viability of intestinal protozoa *Giardia lamblia*, *Microsporidia* sp., *Cryptosporidium parvum*, *Cyclospora cyatenensis* and *Entamoeba histolytica* in drinking water was studied as compared to chlorine disinfection. The protozoa were collected from stool samples, to infect to the distilled water. Chlorinated water samples were prepared at concentrations of 4 ppm, and the parasites were incubated overnight at room temperature with the treated water. Sun treatment was applied for 2 exposures (6 & 24 hrs), in summer and winter. Sun treated water samples were put in tubes and exposed to sun. The 2 disinfection methods were tested in plastic and glass test tubes. Parasites viability was assessed by viability assay using trypan blue stain (0.4%), and bioassay infectivity tests in experimentally laboratory bred mice. Results proved that all parasites' viability was not affected by chlorine, following solar disinfection treatment, parasites became dark blue in colour and deformed by trypan blue stain. High parasites death was recorded for all parasites except *Microsporidia* sp. Bioassay infectivity test showed a statistically significant reduction in mean number of all parasites in intestinal sections compared to controls. The best results were tubes exposure to sun for 24 hrs in summer, where *G. lamblia*, *C. parvum* and *C. cyatenensis* were inactivated or absence in intestinal sections. No statistically significant difference was between the use of plastic and glass tubes, either in chlorine or sun treated parasites. So, solar disinfection proved a simple, cheap

and effective means for improving water for human use, particularly in developing countries.

13. Gupta SK, Suantio A, Gray A, Widyastuti E, Jain N, Rolos R, Hoekstra RM, Quick R. **Factors associated with E. coli contamination of household drinking water among tsunami and earthquake survivors, Indonesia.** *Am J Trop Med Hyg.* 2007 Jun; 76(6): 1158-62.

The December 2004 tsunami in Sumatra, Indonesia, destroyed drinking water infrastructure, placing over 500,000 displaced persons at increased risk of waterborne disease. In June 2005, we assessed the relationship of water handling behaviors to household water quality in three districts: Aceh Besar, Simeulue, and Nias. We surveyed 1,127 households from 21 communities and tested stored drinking water. Factors associated with a reduced likelihood of having contaminated stored drinking water included obtaining water from improved sources (Aceh Besar, adjusted odds ratio (aOR) 0.41, $P < 0.01$; Simeulue, aOR 0.48, $P = 0.02$), using chlorine solution (Simeulue, aOR 0.41, $P < 0.01$), and having free chlorine in stored water (Aceh Besar, aOR 0.42, $P < 0.01$; Nias, aOR 0.28, $P < 0.01$). Reported boiling, even among those who could describe correct practice, was not associated with improved water quality. Water source improvement and household water chlorination appear to be useful strategies to improve household stored drinking water quality in post-disaster situations.

14. International Reference Centre for Water Supply and Sanitation (IRC). [Arsenic in Drinking Water: Thematic Overview Paper 17](#). 2007. (pdf, 1.02MB).

Outlines the global extent of arsenic contamination and its basic chemistry, as well as associated health problems. It looks at removal technologies for centralised and household point-of-use systems, and describes two case-study trials in Bangladesh and in Hungary.

15. Johnson, S. [Health and Water Quality Monitoring of Pure Home Water's Ceramic Filter Dissemination in the Northern Region of Ghana](#). 2007. (pdf, full-text) Massachusetts Institute of Technology/Water and Sanitation, 2007.

Pure Home Water (PHW) is a social enterprise that promotes and disseminates household drinking water technologies in the Northern Region of Ghana. Currently their main product is a pot-shaped Potters for Peace-type ceramic water filter, locally known as the *Kosim* filter. This study used household surveys and water quality testing to monitor the success of their filter program.

16. Kimani-Murage EW, Ngindu AM. **Quality of Water the Slum Dwellers Use: The Case of a Kenyan Slum.** *J Urban Health.* 2007 Jun 6.

As a result of rapid urbanization in a context of economic constraints, the majority of urban residents in sub-Saharan Africa live in slums often characterized by a lack of basic services such as water and sewerage. Consequently, the urban poor often use inexpensive pit latrines and at the same time may draw domestic water from nearby wells. Overcrowding in slums limits the adequate distance between wells and pit latrines so that micro-organisms migrate from latrines to water sources. Sanitary practices in these overcrowded slums are also poor, leading to contamination of these wells. This study sought to assess sanitary practices of residents of a Kenyan urban slum and fecal contamination of their domestic water sources. This cross-sectional study involved 192 respondents from Langas slum, Kenya. Forty water samples were collected from the water sources used by the respondents for laboratory analysis of coliforms. Of these 40 samples, 31 were from shallow wells, four from deep wells, and five from taps. Multiple-tube fermentation technique was used to enumerate coliform bacteria in water. The study found that most people (91%) in the Langas slum used wells as the main source of domestic water, whereas the rest used tap water. Whereas most people used pit latrines for excreta disposal, a substantial percentage (30%) of children excreted in the open field. The estimated distance between the pit latrines and the wells was generally short with about 40% of the pit latrines being less than 15 m from the wells. The main domestic water sources were found to be highly

contaminated with fecal matter. Total coliforms were found in 100% of water samples from shallow wells, while 97% of these samples from shallow wells were positive for thermotolerant coliforms. Three out of the four samples from deep wells were positive for total coliforms, while two of the four samples were positive for thermotolerant coliforms. None of the samples from taps were positive for either total or thermotolerant coliforms. Because the presence of thermotolerant coliforms in water indicates fecal contamination, facilitated by the proximity between the wells and pit latrines, the study suggests that the pit latrines were a major source of contamination of the wells with fecal matter. However, contamination through surface runoff during rains is also plausible as indiscriminate excreta disposal particularly by children was also common. Owing to the fecal contamination, there is a high possibility of the presence of disease pathogens in the water; thus, the water from the wells in Langas may not be suitable for human consumption. To address this problem, treatment of the water at community or household level and intensive behavioral change in sanitary practices are recommended. Efforts should be made to provide regulated tap water to this community and to other slums in sub-Saharan Africa where tap water is not accessible. However, more sampling of different water sources is recommended.

17. Kioga, T. [Water Quality and Business Aspects of Sachet-Vended Water in Tamale, Ghana](#) (pdf, full-text. 2007. Massachusetts Institute of Technology/Water and Sanitation, 2007.

Microbial water quality analyses were conducted on 15 samples of factory-produced sachet water and 15 samples of hand-tied sachet water, sold in Tamale, Ghana. The tests included the membrane filtration (MF) test using mColiBlue24® medium, 3M™ Petrifilm™ test, and Hydrogen Sulfide Presence Absence (P/A H₂S) test.

18. Marobhe NJ, Dalhammar G, Gunaratna KR. **Simple and rapid methods for purification and characterization of active coagulants from the seeds of *Vigna unguiculata* and *Parkinsonia aculeata*.** *Environ Technol.* 2007 Jun;28(6):671-81.

The coagulating properties of aqueous crude extracts and purified proteins of *Vigna unguiculata* and *Parkinsonia aculeata* seeds, which are traditional water coagulants in rural areas of Tanzania, were studied. The coagulation activity assays were done using one millilitre (ml) of kaolin water samples. Coagulating proteins were purified in two-step ion exchange chromatography. The properties of coagulant protein were compared with *Moringa oleifera*. Coagulating components eluted by 0.6 M NaCl in both coagulants are cationic proteins that have the molecular mass of about 6 kDa, which is very similar to that of *M. oleifera*. The proteins of *V. unguiculata* and *P. aculeata* eluted by 0.3 M NaCl also harbour coagulation activity but proteins eluted with 0.6 M NaCl have higher activity. The dosage for coagulation using purified proteins of both coagulants is about 5 to 10 times lower than that of crude seed extracts. The optimum floc settling time of water treated by crude seed extracts and purified proteins ranged between two and two and half hours. Coagulating proteins of both coagulants eluted by 0.6 M NaCl are thermoresistant and retained coagulation activity of 87% to 92% after boiling for two hours at 80 degrees C and one hour at 95 degrees C. Thermotolerant proteins of *V. unguiculata* eluted by 0.6 M NaCl and *P. aculeata* have wider pH range of 5.5 to 8.5 for coagulation activity than those of *M. oleifera* proteins. The present investigation reveals the possibility of using purified natural coagulants for water treatment to produce safe drinking water.

19. Méndez-Hermida F, Ares-Mazás E, McGuigan KG, Boyle M, Sichel C, Fernández-Ibáñez P. **Disinfection of drinking water contaminated with *Cryptosporidium parvum* oocysts under natural sunlight and using the photocatalyst TiO₂.** *J Photochem Photobiol B.* 2007 May 29.

The results of a batch-process solar disinfection (SODIS) and solar photocatalytic disinfection (SPCDIS) on drinking water contaminated with *Cryptosporidium* are reported. *Cryptosporidium parvum* oocyst suspensions were exposed to natural sunlight in Southern Spain and the oocyst viability was evaluated using two vital dyes [4',6-diamidino-2-phenylindole (DAPI) and propidium iodide (PI)]. SODIS exposures (strong sunlight) of 8 and 12h reduced oocyst viability from 98% (+/-1.3%) to 11.7% (+/-0.9%) and 0.3% (+/-0.33%), respectively. SODIS reactors fitted with

flexible plastic inserts coated with TiO₂ powder (SPCDIS) were found to be more effective than those which were not. After 8 and 16h of overcast and cloudy solar irradiance conditions, SPCDIS reduced oocyst viability from 98.3% (+/-0.3%) to 37.7% (+/-2.6%) and 11.7% (+/-0.7%), respectively, versus to that achieved using SODIS of 81.3% (+/-1.6%) and 36.0% (+/-1.0%), respectively. These results confirm that solar disinfection of drinking water can be an effective household intervention against *Cryptosporidium* contamination.

20. Migele J, Ombeki S, Ayalo M, Biggerstaff M, Quick R. 2007. **Diarrhea prevention in a Kenyan school through the use of a simple safe water and hygiene intervention.** *Am J Trop Med Hyg.* 2007 Feb; 76(2): 351-3.

To prevent diarrhea in rural Western Kenya, we implemented the Safe Water System (water treatment with bleach, safe storage, and behavior-change communications) in 2000. We implemented a pilot project in a school in May 2003. Teachers taught students about safe water and hygiene. Safe water storage vessels were placed between classrooms. Two large water tanks for handwashing were positioned by the kitchen and latrines. The vessels were filled daily with water, which was treated with bleach and monitored for free chlorine residuals. Daily student care logs at the local clinic were reviewed. Clinic visits for diarrhea peaked during the January through March period in 2002 at 130 and in 2003 at 71, but in 2004, after project implementation, only 13 diarrhea episodes were recorded. The project saved the school about 5.49 dollars per student per year. The project has been expanded to 70 schools, and an evaluation is planned.

21. O'Reilly, CE, MC Freeman, M. Ravani, J.Migele, A. Mwaki, M. Ayalo, S. Ombeki, RM. Hoekstra and R. Quick. **The impact of a school-based safe water and hygiene programme on knowledge and practices of students and their parents: Nyanza Province, western Kenya, 2006.** *Epidemiology and Infection, forthcoming article.*

Safe drinking water and hygiene are essential to reducing Kenya's diarrhoeal disease burden. A school-based safe water and hygiene intervention in Kenya was evaluated to assess its impact on students' knowledge and parents' adoption of safe water and hygiene practices. We surveyed 390 students from nine schools and their parents at baseline and conducted a final evaluation of 363 students and their parents. From baseline to final evaluation, improvement was seen in students' knowledge of correct water treatment procedure (21-65%, $P<0*01$) and knowing when to wash their hands. At final evaluation, 14% of parents reported currently treating their water, compared with 6% at baseline ($P<0*01$). From 2004 to 2005, school absenteeism in the September-November term decreased in nine project schools by 35% and increased in nine neighbouring comparison schools by 5%. This novel programme shows promise for reducing school absenteeism and promoting water and hygiene interventions in the home.

22. POUZN Project. [Best Practices in Social Marketing Safe Water Solution for Household Water Treatment: Lessons Learned from Population Services International Field Programs](#) (pdf, fill-text). The Social Marketing Plus for Diarrheal Disease Control: Point-of-Use Water Disinfection and Zinc Treatment (POUZN) Project, Abt Associates Inc., Bethesda, MD.

The Social Marketing Plus for Diarrheal Disease Control: Point-of-Use Water Disinfection and Zinc Treatment (POUZN) Project. Abt Associates Inc., Bethesda, MD. This paper synthesizes lessons learned, best practices, successes and challenges of social marketing safe water solution, and discusses how these lessons may be applied to planning safe water treatment programs around the globe.

23. Ram PK, Kelsey E, Rasoatiana, Miarintsoa RR, Rakotomalala O, Dunston C, Quick RE. **Bringing safe water to remote populations: an evaluation of a portable point-of-use intervention in rural Madagascar.** *Am J Public Health.* 2007 Mar; 97(3): 398-400.

Rural populations disproportionately lack access to improved water supplies. We evaluated a novel scheme that employed community-based sales agents to disseminate the Safe Water System (SWS)--a household-level water chlorination and safe storage intervention--in rural

Madagascar. Respondents from 242 households in 4 villages were interviewed; all used surface water for drinking water. Respondents from 239 households (99%) had heard of Sur'Eau, the SWS disinfectant; 226 (95%) reported having ever used Sur'Eau, and 166 (73%) reported current use. Current Sur'Eau use was confirmed in 54% of households. Community sales agents effectively motivated their neighbors to adopt a new health behavior that prevents diarrhea. Future work should focus on strategies for sustaining SWS use, factors that motivate community-based sales agents to promote SWS, and the feasibility of scaling up this approach.

24. Romulo E. Colindres, Seema Jain, Anna Bowen, Eric Mintz and Polyana Domond. **After the flood: an evaluation of in-home drinking water treatment with combined flocculent-disinfectant following Tropical Storm Jeanne - Gonaives, Haiti, 2004.** *Journal of Water and Health Vol 5 No 3 2007 pp 367-374.*

Tropical Storm Jeanne struck Haiti in September 2004, causing widespread flooding which contaminated water sources, displaced thousands of families and killed approximately 2,800 people. Local leaders distributed PūR[®], a flocculent-disinfectant product for household water treatment, to affected populations. We evaluated knowledge, attitudes, practices, and drinking water quality among a sample of PūR[®] recipients.

We interviewed representatives of 100 households in three rural communities who received PūR[®] and PūR[®]-related education. Water sources were tested for fecal contamination and turbidity; stored household water was tested for residual chlorine.

All households relied on untreated water sources (springs [66%], wells [15%], community taps [13%], and rivers [6%]). After distribution, PūR[®] was the most common in-home treatment method (58%) followed by chlorination (30%), plant-based flocculation (6%), boiling (5%), and filtration (1%). Seventy-eight percent of respondents correctly answered five questions about how to use PūR[®]; 81% reported PūR[®] easy to use; and 97% reported that PūR[®]-treated water appears, tastes, and smells better than untreated water. Although water sources tested appeared clear, fecal coliform bacteria were detected in all sources (range 1 - >200 cfu/100 ml). Chlorine was present in 10 (45%) of 22 stored drinking water samples in households using PūR[®].

PūR[®] was well-accepted and properly used in remote communities where local leaders helped with distribution and education. This highly effective water purification method can help protect disaster-affected communities from waterborne disease.

25. Scott B, Curtis V, Rabie T, Garbrah-Aidoo. **Health in our hands, but not in our heads: understanding hygiene motivation in Ghana.** *Health Policy Plan. 2007 Jul; 22(4):225-33.*

Each year more than 2 million children die from diarrhoeal diseases; the same number again die from acute respiratory infections. The simple hygiene behaviour of washing hands with soap represents an effective way of preventing the transmission of many of these infections. However, rates of handwashing across the globe are low, presenting a challenge for health promotion programmes. Behaviour change is not easy, and past efforts based upon health education have met with limited success. New approaches are needed. We propose that much can be learnt from the world of consumer marketing. Rather than base communications programmes for behaviour change on increasing knowledge, marketers aim to respond to the inner desires and motivations of their target audiences. This study used consumer research to investigate the factors motivating handwashing with soap in order to inform a national communications campaign for Ghana. It revealed that the strongest motivators for handwashing with soap were related to nurturance, social acceptance and disgust of faeces and latrines, especially their smell. Protection from disease is mentioned as a driving force, but was not a key motivator of handwashing behaviour. The ways in which these findings have been translated into a handwash promotion campaign are discussed.

26. Scott BE, Lawson DW, Curtis V. **Hard to handle: understanding mothers' handwashing behaviour in Ghana.** *Health Policy Plan.* 2007 Jul; 22(4):216-24.

While handwashing with soap (HWWS) has been identified as a major pathway to reducing the risk of diarrhoeal diseases, and respiratory infections, rates of HWWS remain low across the globe. The current study, a national survey of Ghanaian mothers, found that as few as 4% of mothers engaged in HWWS after defecation, and only 2% after cleaning a child's bottom. In a multivariate analysis, we explored the determinants of handwashing at these key junctures, with and without soap. After defecation, mother's education, knowledge of important times to handwash with soap, the age of her children, and a measure of the quality of child care were all associated with handwashing (in any form). However, only the latter two variables also predicted soap use amongst handwashers. After cleaning a child's bottom, education, knowledge of important times to handwash with soap, and child care quality were associated with handwashing (in any form), yet only one variable, a measure of disgust sensitivity, showed any possible relationship with soap use. While this study has several important limitations, failure to explain much of the observed variance, despite a large range of potential determinants explored, suggests that we need to continue complementing quantitative surveys with in-depth qualitative studies if we are to better understand the motivations for, and constraints to, HWWS in community settings.

27. World Health Organization (WHO). [Combating waterborne disease at the household level.](#) (pdf, full-text). 2007.

A growing body of research has confirmed the key role that point-of-use water quality interventions can play in reducing diarrhoeal disease in a cost-effective manner. This document reviews the case for managing water quality in the home, describes the Network and its objectives, gives a brief overview of low-cost technologies, and outlines some of the implementation challenges that lie ahead.

28. Wrigley, T. **Microbial counts and pesticide concentrations in drinking water after alum flocculation of channel feed water at the household level, in Vinh Long Province, Vietnam.** *J Water Health.* 2007 Mar; 5(1): 171-8.

Low technology water supply, treatment and sanitation techniques were reviewed in a Vietnamese village in the Mekong River Delta as part of an AusAID Project to reduce poverty and to improve the overall living standards and health in the Cuu Long (Mekong) delta for 500,000 rural poor. It was found that dosing of canal water in 200-l ceramic jars with alum, PAC or PAC followed by hypochlorite provides a high level of treatment for drinking water at the household level in a rural village setting in the Mekong River delta. Seventy per cent (7 in total) of the 24 samples collected showed that *Escherichia coli* levels per 100 ml in the jars after treatment showed a 'no risk' profile (0 *E. coli* 100 ml(-1)) i.e. the water would be considered to be of very good quality for drinking according to World Health Organization Guidelines for Rural Drinking Water Supply. This included the eight samples that were dosed with hypochlorite. The remaining 30% of samples (seven in total) ranged from 14 to 47 *E. coli* 100 ml(-1) which is considered an intermediate risk (10-100 *E. coli* 100 ml(-1)) according to WHO guidelines. All control water samples (eight in total) were high or very high risk (>100 *E. coli* 100ml(-1)).

29. Yazdani, M. [High Density Polyethylene \(HDPE\) Containers as an Alternative to Polyethylene Terephthalate \(PET\) Bottles for Solar Disinfection of Drinking Water in Northern Region, Ghana](#) (pdf, full-text). Massachusetts Institute of Technology/Water and Sanitation, 2007.

The purpose of this study is to investigate the technical feasibility of high density polyethylene (HDPE) containers as an alternative to polyethylene terephthalate (PET) bottles for the solar disinfection of drinking water in the Northern Region of Ghana, in a process known as SOLAIR.