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Analysis of Research on the Effects of Improved Water, Sanitation, and Hygiene on the Health of People Living with HIV and AIDS and Programmatic Implications*

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Prepared by the USAID /Hygiene Improvement Project with the Water and Sanitation Program/World Bank.

October 2007



* This review is an adaptation and expansion of an early review written by Dr. Kate Tulenko of the World Bank / Water and Sanitation Programme. Acknowledgement and thanks are extended for her scholarship, dedication and generosity in allowing her work to serve as the base of this review. This adaptation was written by Renuka Bery and Julia Rosenbaum of AED for USAID/HIP, with Dan Campbell, Environmental Health at USAID Web Manager contributing to the research and expanding the annotated bibliography and resource guide.

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Introduction

Diarrheal diseases are the most common opportunistic infections (OIs) experienced by people living with HIV and AIDS (PLHA) in Africa and elsewhere. Most of these diarrheal OIs are water borne or water washed and cause significant loss of functional days (missed work and missed school days), loss of income, considerable human suffering, increased burden on caregivers, weakening of general health and eventually death. Several case studies and position pieces (Kamminga 2006, UN-Habitat 2006, USAID 2006) have been written on the importance of integrating WaSH into AIDS programs. Surprisingly, few programs for PLHA have included a focus on basic water, sanitation, and hygiene (WaSH) behavior change or attended to services and products (such as chlorine for household water treatment, sanitary platforms, or soap) critical to the performance of key WaSH behaviors.

A small but growing body of literature has identified a series of linkages between water, sanitation and hygiene and HIV/AIDS: opportunistic infections negatively impact PLHA quality of life and can speed the progression to AIDS and infection frequency is tied to water and sanitation services available to households and the hygiene practices of household members (Hillbrunner 2007). Ensuring proper WaSH practices benefits those infected with HIV and AIDS by keeping them stronger, well nourished, and able to contribute to the household. In addition, such good practices will also prevent the caregivers and other household members from contracting water-borne diarrheal diseases, which, in turn, helps to keep households economically viable and generally resilient for longer periods of time.

This paper reviews the existing scientific and programmatic evidence, raises WaSH issues in the HIV and AIDS context that need further study to build the evidence base, assesses current WaSH guidance through a review of National HIV/AIDS guidelines from five African countries, and identifies programmatic implications that home-based care programs and the WaSH sectors must consider.

Integrating WaSH into HIV/AIDS Home-based Care Strategies

Noting the general lack of integration of WaSH into AIDS programs, the Africa Unit of the Water and Sanitation Program (WSP) of the World Bank convened a one day “Think Tank” of key water, sanitation and HIV/AIDS stakeholders. The Think Tank recommendations underscored the need to increase cross-sectoral linkages as well as to examine the evidence for effectiveness and cost effectiveness of WaSH services for PLHA. This paper uses the literature review conducted by WSP/World Bank as a starting point, incorporates new research findings and expands the scope of the review to include additional aspects of risk and benefit associated with hygiene, hand washing, feces management, safe water, and disposal of waste water.

This expanded version of the WSP review has been developed specifically as a background resource for home-based care and water and sanitation program managers who are meeting in Malawi to discuss strategies for integrating HIV/AIDS and WaSH objectives into the home based care programs. A further objective is to offer recommendations to the water, sanitation, and hygiene sectors on ways to integrate HIV and AIDS into the strategic planning and programming of those sectors. Thus the prime target audiences for this document are policy makers addressing HIV/AIDS and/or water and sanitation issues and program implementers in these sectors.

In order to identify papers, gray literature, and other publications of research on the effects of WaSH on PLHA, the following databases were searched: Eldis, FirstSearch, BasicBiosis, Science Direct, Social Science Citation Index, PubMed, Cochrane Library, Popline, USAID's DEC, and WorldCat. The searches were run with MeSH terms and key words and included at least one AIDS term (HIV/AIDS, HIV, AIDS, Acquired Immune Deficiency Syndrome) and at least one WaSH term (water, chlorine, "household water treatment", sanitation, hygiene, latrines, sanitary platforms, hand washing, soap). In addition, the authors personally requested via e-mail advocacy documents, educational materials, project reports, manuals, country guidelines containing relevant sections or references on the intersection between HIV/AIDS and WaSH.

The final section of this review begins to outline implications for home-based care and the water and sanitation sectors, and adds practical guidance where appropriate. The purpose of this document is to serve as a springboard for the Malawi meeting participants to identify feasible, affordable, sustainable, and non-stigmatizing WaSH interventions that can be incorporated into HIV/AIDS home based care programs to yield maximum impact on PLHA and their families, on communities, and on government sectors.

HIV-affected Families and WaSH

Access to safe water is considered a basic human need and a basic human right (Kamminga 2006) for all people. Yet this basic right remains unrealized for a large majority of people in developing countries, especially in rural communities. The negative impact of low access to necessary quantities of water, to water of reasonable quality, to basic sanitation and hygiene are magnified for HIV-infected, immuno-compromised individuals. The added burden affects not only the HIV infected, but the entire affected family, increasing risk of diarrheal disease and lost productivity. Therefore, PLHAs and households affected by HIV and AIDS have a substantially greater need for WaSH services: more water; safe water; access to water and sanitation; proper hygiene. Evidence indicates that HIV affected households require more than the 20 liters of water per capita daily (WSP 2007) including 1.5 liters of safe water for drinking with medicines. Indeed, women in southern Africa required 24 buckets of water a day to wash PLHA as well as the clothing and bedding and the house, especially during bouts of extreme diarrhea (Kamminga 2006).

A study from South Africa (Mvula Trust 2007) surveyed home-based caregivers who estimated a need for 200 liters of water daily—a figure that included water necessary for income-generating activities and food production.

PLHA experience periods of illness and relative weakness (Voss 2007) requiring close access to water and sanitation facilities. Studies have shown that those traveling great distances to collect water will reduce intake of water and use less safe water sources and those without easy access to latrines will often resort to open defecation methods (WSP 2007). Increased access to water also assists PLHA and their families to maintain kitchen gardens or engage in income generating activities that will help ensure food security, improved nutrition, and provide additional income for the household.

In addition, the immuno-compromised status of PLHAs renders them more susceptible to opportunistic infections including those related to water, sanitation and hygiene—diarrhea and skin diseases.

In advanced stages of AIDS, PLHAs often have mouth sores which make eating difficult. Documented evidence has shown that softening food with water helps PLHA ingest the food needed to maintain good nutrition (Kamminga 2006, WELL Briefing Note 5). Further, when infants are weaned from HIV positive mothers, a safe water source must be used to mix formula or the babies will be at greater risk for dying from diarrheal diseases. In the first two months, a child who receives replacement feeding is six times more likely to die than a breastfed child (UNICEF 2002).

Fourth, people on antiretroviral treatment (ART) require greater amounts of water for drinking (at least 1.5 liters per day). A great irony exists in giving advanced, costly life-saving ART to patients with a glass of water that could infect them with a life-threatening illness. It is important to maximize the effectiveness of these medicines by using safe water for ingesting them, since a side effect of many ARV drugs is diarrhea. Further, diarrheal illness in PLHA can interfere with and compromise the absorption of these ARV drugs and can even contribute to developing HIV strains that are resistant to antiviral agents (Bushen 2004). Thus safe drinking water becomes that much more compulsory as ART becomes more pervasive in the developing world.

Analysis of Existing Research

Water Quality

Water quality, especially the absence of harmful bacterial, viruses, and parasites, is known to be very important in preventing infection in people with full immune systems. A meta-analysis on interventions to improve microbial quality of water showed that improved water quality is generally effective in preventing diarrhea (Clasen 2007). In extrapolating these findings to PLHA in low resources settings, the concern arises that the environment may be so contaminated that improved water will quickly become contaminated or that the pathogens will infect PLHA through other routes such as the oral-fecal route. It is possible to postulate that no amount of water treatment will have a measurable affect of the health of PLHA. Nevertheless, evidence points towards improving water quality for better outcomes for PLWHA and for their affected families.

Two studies were found on water quality and PLHA in developing countries. The most powerful of these two is a random case control by Lule et al of 392 HIV+ households (including 509 PLHA and their 1,521 HIV- family members) randomized to use home chlorination, safe storage of household water and basic hygiene education versus basic hygiene education alone (Lule 2005). Those PLHA in the intervention arm reported 25 percent fewer diarrhea episodes (a discrete case of diarrhea having a specific beginning and end and usually lasting from several days to several weeks) and 33 percent fewer days with diarrhea. The health benefits were extended to household members. This is important because compared to many targeted HIV and AIDS interventions which benefit only the target patient, WaSH services in general have the potential to improve the quality of life for the whole family and therefore increase their potential cost-effectiveness.

The Lule study found that the reduction in diarrhea for PLHA did not extend to those who consumed water outside the house. This group consisted mainly of people who worked outside the

home and undoubtedly drank from contaminated sources outside the house. Since income is critical to PLHA, lack of clean water should not be a barrier to employment. This evidence suggests the need to educate PLHA on carrying adequate supplies of clean water with them, or if possible, treating and storing clean water at their worksite.

Another interesting finding of the Lule study was that most HIV+ households (60%) did not treat their water before the study and the most common form of treatment was boiling, a practice which is expensive (fuel), time-consuming (boiling and cooling), and often improperly practiced (not boiling for adequate length of time) and which is difficult to use to treat large volumes of water. Other studies (Kangamba 2006, Lockwood 2006, WSP 2007) have yielded similar results, but the WSP study in India found that PLHAs adopted safer water and hygiene practices than the general population but that water treatment was considered costly and time consuming.

A study of home-based care of end-stage PLHA in Ngamiland, Botswana (two stage stratified random sample survey) (Ngwengya 2006) revealed that caregivers who experienced periodic water shortages due to equipment failure or temporary spikes in water costs, reported using lower quality sources of water such as open wells and surface water such as rivers and lakes. The study was not designed to measure adverse effects of this drop in water quality but reinforces anecdotal evidence that as the financial or time cost of water rises, PLHA must compromise on water quality and quantity. In the setting of decreased household finances and increased time required for chores such as water carrying, these data support the need for HIV/AIDS programs to assist PLHA to weigh carefully the value of safe water against other critical needs such as quality of housing, quality and quantity of food, access to medications, etc. Also if the quality of the available water source declines, the need increases for PLHA to use home-based water treatment and safe water handling.

Four studies were found on water quality for PLHA in the developed world. For HIV+ people living in San Francisco, drinking tap water (as opposed to bottled water or treated tap water) was a risk for having cryptosporidiosis (OR 6.76 inside the home, OR 3.16 outside the home) (Aragon). Tap water in developed countries was also found to be a source of atypical mycobacterial infections such as *M. genavense* (Hillebrand-Haverkort 1999) and *M. avium* (Aronson 1999). The Aronson study found that water in hospitals was more likely to be contaminated (100 percent) than water in private homes (82 percent). This finding reinforces the need for proper cleaning of water taps and proper water handling, especially in hospital settings where the risk of nosocomial infection is great. The Aronson and Hillebrand-Haverkort studies are not included in the table of research because they did not measure outcomes for PLHA.

Sorvillo (1994) studied a natural experiment on the effects of municipal water filtering on cryptosporidium infection in PLHA. Until 1986, Los Angeles had two municipal water suppliers, one that used filters that would remove cryptosporidium spores and one that did not. HIV+ people living in sections of the city provided with filtered tap water were 32 percent less likely to have cryptosporidiosis than those living in sections of the city provided with unfiltered tap water (4.2% compared to 6.2%).

Current water access and collection practice virtually guarantees high contamination by the time water reaches the home. Rural and municipal water systems are notoriously under-maintained and too often contaminated at the source. This is further compounded by the perception that piped water is “safe” so few measures are taken to treat or protect drinking water.

Although studies in developed countries do add to the overall knowledge pool and evidence for improving water quality for PLHA, clearly more studies are needed on the effectiveness of different water purification technologies on the reduction of diarrheal disease in PLHA in low resource settings.

Water Quantity

Water quantity is also a factor in caring for PLHA, especially in late stage AIDS. The WSP Field Note on WaSH and HIV in South Asia (June 2007) indicates that home-based care requires more than the 20 liters of water per person per day that is considered basic access, but it does not identify a specific amount of water required by HIV affected households. A home-based care study in Ngamiland, Botswana (Ngwengya 2006) revealed that care givers who experienced periodic water shortages due to equipment failure or prohibitive costs reduced the frequency of bathing patients from twice daily to once daily or not at all. For end-stage, bed-ridden PLHA, caregivers reported requiring 20 to 80 additional liters of water per day, depending upon the severity of the patient's symptoms, especially diarrhea.

A study by Molose and Potter interviewed caregivers of PLHA who reported that the average water needs for home-based care was 200 liters and included water for laundry and cooking, bathing, drinking. A large portion of the water, however, was also required for income generation schemes and food production. There was anecdotal evidence that hygiene improved based on water quantity, but the improvements were not quantified. In general, the methodology is not as rigorous as the Ngwengya study. For example, the cases were not chosen at random from a pool of PLHA nor were they matched with a control set and there was no adjustment for the caregivers' access to water which varied considerably from household to household. Clear definitions for inclusion were also not set. The publication was not peer reviewed and is presented more as an advocacy piece or formative research piece with extensive quotes and use of the names of the interviewees. The study also occurred in the context in which some caregivers are compensated for their caregiving which would affect their access to water.

The Ngwengya Botswana study was not designed to measure adverse effects of this change in bathing patterns, however bathing and proper hygiene at end-stage has two clear benefits: preserving the dignity of the PLHA and protecting caregivers and household members from infection with HIV or more likely, other disease-causing pathogens.

Water Access (Cost, Carrying Distance, Physical Requirement at Source)

No studies were found on the effect of water access on PLHA, yet WSP has noted that lack of access has led to the use of unsafe water among PLHA. Women and girls in Africa and Asia walk on average 6km per day to collect water; collectively spending 40 billion hours every year fetching water (WSSCC 2004) The WSP (2007) also observed that on average in India, women spend 2.2 hours per day fetching water which translates into 150 million working days/year or a cost of \$208 million. Studies in Zambia (Kangamba 2006) and Malawi (Lockwood 2006) indicate that water access in rural areas is on average 400 meters away from the home, but facilities are poorly maintained. In urban areas, water is purchased but the cost can become prohibitive. WELL Briefing Note (2004) indicates that improved water supply eased domestic burdens and improved economic productivity. It is further noted that 10 percent more water used for domestic cleaning led to a 1.3 percent reduction in diarrhea incidence in households where the effect of HIV was not known.

Criteria of access that are worth investigating include the cost of water, the distance the water needs to be transported, and the degree of physical effort needed to extract the water at the source (eg: number of pounds of force needed to depress a pump handle and the number of times the handle needs to be pumped; the number of feet that a bucket needs to be pulled up a well, etc).

Kaminga and others have also noted that PLHA's have less access to decisions being made in community-managed water systems which can further limit their access to water. The WSP study noted that PLHAs are highly marginalized in society due to stigma.

Several studies also mention the importance of water access in food security of HIV affected households (Kgalushi 2004, Kamminga 2006, WELL 2005). In addition, many income generation activities such as beer making, food production and livestock rearing require accessible water (Kangamba 2006) and these activities often ensure sufficient nutrition and the continued productive livelihoods for these households.

Sanitation

Only one study found that improved sanitation can improve the health of PLHA. The 2005 Lule study did not have sanitation as an intervention, however, researchers recorded the latrine access of all participants in the study and found that the presence of a latrine in the family compound was associated with fewer episodes of diarrhea (IRR 0.69), fewer days with diarrhea (IRR 0.63), and fewer days of work or school lost due to diarrhea (IRR 0.63).

Since many water borne pathogens that affect PLHA, such as *Mycobacterium avium*, are becoming increasingly resistant to water treatments such as chlorine, monochloramine, chlorine dioxide, and ozone (Taylor 2000), it is increasingly important to use sanitation to prevent the fecal contamination of drinking water.

Studies have revealed that in developing country settings, pathogens that affect PLHA are generally the same as those that affect people with full immune systems, although the concentrations may be different (Lule). This is significant for two reasons: 1) If diarrhea in PLHA is mainly caused by infectious agents already present in the environment and the body, then improved WaSH may not protect PLHA. 2) If the diarrhea of PLHA is more highly concentrated and therefore more infectious than that of HIV negative people, then WaSH efforts are critical to prevent further transmission of diarrhea causing pathogens in both the PLHA and other household members.

Kangamba and Lockwood (2006) found in Zambia and Malawi respectively that most home-based care clients had a latrine, but in many cases lack of water rendered these (flush) latrines unusable. Further, at least 20 percent of the latrines in both studies were poorly maintained, with fecal matter around them indicating prime transmission sites for water-borne pathogens. Barriers to improved sanitation were evident in both countries: inhospitable soils often led to latrine collapse; cultural beliefs prevented use; and cost, lack of donor interest, and fewer adult male headed households prevented new latrine construction. Further, in HIV-affected households, the available and diminishing resources have already been diverted to purchasing food, medicine and in some cases water.

Risks associated with feces and feces management

Feces itself presents little risk of HIV infection though great risk of transmitting diarrhea-causing pathogens. HIV has never been isolated in urine or feces (WEF 2000) and international guidelines all rate the risk of HIV infection from feces itself to be low to none (CDC 2007).

However, the feces of end-stage PLHA is likely to have increased amounts of blood and white blood cells carrying HIV virions and the late stage PLHA is more likely to have other infections that could affect household members.

Evaluating the risk of HIV transmission through feces is highly contextual and guidelines encourage use of general precautions (gloves) when handling feces or soiled clothing and bedsheets. Whether this recommendation is feasible in a resource-poor household environment is questionable, particularly in light of the relatively low risk of HIV transmission. Several studies indicate that HIV, a very unstable virus, loses its infectivity soon after leaving the body. HIV is also rapidly inactivated by heat or the presence of a hostile environment such as water or urine. Research also shows that the composition of feces and urine quickly diminish the infectivity of any HIV virions present (Moore 1993, WEF 2000).

One study (Moore 1993) showed that HIV infected blood introduced into dechlorinated tap water had no detectable HIV virions after 5 minutes. Other scientists have placed concentrated HIV virus in feces, wastewater and biosolids to study its survival. These studies have determined that urine and feces inactivate the virus within one hour and in wastewater the viral infectivity was gone within 48 hours (Water Environment Federation 2000) even at the high concentrations that far exceed what would normally be found in waste water.

Nonetheless, other infectious agents that cause diarrhea are easily transmitted to caregivers and other household members unless fecal matter is cleared away quickly and thoroughly with water and a cleaning agent. This is discussed further in the hygiene section, below.

Hygiene and Hand Washing

Evidence in general population studies clearly show a 30-40 percent reduction in diarrheal disease associated with hand washing or the proxy of presence of soap (HIP 2005, Curtis and Cairncross 2003, Fewtrell 2005). The few studies that consider HIV-positive status indicate a protective effect of hand washing on diarrheal disease. Three studies were found on HIV/AIDS and hygiene. In a study on the effects of hand washing with soap on diarrhea rates in PLHA in the United States, Huang and Zhou found a 58 percent reduction in diarrheal incidence from 2.92 episodes of diarrhea to 1.24 episodes (Huang 2007). In a study of male sexual partners of Kenyan women with genital symptoms, Meier et al (Meier 2006) found that men with reported lower hygiene behaviors were more likely to be HIV positive than the women's other sexual partners (OR 0.41), including adjustment for confounding factors. This study used five hygiene variables and was controlled for socioeconomic status and other potential confounders. It has also been suggested (Short 2006) that post-coital penile hygiene can reduce HIV transmission in men. This supports evidence that circumcision protects men from HIV infection, presumably because, in part, circumcision makes penile hygiene easier. It should be noted that post-coital douching in women is not recommended (CDC 2007) as it dilutes the anti-viral properties of the acidic vaginal secretions and can flush

vaginal pathogens up through the cervical os, into the uterus, and out through the fallopian tubes into the peritoneal cavity; although no specific studies were found regarding this phenomenon and HIV. This is relevant for secondary prevention of HIV infection.

The Lule study found that presence of soap in the household (an indicator for hand washing and general hygiene) was associated with fewer days of diarrhea (IRR 0.58) and fewer lost days of work or school due to diarrhea (IRR 0.56). It is important to note that some hygiene related opportunistic infections in PLHA such as TB or toxoplasmosis cause disease either by primary infection, re-infection, or recrudescence (Onadeko 1992) of the infectious agent. In this case, it is not clear whether increased hygiene can significantly affect these diseases.

In two southern states in India, knowledge of safe water, sanitation and hygiene issues were greater among HIV positive individuals than among the general public. And where possible, PLHAs had adopted safer water and hygiene practices such as purifying water with some method and washing hands with soap after defecation (WSP, 2007). Research in Zambia and Malawi found that fewer than half the houses studied had a hand washing facility and only 20 percent had water to use. A large gap was noted between hygiene knowledge and practice among those surveyed. Further, in Zambia only 38 percent surveyed had knowledge of hygiene practices and no homes surveyed had been visited by a hygiene promoter in the previous two months.

Although solid field research provides evidence that hand washing can decrease respiratory infections in people with full immune systems (Luby 2005), no similar research has been done on PLHA. Additionally, ample evidence exists that improved body hygiene (daily bathing) and regular laundering of clothing and bed linen decrease skin infections and skin parasites (scabies, lice, bed bugs, etc) in people with full immune systems and is also considered to be such a basic part of human dignity, that no other research is needed to justify their integration into HIV/AIDS programming.

Waste water related risk of HIV and water-borne disease

No direct studies document HIV transmission through waste water, but by definition, diarrhea pathogens are water borne. Questions have arisen about whether HIV can be transmitted through waste water contact. As documented above, HIV is relatively unstable and even at unusually high concentrations loses its infectivity after a few hours, an almost negligible risk exists for transmitting the HIV virus to household members through waste water, especially as the studies indicate that the virus is further inactivated by presence of water or urine. Studies have also shown (Moore 1993; Ansari 1992) that the necessary conditions for HIV transmission are absent in wastewater systems. However, pathogens causing diarrhea remain infective and can be transmitted through waste water, so guidelines should recommend that caregivers practice proper hygiene techniques to limit diarrhea transmission throughout the household.

Cost-Effectiveness

The only study on cost effectiveness of WaSH in improving PLHA health was by Shresha et al, separately analyzing the Lule study data. Using the program costs from the Lule study, the researchers calculated that it cost \$5.21 per diarrhea episode averted, \$0.62 per diarrhea-day averted, and \$1,252 per disability adjusted life year (DALY) gained. The cost per DALY was artificially high in this study for two reasons. First, the program studied rapidly diagnosed and treated diarrhea

though mortality remained high. Second, the DALY included all program costs, including those for start-up. If only the costs per household were calculated, it would be about \$5/year (Mermin 2005) and would be comparable to the cost effectiveness of the EPI program (tuberculosis, diphtheria, pertussis, tetanus, polio, measles) at \$7 per DALY (DCP2 2006). By comparison, the cost for ART therapy in Africa is calculated at \$910 per DALY (Walensky 2007).

Operations Research

No operations research studies were found of ongoing provision of WaSH services into PLHA programs. Clearly more research is needed on the best ways to integrate WaSH into programs.

Review of Existing National HIV/AIDS Guidelines

A cursory review of national home-based care HIV/AIDS guidelines of five Anglophone African countries - Kenya, Malawi, South Africa, Tanzania and Zimbabwe was taken to assess the current WaSH guidance available to HIV and AIDS programs and to those affected by or infected with HIV. Other guidelines are also critically inventoried with links for access in the annotated annexes, but are not summarized here.

Keyword searches on the words “water, sanitation, toilet, latrine, hand washing, hygiene” and different spellings of “feces and diarrhea” were conducted on each of the five national HBC guidelines reviewed. The South African guideline did not mention water, sanitation or hygiene. Each of the other national HBC guidelines specified the importance of drinking “safe water” while the Kenya guidelines specifically mentioned “boiling all untreated drinking water.” None of the national HBC guidelines provided guidance on how to treat water to make it safe, or on “feces management,” on the risk of HIV transmission via (blood and puss in) feces or the transmission of diarrhea and/or HIV via waste or wash water.

In the background document prepared for the Malawi workshop (Hillbrunner 2007) summarizes a more rigorous review the home-based care guidelines for Zimbabwe and Malawi.

Zimbabwe is a notable exception. Its *Water and Sanitation Sector HIV/AIDS Response* is the most comprehensive government policy linking these two sectors. Other countries do not have this type of unified document, nor does its national HIV/AIDS policy address water and sanitation issues. However, Malawi’s *National Community Home Based Care Policy and Guidelines* (MOH 2005) does include some key guidance for caregivers related to water and sanitation. Its recommendations include:

- That water for PLWHA shall be obtained from a protected source and safety measures taken to avoid contamination.
- That during home visits caregivers should assess general cleanliness of home surroundings, waste disposal, availability of safe water and its utilization and intervene where necessary

In addition, the 2006 National Sanitation Policy for Malawi requires that sanitation policy and planning be “HIV and AIDS aware” and includes an appendix detailing the linkages between water, sanitation, hygiene and HIV/AIDS (MIWD 2006).

Clearly, enhanced guidelines and guidance are needed regarding water, sanitation and hygiene in national home-based care guidelines.

Building a Case for WaSH Solutions

Despite considerable increase in funding and global efforts fewer than 2 million PLHA in developing countries currently have access to antiretroviral treatment. In Africa in 2006, the growth of the epidemic (2.8 million) has outstripped the global efforts to put people on treatment (UNAIDS 2007).

Recognizing the need to manage limited access to ART strategically, many programs have explored balancing the development of resistance (which happens over time) with effectiveness and cost to maximize total productive lifespan and minimize cost and resistance (Badri 2006). Alternate ways to improve PLHA health will be essential to slow the progression to AIDS for those PLHA who do not yet require ART.

Beyond identifying cost-effective strategies for clinical management, governments must consider the most cost-effective strategies to reduce diarrheal diseases that impact HIV-affected and infected people, families and communities to include in national policies and official guidance and guidelines.

Many AIDS specialists (Mermin 2006, Grant 2005, Grubb 2005) have observed that the AIDS community has not yet explored other ways to prevent opportunistic infections and improve the health, wellbeing and longevity of PLHA and their families. And the water sector has not yet fully answered the call to contribute to the fight against HIV and AIDS.

Improvements in access to water for PLHA can either be targeted through systems such as vouchers or can be extended to the general community via efforts such as placing water sources closer to population centers or installing more ergonomic water extraction devices. The ergonomic issue and the carrying distance issue are particularly important for child-headed households in which the children or the immune-compromised may not have the physical strength to use the water extraction devices or carry water long distances.

Lack of proper access to WaSH products and services contributes to what UN-Habitat refers to as “difficult environments for the proper treatment of HIV” (UN-Habitat 2007). Good evidence exists that infections such as diarrhea hasten the reduction of the CD4 count and advance progression toward AIDS. Repeated diarrheal episodes weaken the immune system and severely deplete nutritional status. Mermin et al. found that in Africa, diarrhea is four times more common in HIV-positive children and seven times more common in HIV-positive adults than in HIV-negative family members. See Table 3 for a list of the various ways diarrheal disease affects PLHA. Thus reducing diarrhea transmission should be a primary objective.

Most WaSH activities require fewer skilled workers than ART. The product inputs to WaSH services (chlorine, soap, covered buckets, sanitary platforms) are usually available in local markets through effective private sector supply systems and do not require establishing parallel government systems. The fact that these products can be purchased locally maintains availability and keeps costs low. With further study, improved water, sanitation, and hygiene may be shown to improve the health and productivity of people living with HIV and AIDS and may be more cost-effective, less stigmatizing, and easier to deliver than antiretroviral treatment.

Further, the CDC has calculated the initial cost of a basic preventive care package at \$50/person for an insecticide treated bednet and a Safe Water System and \$20/person in subsequent years to retreat

the net and supply chlorine to treat drinking water for the year. Though seemingly expensive, the cost/benefit analysis might offset the recurring costs if the entire household is positively affected and diarrhea transmission reduced in addition to improving the health of PLHA. Indeed, healthy PLHAs can be productive longer, improving the economic viability of their households. Further, those PLHA taking ART with safe water will improve the effectiveness of the drugs themselves as diarrhea can limit absorption of the medication in the body (Bushen 2004).

Cotrimoxazole prophylaxis can decrease the incidence of diarrhea and mortality in PLHA, but resistance can easily be developed (Joloba and Mermin report areas of over 70% resistance), the drug is imported, relatively expensive, stigmatizing, benefits only the person taking it, relies on sophisticated logistics system, and is generally legally available only through the formal health care system. Improved water, sanitation and hygiene efforts when compared with Cotrimoxazole are generally more affordable, produced locally, distributed through legal formal and informal sector, and benefit the entire household.

No studies have documented the relative risk to caregivers in washing PLHA and their clothing and bedding at end stage disease when diarrhea may be mixed with blood and pus secretions that may contain the HIV virus. Yet, it is well documented that though blood and pustular secretions can contain the HIV virus, hostile environments outside the body such as feces and urine and indeed water itself, render the virus undetectable in a relatively short time. Thus, while caregivers in home care settings should practice caution to prevent unintentional transmission of HIV through blood-blood exchange, relatively low risk exists of HIV transmission through wastewater. Of greater concern may be the risk of further stigmatizing HIV-affected households by emphasizing cautionary hygienic practices to prevent HIV transmission. Instead, home-based care guidelines should emphasize hygienic practices to prevent transmission of diarrheal pathogens to other members of the household. So for example, wastewater should be disposed of in a special place to prevent diarrhea-causing pathogens from contaminating the environment and transmitting diarrhea.

How Much Evidence is Enough?

Trends in forming national policy and in the global development community show movement toward attribution, data-based decision- and policy-making, results-based management, and accountability that require evidence of the effectiveness and cost-effectiveness of interventions compared to other possible interventions. Organizations such as the Cochrane Collaboration and British Medical Journal's clinical evidence database have facilitated much of this work. The question that arises is: how much evidence is enough? How many studies need to be done in how many different settings before we can justify investing large amounts of limited funding? If an intervention is shown to work in Latin America, do we need to test it in Africa before scaling it up there? If an intervention is shown to be helpful in people with full immune systems, do we need to demonstrate that it is effective with PLHA before we can integrate it into large scale HIV/AIDS programs?

Fortunately, the two fields of HIV/AIDS and water have recognized venues through which the validity and sufficiency of evidence can be debated and decided: the annual Stockholm Water Week and the biannual World Water Forum and the biannual global and Africa-specific AIDS conferences.

Some progress has already been made on designing and recommending non-ART care packages for PLHA. Prevention is particularly valuable in developing country settings because curative services are difficult to access in many low resource settings (Peterson 2004). The US State Department's Preventive Care Package summarizes evidence-based interventions for PLHA and their families in resource-poor settings that include integrating three key hygiene practices (hand washing, treatment of drinking water and safe disposal of feces) into all HIV and AIDS programs (USAID 2006).

Consensus is growing that while additional research will shed further light on impacts and cost-effectiveness of WaSH interventions on health and well-being of PLWHA, enough evidence exists to more deliberately and clearly incorporate WaSH recommendations into national and programmatic guidance.

Programmatic Implications

The literature and research findings clearly point to ideal water, sanitation and hygiene recommendations to stem the transmission of diarrheal disease throughout the HIV+ community and their households. In general, knowledge is relatively high about WaSH technology and practices necessary to remain healthy, however, the challenge is to translate these ideal recommendations into feasible actions that governments, communities, and individuals can take to prevent the spread of diarrhea especially in households affected by HIV and AIDS.

Home-based Care Programs

Water, sanitation and hygiene have been shown to prevent or reduce waterborne opportunistic infections such as diarrhea and skin rashes in PLHAs and to prevent diarrhea transmission in families affected by HIV and AIDS. Yet studies and experience suggest that knowledge of wash practices among home-based care workers and PLHAs is uneven. Guidelines for home-based care programs exist, but do not routinely cover WaSH techniques and strategies to reduce diarrhea and skin diseases. Developing and integrating specific guidance on WaSH efforts should be incorporated into all home-based care resources and training.

The following begins to outline program implications suggested by the research:

Water quantity: The research has shown that PLHA and families with more water have cleaner environments and therefore fewer routes for transmitting diarrhea causing pathogens. A long term goal would be for every household to have a water source close to home, however, in the short term, water collection and saving technologies should be developed. Country programs should consider the following:

- National guidelines should include estimates for water consumption in HIV-affected households that are greater than the “basic access” of 20 liters per person per day.
- Home-based care guidelines should include a section on the amount of water needed to keep PLHAs and the environment clean. This should include an estimate of water quantity needs as well as information on what to clean and how.
- HBC guidelines should provide specification on water collection technologies such as rain water catchment plans should be elaborated in home-based care guidelines

Water quality: Safe drinking water is always important, but never more so than for people with compromised immune systems and indeed PLHA who have begun treatment with antiretroviral medication. In some home-based care guidelines safe water may be mentioned, but caregivers need more details on how to provide safe drinking water:

- Include detailed instructions on water treatment techniques including boiling, hypochlorite solution, SODIS, and instructions on proper storage and handling to reduce contaminants
- Include hypochlorite solution (chlorine), water storage container and information on other options as part of all ART distribution to ensure medicines are taken with clean water
- Include covered water vessels with spigots as possible in basic care package taking care to use the most typical vessels available to avoid stigmatization

Water access: Water access can impact HIV-affected households in several areas including consistent use of safe water sources, fewer resources spent in obtaining safe water, more time to engage in domestic chores and caring for PLHA, and greater economic productivity. Home-based care guidelines should:

- Identify water saving techniques and describe how to install them. For example, instructions on rain water catchment systems and installing a “tippy-tap” should be included in all home-based care guidelines in resource-poor areas.

Sanitation access: Although latrines are sometimes available, in most cases, they are not being used or properly maintained. Yet proper sanitation is a key factor in controlling water-borne pathogens and maintaining safe drinking water and a clean environment. Further, alternatives are needed when PLHA cannot easily use latrines. Home-based care guidelines should:

- Identify and promote sanitary options for defecation, including drawing from the disability literature to allow for people with mobility challenges to use latrines more easily
- Ensure that toilets or latrines can accommodate more than one person to assist unstable users
- Recommend/provide alternative technologies such as installing poles or strengthening venting poles to serve as support, providing seats/stools and other devices
- Identify and promote appropriate options for feces management when mobility is limited, such as potties, home-crafted potties and squat pots
- Provide detailed instructions on keeping the person, house, and surrounding environment clean

Hygiene and hand washing knowledge and practice: The research indicates that good hygiene practices are not consistent among caregivers and PLHAs. Barriers of knowledge, skills and supplies must often be overcome to promote proper hygiene practice. Home-based care programs should:

- Develop a comprehensive hygiene component to include in all home-based care guidelines and training, including guidance and technologies for washing in water scarce situations; proper disposal of waste water; and clear communication on risk and protective measures required for feces handling, bathing and laundering
- Make hygiene materials available for home-based care programs to distribute to caregivers and others who interact with HIV-affected households
- Include hygiene in all nutrition guidelines for HBC programs
- Include hypochlorite solution and soap in all HBC kits

Water, Sanitation and Hygiene Sectors

HIV and AIDS have and will continue to affect the WaSH sector through loss of skilled labor, shifting demand and reduced resources. These sectors have severely lagged in planning strategically to address the potentially devastating effects on the sector. Integrating HIV and AIDS into the WaSH sector at all levels (national, sub-regional, community) is critical to mitigate serious consequences.

The **Water Sector** should take the following actions:

- Mainstream HIV into water and sanitation planning and forecasting
 - Develop and implement workplace HIV policies
 - Have water policies and planning committees reflect the realities of HIV and AIDS
 - Target areas of HIV prevalence when constructing new water posts
 - Assess effects of inability to pay on water systems; develop alternative structures, such as focused subsidies

- Identify and address issues specific to HIV-infected and affected families
 - Develop and promote new water collection technologies and strategies to bring water closer to the home (rainwater catchment systems, ergonomic pump designs using local materials, etc)
 - Promote water saving technologies such as “tippy taps” for washing hands and clothing/linens
 - Integrate perspectives of PLHA and affected families into community water management and planning schemes
 - Identify cost containment and efficient water management strategies to manage community water supplies
 - Develop strategic partnerships with other sectors/stakeholders to address most vulnerable: women and children

The **Sanitation Sector** should take the following actions:

- Mainstream HIV into water and sanitation planning and forecasting
 - Develop and implement workplace HIV policies
 - Have sanitation policies and planning committees reflect the realities of HIV and AIDS
 - Recommend hand washing stations as part of a twin design for all latrine construction

- Identify and address issues specific to HIV-infected and affected families
 - Include minimum standards for latrines that allow for an assistant to accompany the PLWA to the latrine, and options for outfitting latrines with support poles, squatting stools, or seats for greater comfort
 - Develop strategic partnerships with other sectors/stakeholders to address most vulnerable: women and children

Other Entry Points

Counseling and testing programs are another entry point where WaSH efforts can be integrated into PLHA and home care settings through voluntary counseling and testing training and counseling guidelines.

WaSH efforts should also be promoted and strengthened in HIV and AIDS treatment programs with special attention focused on the need to consume safe water while taking ARV drugs. Further, prevention of mother-to-child transmission of HIV programs can also strengthen efforts to ensure that mothers who choose not to exclusively breastfeed have access to safe water and hygienic environment in which to prepare the replacement foods.

A potential synergy can be exploited by linking home-based care programs with other community support programs such as community water management and agricultural extension/micro-finance schemes.

School and orphans and vulnerable children (OVC) programs are also entry points to promote proper WaSH practices. Any guidance materials developed with the home-based care community will likely be relevant to school and OVC programs and should be shared and promoted within those groups to the greatest extent possible.

Conclusion

A vast amount of evidence exists on the effects of WaSH on populations in general and limited but encouraging research and field experiences exists on the effects of WaSH products and services on PLHA. The new program implications expounded above illustrate the vital necessity to integrate WaSH into HIV/AIDS programming. Similarly, the WaSH sector must immediately begin to consider HIV/AIDS implications in its own strategic planning and programming to adequately meet the needs and the challenges posed to the sector by HIV/AIDS.

This paper has highlighted several key intersection points between HIV/AIDS and WaSH sectors based on the literature reviewed, but undocumented and future experience will also dictate new entry points. As a first step, the new program implications should be integrated into existing implementation guidance, current guidelines and training at all levels. Further, bold initiatives should be considered to advocate for revised national policies and guidelines, and placing increased attention and resources into developing and mainstreaming new technologies and labor saving schemes for water and sanitation that will benefit not only those HIV-affected families, but entire populations.

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