World Health Organization

International Network to Promote Household Water Treatment and Safe Storage

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HWTS Network Bulletin

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Network Progress: An Update from the Secretariat *Bruce Gordon*

For more than 1 billion people without access to safe drinking water, simple and cheap measures can make an immediate impact. Household water treatment and safe storage (HWTS) techniques have been shown to dramatically improve water quality and reduce the spread of deadly waterborne diseases.

Over the last five years, all facets of household water interventions have developed. However, lack of awareness of HWTS efficacy and cost-effectiveness, insufficient advocacy, and research gaps are barriers to scaling-up implementation activities. To address these barriers through coordinated action, WHO established the HWTS Network. Participants are currently engaging with decision-makers, actively carrying out research, and implementing pilot projects around the globe.

The HWTS Network has grown substantially, from 24 organizations in early 2003 to 67 organizations in early 2005. It is comprised of a variety of constituent groups including NGOs, the majority engaged directly in HWTS implementation (24); private-sector participants, including companies producing or developing new technologies or supplying materials like disinfectants (14), academic institutions carrying out research on HWTS (11), government ministries or agencies (6), professional associations, including health sector participants like nurses; and international organizations (7).

The Network is committed to gaining more representation from developing countries. Most importantly, an informal survey done in 2004 showed that implementation activities were taking place in approximately 50 southern countries.

Household water management was a focus of discussion at major international meetings, including the September 2004 IWA Congress in Marrakech and a December 2004 Network side event at the Global WASH Forum in Dakar. The Dakar Statement, agreed to by 500 participants, called for scaling-up of practical actions including "continuing innovative technical work in... household water treatment..."

Participants at these meetings welcomed the WHO-led Network, and appreciated WHO efforts to see household water treatment and safe storage recognized as a major contribution to the Millennium Development Goal for access to safe water. Home water management has also been included in key reports, including the Millennium Task Force recommendations for achieving access to safe drinking water, and the WHO/UNICEF's Joint Monitoring Programme's 2005 Global Water Assessment (in press).

Since its launch, the Network website www.who.int/household_water has received about 160,000 hits. The Network mailing list reaches approximately 150 influential professionals in developed and developing countries interested in HWTS.

PSI Sends Critical Water Purification Tools to Tsunami Survivors

Diane Freeman & Chuck Szymanski

As December's tsunami overtook the coastlines of several Asian countries, many of the survivors were left without essential resources such as clean water. In the wake of this disaster, PSI offices in Pakistan, India and Myanmar quickly mobilized products and staff to address relief efforts, including the distribution of two safe water products, PUR and *Safewat*.

The World Health Organization warned that the number of people dying from disease after the tsunami could surpass those killed during the catastrophe itself, and aid workers citied clean water as a top priority. While PSI is not primarily a disaster relief organization, efforts were concentrated on ramping up existing safe water programs in South Asia and expanding collaboration with Procter & Gamble (P&G) to reduce incidence of water borne illnesses such as cholera and diarrhea which threatened to compound the devastation of the tsunami.

PSI's affiliate Greenstar Social Marketing in Pakistan had a stock of nine million packets of *PUR Purifier of Water* donated by P&G, enough to sanitize 90 million liters of water. Greenstar staff worked tirelessly with local government agencies to organize the logistics of moving 8.8 millions sachets PUR. Shipments of PUR sachets were shipped from Greenstar warehouses by AmeriCares for distribution by the International Federation of the Red Cross in Indonesia and Sri Lanka as well as other aid organizations such as World Vision and UNICEF. PUR is being given free to survivors.

PUR packets contain a powdered combination of calcium hypochlorite and iron sulfate which removes pathogens and causes particles to settle when mixed with water. Point-of-use water treatment approaches like PUR have shown reductions of 30-50% in diarrhea disease, with even higher reductions during waterborne epidemics.

PSI/India is currently diverting its supplies of *Safewat* water purification solution and *Neotral* oral rehydration salts directly to the hardest hit areas of Tamil Nadu, in the south, where they were distributed through government and NGO schemes. *Safewat* production was scaled up and labels reprinted in Tamil Nadu 16,500 bottles of *Safewat* and over 10,200 sachets of *Neotral* were distributed.

(see Critical Water Purification pg. 3)

Calendar of Events

A summary of upcoming meetings, conferences and other opportunities for members to highlight Network activities and advance our mission.

June 6-10, 2005	**Learning Alliances for Scaling Up Innovative Approaches in the Water and Sanitation Sector** Delft, The Netherlands
August 21-27, 2005	**World Water Week including Stockholm Water Symposium** Stockholm, Sweden
September 4-9, 2005	**13 IWA International Symposium on Health-Related Water Microbiology** Swansea, Wales, UK
Oct 31-Nov 4, 2005	**31st WEDC International Conference** Kampala, Uganda
March 16-22, 2006	**4th World Water Forum** Mexico

PUR Water for Tsunami Survivors

Greg Allgood

Following the devastating tsunami-waves in South East Asia, P&G worked with a broad group of partners to provide more than 15 million PUR sachets to survivors. Many HWTS Network partners were involved in providing or deploying the PUR sachets including Samaritan's Purse, Population Services International, the International Federation of the Red Cross, CARE, WorldVision, and UNICEF. In addition, AmeriCares, WorldVision, Aquaya, and the International Rescue Committee were critical in these relief efforts. Although P&G usually provides the PUR sachets at cost for global relief, because of the magnitude of this disaster, P&G donated product and cash donations totaling $2.5 million dollars. More than 2,370 P&G employees provided more than $600,000 in cash to partner organizations to help with the deployment. These concerted efforts by Network members received the attention of the international media helping to build broad awareness of household water treatment, resulting in cover stories in the Philadelphia Inquirer, Atlanta Constitution, and a marketplace cover story in the *Wall Street Journal*.

Greg Allgood is Associate Director of P&G Health Sciences Institute

3rd Annual HWTS Network Meeting

May 30 — June 2, 2005
Bangkok, Thailand

The 3rd meeting of the Network, organized by WHO, in collaboration with the Department of Health Thailand and the Asian Institute of Technology, comes at a critical juncture for home treatment, a time when household approaches are being carried forward by increasing political recognition and a growing body of scientific evidence. Despite, this there is a certain disconnect of awareness of HWTS as a viable policy option, and certain disconnect among practitioners.

This meeting offers a chance to take stock of where we are, to reaffirm where we want to be, and to re-invigorate our efforts to get there. It will allow us to look critically at what is working and what needs to be improved. Importantly, we can capitalize on this meeting to build awareness of HWTS in the most populous region of the world, where many stand to benefit.

The Bangkok meeting will include a two day technical symposium covering the state of the art in HWTS technologies and systems, and tackling the most important challenges, including those relating to acceptability, affordability, and long-term utilization. Key regional issues, such as HWTS use following emergencies, and arsenic and fluoride removal, will also be addressed by presenters.

Critical Water Purification Tools to Tsunami Survivors

(continued from pg. 2)

PSI/India, with 17 years of experience in health education and making health products available to low income people, has also made its communication staff available for training and educating affected populations about the importance of treating their water to avoid water-born illness and promptly treating dehydration associated with diarrhea with oral rehydration therapy. PSI/India staff members also took up a collection to purchase emergency relief supplies such as rice to those most in need.

PSI/Myanmar collaborated with World Vision and UNICEF to send its *WaterGuard* hypochlorite solution to affected areas in the Ayeyarwady Delta and Kawthaung in the south. Thousands of bottles of *WaterGuard* have been distributed for free and PSI/Myanmar has conducted educational sessions on safe water and sanitation. UNICEF is distributing "family kits," which include a bottle of *WaterGuard*, to families in affected areas.

The PSI/Myanmar staff traveled by car, boat and tractor to remote villages in the Ayeyarwady Delta region to deliver WaterGuard and conduct health education meetings. PSI was the first organization to provide assistance to some of the affected villages, and their assistance was greatly appreciated. "Even before the tsunami, these communities didn't have enough water to drink," says Tin Tin Kyaw, junior project officer of the Water Project. "Now all their water supplies have been damaged and people have to dig holes in the ground to find household water.

This water is often contaminated and they have already suffered from diarrhea. They are very happy to use *WaterGuard*."

PSI currently runs safe water programs using sodium hypochlorite solution or PuR in 15 countries in Africa, Asia, and Latin America.

Chuck Szymanski is Senior Manager for MCH and Diane Freeman is Senior Program Assistant for the Asia Department at PSI/Washington.

The Case for Community Water Education *Camille Dow Baker*

Over 1.1 billion people around the world do not have ready access to water, clean or dirty. This statistic is staggering, but equally daunting is the solution to this global issue. It's widely recognized that the

technologies exist – the question is how do we implement them on such a massive scale?

Since 2001, the Centre for Affordable Water and Sanitation Technology (CAWST) has worked on a possible answer – Community Water Education. We've learned that education and training is a catalyst to community action if we trust the process and have faith in the people we train.

Community Water Education is based on four principles:

1. **Everyone is responsible.** Water is a basic need for survival; a hugely mobile, shared resource; a vehicle for our waste; and the foundation for many economic livelihoods. It is a shared responsibility and everyone needs the knowledge to share and protect this vital resource.

2. **Training and education spawns community leadership.** Moench et al. state, "Since both natural and social conditions are changing and subject to substantial uncertainty, we need the capacity to enable society to respond to constraints that could be local or regional, short or long term, political, economic or technical."

3. **Water management skills at every level are vital.** The lesson learned in the introduction of many household treatment technologies is that successful implementation is dependent on education and training to accompany the technology. This is especially relevant given that the solutions being proposed to address issues of both water supply and water quality, such as rainwater harvesting and household water treatment, are decentralized to the household level. So we need to develop skills at the household level. According to Moench et al. "Historically, most water problems were solved by additional water development….Now, development opportunities are limited, and perspectives are changing towards how the resource base can be managed and allocated." And as the population increases, the possibility of water contamination increases, so self-regulation to manage water quality over the long term will be critical. This requires training and education.

4. **Education and training is often the only outside intervention required.** Our experience demonstrates that knowledge of water issues and potential solutions, and the motivation to do something about it, are the catalysts to self-directed community action. Often all you need to do is get the ball rolling.

Given this case, more can be done to support Community Water Education. At household water treatment seminars conducted by CAWST in Haiti and the Dominican Republic in 2003, NGOs and government agencies said that a lack of education and training was the biggest challenge facing the implementation of water services for the poor. However only 1.5 % of the aid directed to water over the last 10 years was spent on education and training.

Long-term capacity-building is needed, however short-term technical assistance still forms 38% of the aid provided to developing countries. CAWST's research shows that currently, water education is largely part of specific infrastructure projects, directed primarily to specialists.

CAWST proposes Community Water Education that is:

- Holistic, covering education about water diseases; simple methods to protect families; hygiene and sanitation; technologies that can be built locally; and project management.
- Directed specifically to children in school; community health workers; community based organizations; manufacturers of water products; water program organizers; youth, women's and faith-based groups; trainers; and "the average Joe".
- Focused on the needs of those most vulnerable; accessible to a non-technical audience; interactive, so knowledge transfer can occur in all directions; long term, nurtured with continuous and collaborative learning

within a structured framework.

Based on trust in the process, and faith that the people we train will use the knowledge in their own way and in their own time.

We should start now. As the world population increases to 7.8 billion in the next 20 years, conquering the problem will be more difficult. If the world community is going to get control of our water issues, we need shared knowledge and understanding. We need to trust the process. We need to have faith in people.

Camille Dow Baker, P.Eng., M.Evds, is President & CEO of The Centre for Affordable Water & Sanitation Technology (CAWST), a Canadian based NGO (www.cawst.org)

Quality Meets Quantity at Household Level Sally Sutton

We all know about the millions of people worldwide who suffer the health, economic and other consequences of not having access to adequate quantities and quality of water. Particularly in countries where the state struggles to provide acceptable water supply services, one of the ways that the Millennium Development Goals will be reached is by improvements in the ways in which households are supplying themselves.

It's at this household level where two water sector related networks find common ground. The HWTS Network's focus on water quality is complemented by the Rural Water Supply Network's (RWSN) focus on access to safe rural water supply services. It is recognised that the un-served have problems with quantity as well as quality, and there are obvious synergies between the work of these two networks.

The RWSN was originally conceived as the 'Handpump Technology Network' which recently broadened its mission from handpumps to focus on rural water supply solutions that work. RWSN is a knowledge network which promotes innovation, learning and best practice towards achieving sustainable and cost-effective rural water. It's main implementing agencies are the Skat Foundation, UNICEF and the Water & Sanitation Program Africa (administered by the World Bank), and also has links with WaterAid. It has three new thematic focus areas: cost-effective boreholes; sustainable handpumps and sustainable household 'self supply'.

RWSN's theme of 'self supply' involves an approach that promotes low cost incremental improvements - building step by step on what people have already done for themselves. The idea is to make the most of households' investments using local capital and human resources. This 'incremental progress' approach is shared by both networks, and RWSN can learn from HWTS about how to improve on the quality of water that households supply for themselves.

Most water treatment in the rural context comes up against the same barriers as does provision of water itself. These are: problems with the supply of consumable items; rural people have only seasonal or limited availability of funds; strong preferences in taste of water which tend to outweigh consideration of safety; and a variety of practices affecting cost-effectiveness of treatment (including ingrained traditions of throwing away any water stored overnight).

With improved access, incremental benefits in improved water quality, hygiene, nutrition and income may help to make the adoption of household water treatment more achievable.

The RWSN looks forward to working with HWTS to share lessons learned and further develop the common approaches to improving household level water quality and quantity. HWTS readers are encouraged to visit the RWSN website on www.rwsn.ch for more information on RWSN, new publications, and to register as a new member of RWSN.

Sally Sutton is with SWL Consultants

Solutions Benefiting Life *David Elliott*

Solutions Benefiting Life Institute (SBL) is a non-profit organization focused on developing and implementing a household water purification system for developing countries based on colloidal silver ceramic technology. We started making filters after attending a workshop given by Ron Rivera of Potters for Peace.

We have started field testing a low cost, sustainable clay water filter system at sites in India and Nepal, following a year of extended bacterial testing at our facility in Wayland, MA.

The SBL filter test data consistently shows flow rates >2 liters/hour, with bacteria levels well below the EPA standards.

The data and details of the 1 year test program are available in a technical paper, to be distributed at the Network meeting in Bangkok.

The water purification system we have installed at sites in the field consists of a pot shaped filter, a 10 liter recepticle, water test kit, colloidal silver samples, and instruction manuals printed in Hindi and Nepali. SBL gives equal importance to education, culture, and habits of the people at all three work sites in Nepal and India, as well as field visits every 3 months to support the people using the system.

SBL follows the micro-business concept in introducing their filter system, working with local community leaders, schools, microlending bank, and local womens' organization to integrate fully into the community. We have now established two production sites in India and Nepal, where local potters are beginning to produce both filters and receptacles in small quantities. We are excited that people are drinking purified, healthy water from our system.

David Elliott is Founder/President of UV TechSystems

Research on HWTS for Arsenic and Fluoride Mitigation in Asia *Terrence Thompson*

The WHO/UNEP/ADB High Level Meeting on Health and Environment (Manila, Nov. 2004) identified as a priority environmental health issue in Asia the human exposure to unsafe levels of naturally occurring arsenic and fluoride in drinking water. The magnitude and extent of problem is not yet fully known, but large populations are exposed to unsafe levels of arsenic and fluoride in groundwater supplies in Bangladesh, India, China, Vietnam, Cambodia, Lao PDR, Myanmar, Sri Lanka and other Asian countries.

In the long term, investments in infrastructure are needed in order to provide safe drinking water to all through community systems. In many arsenic and fluoride affected countries, however, investment needs for long-term solutions are large. Low-cost short and medium-term solutions are needed to mitigate the health impact attributable to the presence of chemicals and other contaminants in drinking water.

Simple, low cost technologies for mitigating the health effects of arsenic and fluoride in drinking water at household level have been developed and implemented in several countries. Research and development (R&D) of such technologies is ongoing. However several countries could benefit by stimulating R&D activities on HWTS and by stimulating evaluations of promising technologies under field conditions. Related to this, research is needed to further develop and evaluate portable test kits for determining arsenic and fluoride concentrations in water.

Moreover, while much research has been directed already towards the development of point-of-use technologies for removing arsenic and fluoride from drinking water, a challenge remains to develop appropriate technologies to deal with the problem of water treatment sludges and other residuals.

The Government of Japan, through its Ministry of Health, Labour and Welfare (MHLW), provided WHO with financial support to conduct the WHO/UNEP/ADB High Level Meeting on Health and Environment in 2004; and is providing separate funding to follow-up on the recommendations of that meeting, including support for research on simple low-cost technologies suitable for use at household level for mitigating the health effects of arsenic and fluoride in drinking water.

WHO will work with national health authorities and research institutes in four Asian countries (Cambodia, Lao PDR, Vietnam and Myanmar) to identify recent and ongoing research related to HWTS for mitigation of arsenic and fluoride in drinking water, identify gaps in knowledge, identify needs and opportunities for new research, develop and support the implementation of relevant research projects, and publish the results. It is expected that the principle investigators from each of the four countries will participate in the 3rd Annual Meeting and Technical Symposium of the International Network HWTS.

Household arsenic filter unit, Vietnam. (Photo, Dr. Hiep Nhi, 2005)

Terrence Thompson is the Environmental Health Advisor for the S. E. Asia Region for WHO

Health Improvements in SODIS Projects

Regula Meierhofer, Martin Wegelin

Solar water disinfection (SODIS) is a simple method to improve the microbiological quality of drinking water (www.sodis.ch). Various health assessments conducted in the 1990s show that the risk of contracting diarrhoea is significantly reduced when people drinking untreated raw water switch to the consumption of SODIS treated water (Conroy et al. 1996, 1999, 2001). Since 1999 SODIS, projects have been implemented in areas where the local population does not have access to safe drinking water. Health assessments during project the evaluation have shown a positive health impact of such projects:

A case-control evaluation by the Swiss Tropical Institute, in collaboration with Bolivian partner institutions, examined the effect of SODIS on the health of children under 5 during in the 18 communities of the Mizque District in **Bolivia**. The study showed that the consumption of SODIS treated water has a significant impact on health: children of families regularly using SODIS, had 35% less diarrhoea (Hobbins, 2003).

(see SODIS pg . 7)

SODIS *(continued from pg. 6)*

Health centres of the local government in **East Lombok, Indonesia** introduced SODIS in more than 60 villages during 20 months (2003-2004). Two thirds of the population, 80'000 people, now use SODIS for the treatment of their drinking water.

Water quality tests have shown that the average contamination with E.coli of 164 CFU/ 100ml has been reduced to an average contamination of 4 CFU/ 100 ml. The data on diarrhoea incidence gathered by the health centres showed that diarrhoea in the local population has been reduced by 73%.

A health impact evaluation was conducted after introducing SODIS in the cities Rajoa and Chiniot in **Pakistan**. It showed that diarrhoea incidence was reduced from 26% to 13% in Rajoa and from 39% to 19% in Chiniot. The **Nepalese** NGO ENPHO disseminates SODIS since 2002 in the Kathmandu valley and the Terai flatland of Nepal. A diarrhoea reduction of about 50% among children below 5 years was achieved among the 5000 families trained in SODIS. A similar effect was observed during a health study among children below 5 years in **Usbekistan**. Children of SODIS users had a reduction of diarrhoea incidence of 53%, whereas in the control group the occurrence of diarrhoea illnesses increased.

The health improvements obtained during the above impact evaluations show that household water treatment using solar water disinfection significantly reduces diarrhoea illnesses in the range of 20 to 70%. This is in line with the recent systematic review on water, sanitation and hygiene interventions to reduce diarrhoea (Fewtrell, 05), which revealed that a diarrhoea reduction of 26 to 39% are achieved through household water treatment interventions.

Regula Meierhofer & Martin Wegelin are with the Swiss Federal Institute for Environment, Science and Technology

Silver Ceramics Removes the Bacteria and the Particles

Reid Harvey

The technology of the Silver Ceramic System (SCS) *pottery purifier* has been implemented in the field in Nepal by International Development Enterprises. Reports indicate success for the *candle purifiers* and recognition of the system's marketability to the poor.

Now the purifier medium is being adapted to a new, all pottery design of one piece, utilizing a *disk purifier*. At $2.50 per system this is far less expensive than the current alternatives and will also prevent bacterial re-contamination of the filtered water, a first for a flat-bottomed filter.

All systems give two liters of flow per hour, but there has been a choice between two eight-liter, or two twelve-liter containers per system. At $4.00 and $6.50, respectively these have included upper and lower containers. But at $2.50 the new pottery system should be affordable, even to the very poor.

The low price is possible, because it is the *village potter* who will put the systems together. In the livelihood approach to development it is understood that prices are minimized for the poor by their purchase of goods and services from neighbors, of similar low income. The silver treated purifier disk is produced in a nearby factory, fired at 1000° C, but their small size suggests these should cost no more than $1.00.

The only quality control required of the potter is to be sure there is no leakage from the upper part of the cylinder. This is simplified by the use of a very thick purifier disk at 5.0 cms. The periodic cleaning of the disk involves only the removal of particles from its top surface. Since there is never any reason to touch the bottom, there is no bacterial recontamination of the filtered water.

The concentrated colloidal silver used to treat the project purifiers, in current field use, has been produced by the IDE Nepal. This has shown self reliance and a minimized need for imported silver. The overall success of the project has prompted senior staff to report the readiness of the systems for tsunami relief or other emergencies.

A virtue of these small-sized ceramic, household systems is the removal of, not only the bacteria, but also particles. Silver ceramics should be evaluated along with other HWTS systems, and healthy competition between technologies is certainly beneficial to vulnerable poor.

Arsenic and Fluoride Removal – New Household Approaches for Addressing Chemical Contamination

Susan Murcott

Arsenic and fluoride are two chemicals of concern in drinking water. Elevated levels of arsenic are found in groundwater supplies on every continent, and the situation is especially acute in South Asia. Fluoride is naturally occurring in drinking water in certain regions, including India and parts of Africa.

Since it was created in 2003, the HWTS Network has focused primarily on technologies to improve the microbial quality of drinking water and on reducing the risk of diarrhoeal diseases. More recently, however, the Network has embraced inclusion of technologies to address chemical contamination into its sphere of focus and action. While microbial contamination is the most immediate and widespread health concern in terms of drinking water quality worldwide, chemical contamination of is also a major public health issue. This article briefly describes several household water treatment innovations that address either arsenic or fluoride contamination: While many fluoride and arsenic removal technologies are high-tech and expensive, absorption processes lend themselves to small-scale, low-cost systems. Adsorption is a mass transfer process whereby a substance is transferred from the liquid phase (drinking water) to the surface of a solid (the adsorption media) and becomes bound by chemical or physical forces. All of the systems described below use one of various types of naturally occurring or commercial adsorbent media.

Fluoride Household Treatment Systems

Mytry: A start-up company in India, Mytry De-Fluoridation Technologies (MDFFT) produces a fluoride removal filter based on research conducted at the India Institute of Technology. The Mytry filter is a two-bucket system with activated alumina in the upper bucket as the adsorption filter medium. MDFFT is producing 50 fluoride removal filters per day and has sold 9,000 since 2004.

The Catholic Diocese of Nakuru –Kenya (CDN): CDN has extensively researched and is now implementing both household and community-scale filters using bone-char, a medium derived from scrap bone from butchering operations. This bone-char is placed into either 2-bucket systems or into larger cylindrical tanks, through which fluoride-contaminated water passes. To date these systems have been implemented only in and around Nakuru, Kenya.

Arsenic Treatment Systems: A collaborative technology verification program between the Ontario Centre for Environmental Technology Advancement (OCETA) and the Government of Bangladesh has been underway for the past several years. To date, four household or community-scale treatment technologies for arsenic removal have been given "provisional verification," which means that they consistently achieved < 50 µg/l of arsenic in the treated water - the Bangladesh drinking water standard. The four systems are now being implemented in some villages in Bangladesh and will be closely monitored over the next two years. These technologies are:

MAG/Alcan: Uses an activated alumina media (same media as in the Mytry system described above, but for arsenic rather than fluoride removal). This is a 2-bucket system with a very high flow rate of 127 L/hour and a cost of $33 per system.

SONO 45-25: Employing zero valent iron and sand, this technology is based on an indigenous Bangladeshi system called the 3-*kolshi* (also know as the "3-pitcher" system). The SONO 45-25 uses the same adsorption media concept as the 3-*kolshi*, but in 2- bucket system, with a good flow rate of 15 L/hour. The system costs $10.

READ-F: This system, developed by Shin Nihon Salt Co. Ltd. Japan, uses hydrous cerium oxide as its treatment media. The media is housed in a single unit and costs $50 per household.

The AdsorpAs® -SIDKO - This is a community-scale system, providing arsenic-free water for communities of 20 – 80 households at an expensive cost of $4,250 per system. The treatment media is a granular ferric hydroxide.

Two other promising arsenic remediation systems are currently being implemented in Ghana and Nepal respectively.

Laterite Treatment: Researchers at New Mexico Tech and the Royal Institute of Technology in Sweden have developed a household and community-scale arsenic removal systems using laterite, a red-colored acidic soil common in tropical regions. Latrite is comprised chiefly of hydrous oxides of iron and aluminum, as well as clay and smaller amounts of manganese and titanium. It is a low cost and effective arsenic adsorbent media.

Kanchan™ Arsenic Filter (KAF): Researchers at Massachusetts Institute of Technology have developed the Kanchan ™ Arsenic Filter. This filter treats both microbiological and arsenic contamination by combining a household-scale slow sand filter with an adsorbent media of non-galvanized iron nails. The rust (ferric hydroxide) is the key to arsenic removal in this system. More than 2,000 units of the KAF have been implemented in southern Nepal in 2004, reaching 15,000 people. The system has a flow rate of between 15 – 30 L/hour and costs $15.

More information on these and other household and community-scale fluoride and arsenic remediation systems will be available on the MIT Web site: http://web.mit.edu/watsan after consensus is reached on a format/template for data collection, following the WHO Network meeting in Bangkok in June 2005.

Susan Murcott is a research engineer and lecturer in the Civil and Environmental Engineering Department at the Massachusetts Institute of Technology

Technology Verification for Household Water Treatment & Storage

Joe Brown and Mark Sobsey

The extent to which a water treatment process reduces microbial pathogens is critically important in determining how useful it will be in reducing the risks of waterborne disease and providing safe water. Because of the diversity of microbial pathogens and their properties, it is also important to verify whether a technology is effective in reducing all or just some of them. Recent experiences highlight the importance of this. For example, chlorination, a widely used disinfection technology that is effective against most pathogens, was found to be ineffective in reducing the infectivity of a newly discovered but ubiquitous waterborne protozoan parasite *Cryptosporidium parvum* in the 1990s. Partly because of such experiences, there are now strict guidelines, performance standards and protocols for technology verification of pathogen reductions by drinking water treatment processes in the developed world.

Establishing and verifying performance requirements for household water treatment and storage technologies used in the developing world is especially challenging because raw water is often poor and variable in quality and only one treatment barrier is typically applied. Therefore, it becomes especially important to understand and quantify the effectiveness of these individual technologies in reducing all classes of pathogens in waters of diverse quality. In order to do this systematically, a system for HWTS technology verification is needed. Furthermore, this HWTS technology verification system needs to be is consistent with the World Health Organization Guidelines for Drinking-water Quality (GDWQ), its health based targets for the provision of safe water and its encouragement of incremental improvement in drinking-water quality.

The development of guidelines for HWTS technology verification will help establish minimum standards for microbiological effectiveness and define the conditions under which a given technology is appropriate for use as an intervention. Implementers and decision makers will then have a guide for matching appropriate technologies with communities based on stated health based targets and water quality characteristics. Establishing a common metric for all technologies will help define a range of conditions under which a given technology would and would not be indicated for use.

Water treatment technology verification protocols for microbiological performance, often referred to as ETVs after the US EPA's *Environmental Technology Verification* programme, already exist in the United States and some other countries. These developed country protocols are highly prescriptive and based on performance targets for waterborne pathogen reductions that are linked to country-specific standards and are not necessarily derived from health-based targets.

ETVs specify the test pathogens, test water quality, frequency and duration of challenging the technology with pathogen-laden water, minimum pathogen reduction requirements, and other procedural and performance specifications. Current protocols have the advantage of being universal, enabling direct comparisons to be made between a wide range of technologies. However, they were developed principally for devices and unit processes to be used in developed countries and are less suited to conditions and HWTS practices in developing countries.

The development of new protocols for laboratory verification will enable manufacturers and implementers to ensure effectiveness of a candidate HWTS technology. Minimum performance standards will be set for each treatment technology, including single barrier and multi-barrier systems. Minimum performance may be demonstrated using several comparable testing methodologies and test microbes that can be used in a developing world context. Manufacturers' claims for technology effectiveness can be verified with these protocols. Results of verification in laboratory tests can be used together with water quality data from the target community or region to establish the ability of the technology to meet the WHO GDWQ health-based target of 10^{-6} DALYs (Disability Adjusted Life Years)/person/year.

In essence, protocols must be sensitive to the needs of implementers and technology manufacturers in developing countries without sacrificing their purpose as common metrics of performance. For example, mammalian viruses as test microbes may be replaced by bacteriophages (bacterial viruses) due to their relative simplicity of production and analysis and low cost, but equivalence testing would first be needed to justify their replacement of enteric viruses for a given type of technology. If bacteriophages behave similarly to human viruses in a treatment process (e.g., chlorination) under well-defined conditions, then a case for replacement can be made. Similar simplifications or substitutions can be made for other methods if equivalency can be experimentally substantiated. Other challenges result from setting minimum standards to be met by HWTS technologies when the stated goal is incremental improvement.

Guidelines must acknowledge that any improvement in water quality is preferable to inaction, while encouraging appropriate health target-based performance standards for candidate technologies.

The development of appropriate technology verification guidelines as policies and protocols will assist in the selection of HWTS intervention technology to meet health-based targets and performance requirements for the reduction of microbes in drinking water based on a reference level of acceptable risk, currently defined as 10^{-6} DALYs/cap/year. Minimum performance targets and flexible but comparable laboratory verification of HWTS technology will facilitate technology certification, inform implementers, protect users, and provide a basis for decision making in household water treatment interventions and implementation initiatives.

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Implementation Working Group Update

At the June 2004 Network Meeting in Nairobi, Kenya meeting, the Implementation Working Group (IWG) set down five actions to undertake during YEAR 1. Here is a brief progress report on the status of those activities:

1a. Create Web-based database of implementation experience of the Members.

1b Create Web-based tool for HWTS technology and program options, organized according to key parameters.

This first set of activities has been coordinated by Susan Murcott of MIT. A draft implementation program survey was prepared in December and circulated by email to IWG members for comment. A team of MIT researchers took this improved draft survey to field sites in five of Kenya's eight Provinces during January 2005. There, they engaged the staff of household drinking water and safe storage (HWTS) implementation programs to respond to, iterate and refine this survey. Program staff included a number of members of the WHO IWG, including colleagues from the Ministry of Water Quality, Bushproof, Anglican Church of Kenya (ACK), Care-Kenya/CDC. Next, we extracted from this effort a set of questions in a "short form." which was circulated to IWG members in an easy-to-fill-out Excel Template. The Excel Template can be downloaded from this page of the Network website : http://www.who.int/household_water/implemntation/en/

We encourage all implementing organizations to please take the time to fill out and send in a copy of this survey. This will enable us to begin to build a Global Map of Implementation Programs. Also, we intend that a Web-based tool of specific technologies, organized according to key parameters will also be ready by the Bangkok meeting.

2a. Develop agreed common guidance and approaches for technology verification.
2b. Create Web-based tool for sharing technology verification methodologies and results.
2c. Develop agreed common guidance for evaluation, including both impact evaluation for health, water quality, and behavior/use as well as program implementation evaluation

This second set of activities has been coordinated by Bruce Gordon of the Network Secretariat, with input on technology verification from Mark Sobsey of University of North Carolina and on program implementation evaluation from Rob Quick of the Centers for Disease Control and others from the IWG.

3. Develop tool for formative research

This action has been coordinated by John Borrazzo and Rochelle Rainey of USAID. USAID, in October 2004, awarded a contract to implement its Hygiene Improvement Project.(HIP). During the 1st quarter of 2005, HIP, has engaged other partners to continue to develop this tool and test it with UNICEF in Nepal. The results to date will be presented at the June 2005 Bangkok meeting.

4. Develop tool for estimating programmatic costs

A draft of this tool has been developed by Tom Clasen of London School of Hygiene and Tropical Medicine. This was circulated to members in December 2004.

5. Develop program and business development checklist

A program and business development checklist was sent out as part of the IWG December 2004 Progress Report.

A more complete overview and synthesis of the YEAR 1 actions of the IWG will be presented at the June 2005 Bangkok meeting and will be available on the Network Web site http://www.who.int/household_water early this summer. We look forward to using the Bangkok meeting as an opportunity to formulate our next steps for YEAR 2 and to continue to refine and expand these activities.

Membership Information

Membership in the Network is open to all interested organizations that agree with the Network mission and guiding principles and who are willing to commit themselves to working toward achieving the objectives of the Network.

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