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ANNOTATED BIBLIOGRAPHY OF RESEARCH AND RESOURCES LINKING WATER, SANITATION AND HYGIENE WITH HIV/AIDS HOME-BASED CARE. Prepared by USAID Hygiene Improvement Project. October 2007

Introduction

This bibliography contains citations and abstracts of 90 articles and reports that discuss linkages between water, hygiene and/or sanitation with HIV/AIDS care and treatment, or some aspect of health and well-being of people infected or affected by HIV and AIDS. In addition to the citations and abstracts, links to the full-text documents are included if available.

This bibliography is organized into 3 categories. These are:

A - [Peer-review Literature](#) – 32 published journal articles are included in this section.

B - Reports – This category includes 38 fact sheets, project reports and other documents from organizations.

C - Guidelines/Manuals – This section includes 20 guidelines and manuals on issues regarding home-based care (HBC).

A. Peer-review Literature

Ansari SA, Farrah SR, Chaudhry GR. (1992). **Presence of human immunodeficiency virus nucleic acids in wastewater and their detection by polymerase chain reaction.** *Appl Environ Microbiol. Dec;58(12):3984-90.*

The human immunodeficiency virus type 1 (HIV-1) released by infected individuals or present in human and hospital wastes can potentially cause contamination problems. The presence of HIV-1 was investigated in 16 environmental samples, including raw wastewater, sludge, final effluent, soil, and pond water, collected from different locations. A method was developed to extract total nucleic acids in intact form directly from the raw samples or from the viral concentrates of the raw samples. The isolated nucleic acids were analyzed for the presence of HIV-1 by using in vitro amplification of the target sequences by the polymerase chain reaction (PCR) method. HIV-1-specific proviral DNA and viral RNA were detected in the extracted nucleic acids obtained from three wastewater samples by this method. The specificity of the PCR-amplified products was determined by Southern blot hybridization with an HIV-1-specific oligonucleotide probe, SK19. The isolated nucleic acids from wastewater samples were also screened for the presence of poliovirus type 1, representing a commonly found enteric virus, and simian immunodeficiency virus, representing, presumably, rare viruses. While poliovirus type 1 viral RNA was found in all of the wastewater samples, none of the samples yielded a simian immunodeficiency virus-specific product. No PCR-amplified product was yielded when wastewater samples were directly used for the detection of HIV-1 and poliovirus type 1. The wastewater constituents appeared to be inhibitory to the enzymes reverse transcriptase and DNA polymerase.

Aragon TJ, Novotny S, Enanoria W, Vugia DJ, Khalakdina A, Katz MH. (2003). **Endemic cryptosporidiosis and exposure to municipal tap water in persons with acquired immunodeficiency syndrome (AIDS): a case-control study**. *BMC Public Health* 2003; 6(32):2.

BACKGROUND: In persons with acquired immunodeficiency syndrome (AIDS), *Cryptosporidium parvum* causes a prolonged, severe diarrheal illness to which there is no effective treatment, and the risk of developing cryptosporidiosis from drinking tap water in non-outbreak settings remains uncertain. To test the hypothesis that drinking tap water was associated with developing cryptosporidiosis, we conducted a matched case-control study among persons with AIDS in San Francisco.

METHODS: Among patients reported to the San Francisco AIDS Registry from May 1996 through September 1998, we compared patients who developed cryptosporidiosis to those who did not. Cases were individually matched to controls based on age, sex, race/ethnicity, CD4+ T lymphocyte count, date of CD4+ count, and date of case diagnosis. Population attributable fractions (PAFs) were calculated.

RESULTS: The study consisted of 49 cases and 99 matched controls. In the multivariable analysis with adjustments for confounders, tap water consumption inside and outside the home at the highest exposure categories was associated with the occurrence of cryptosporidiosis (inside the home: odds ratio (OR), 6.76; 95% CI 1.37-33.5, and outside the home: OR 3.16; 95% CI 1.23-8.13). The PAF was 85%; that is, the proportion of cases of cryptosporidiosis in San Francisco AIDS patients attributable to tap water consumption could have been as high as 85%.

CONCLUSIONS: Although the results from this observational study cannot be considered definitive, until there is more data, we recommend persons with AIDS, especially those with compromised immune systems, consider avoiding tap water.

Aronson T, Holtzman A, Glover N, Boian M, Froman S, Berlin OG, Hill H, Stelma G Jr. (1999). **Comparison of large restriction fragments of *Mycobacterium avium* isolates recovered from AIDS and non-AIDS patients with those of isolates from potable water**. *J Clin Microbiol* 1999; 37(4): 1008-12.

This study examined potable water in Los Angeles, California, as a possible source of infection in AIDS and non-AIDS patients. Nontuberculous mycobacteria were recovered from 12 (92%) of 13 reservoirs, 45 (82%) of 55 homes, 31 (100%) of 31 commercial buildings, and 15 (100%) of 15 hospitals. Large-restriction-fragment (LRF) pattern analyses were done with *Asel*. The LRF patterns of *Mycobacterium avium* isolates recovered from potable water in three homes, two commercial buildings, one reservoir, and eight hospitals had varying degrees of relatedness to 19 clinical isolates recovered from 17 patients. The high number of *M. avium* isolates recovered from hospital water and their close relationship with clinical isolates suggests the potential threat of nosocomial spread. This study supports the possibility that potable water is a source for the acquisition of *M. avium* infections.

Badri M, Cleary S, Maartens G, Pitt J, Bekker LG, Orrell C, Wood R. (2006). **When to initiate highly active antiretroviral therapy in sub-Saharan Africa? A South African cost-effectiveness study**. *Antivir Ther.* 11(1):63-72.

BACKGROUND: Large-scale programmes increasing access to highly active antiretroviral therapy (HAART) are being implemented in sub-Saharan Africa. However, cost-

effectiveness of initiating treatment at different CD4 count thresholds has not been explored in resource-poor settings.

METHODS: A cost-effectiveness analysis was conducted from a public health perspective using primary treatment outcomes, healthcare utilisation and cost data (Jan 2004 local prices; US dollars 1=7.6 Rands) derived from the Cape Town AIDS Cohort. A Markov state-transition model was developed to estimate life-expectancy, lifetime costs, quality-adjusted life-years (QALYs), cost per life-year and QALY gained for initiating HAART at three CD4 cell count thresholds (<200/microl, 200-350/microl and >350/microl), including the no antiretroviral therapy (No-ART) alternative. Each treatment option was compared with the next most effective undominated option.

RESULTS: Mean life-expectancy was 6.2, 18.8, 21.0 and 23.3 years; discounted (8%) QALYs were 3.1, 6.2, 6.7 and 7.4; and discounted lifetime costs were US dollars 5,250, US dollars 5,434, US dollars 5,740, US dollars 6,588 for No-ART, and therapy initiation at <200/microl, 200-350/microl and >350/microl scenarios respectively. Clinical benefits increased significantly with early therapy initiation. Initiating therapy at <200/microl had an incremental cost-effectiveness ratio (ICER) of US dollars 54 per QALY versus No-ART, 200-350/microl had an ICER of US dollars 616 versus therapy initiation at <200/microl, and >350/microl had an ICER of US dollars 1,137 versus therapy initiation at 200-350/microl. ICERs were sensitive to HAART cost.

CONCLUSIONS: HAART is reasonably cost-effective for HIV-infected patients in South Africa, and most effective if initiated when CD4 count >200/microl. Deferring treatment to <200/microl would reduce the aggregate cost of treatment, but this should be balanced against the significant clinical benefits associated with early therapy.

Bland RM, Rollins NC, Coovadia HM, Coutsooudis A, Newell ML. **Infant feeding counselling for HIV-infected and uninfected women: appropriateness of choice and practice.** *Bull World Health Organ.* 2007 Apr; 85(4):289-96.

OBJECTIVE: To examine infant feeding intentions of HIV-infected and uninfected women and the appropriateness of their choices according to their home resources; and to determine their adherence to their intentions in the first postnatal week.

METHODS: Feeding intentions of pregnant women were compared against four resources that facilitate replacement feeding: clean water, adequate fuel, access to a refrigerator and regular maternal income. First-week feeding practices were documented.

FINDINGS: The antenatal feeding intentions of 1253 HIV-infected women were: exclusive breastfeeding 73%; replacement feeding 9%; undecided 18%. Three percent had access to all four resources, of whom 23% chose replacement feeding. Of those choosing replacement feeding, 8% had access to all four resources. A clean water supply and regular maternal income were independently associated with intention to replacement feed (adjusted odds ratio (AOR) 1.94, 95% confidence interval (CI) 1.2-3.2; AOR 2.1, 95% CI: 1.2-3.5, respectively). Significantly more HIV-infected women intending to exclusively breastfeed, rather than replacement feed, adhered to their intention in week one (exclusive breastfeeding 78%; replacement feeding 42%; P<0.001). Of 1238 HIV-uninfected women, 82% intended to exclusively breastfeed; 2% to replacement feed; and 16% were undecided. Seventy-five percent who intended to exclusively breastfeed adhered to this intention postnatally, and only 11 infants (<1%) received no breast milk. The number of antenatal home visits significantly influenced adherence to feeding intention.

CONCLUSION: Most HIV-infected women did not have the resources for safe replacement feeding, instead choosing appropriately to exclusively breastfeed. Adherence to feeding intention among HIV-infected women was higher in those who chose to exclusively breastfeed than to replacement feed. With appropriate counselling and support, spillover of suboptimal feeding practices to HIV-negative women is minimal.

Bushen OY, Davenport JA, Lima AB, Piscitelli SC, Uzgiris AJ, Terezinha M, Silva J, Leite R, Kosek M, et al. **Diarrhea and Reduced Levels of Antiretroviral Drugs: Improvement with Glutamine or Alanyl-Glutamine in a Randomized Controlled Trial in Northeast Brazil.** *Clin Infect Dis.* 2004 Jun 15;38(12):1764-70.

The effects of therapy with glutamine and alanyl-glutamine on diarrhea and antiretroviral drug levels in patients with acquired immune deficiency syndrome (AIDS) were examined in a study in northeast Brazil. Patients with AIDS and with diarrhea and/or wasting were randomized into 4 groups to determine the efficacy of glutamine or high- or low-dose alanyl-glutamine given for 7 days, compared with isonitrogenous glycine given to control subjects. The dose-related efficacy of alanyl-glutamine and glutamine in treating diarrhea and in increasing antiretroviral drug levels shows that these supplements may help to improve therapy for patients with AIDS who have diarrhea and/or wasting in developing, tropical areas.

Clasen T, Schmidt WP, Rabie T, Roberts I, Cairncross S. (2007). **Interventions to improve water quality for preventing diarrhoea: systematic review and meta-analysis.** *BMJ.* 2007 Apr 14;334(7597):782.

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

Colebunders R, Francis H, Mann JM, Bila KM, Izaley L, Kimputu L, Behets F, van der Groen G, Quinn TC, Curran JW. (1987). **Persistent diarrhea, strongly associated with HIV infection in Kinshasa, Zaire.** *Am J Gastroenterol* 82: 859–864.

To determine the predictive value of persistent diarrhea for human immune deficiency virus (HIV) infection, 128 consecutive patients presenting at Mama Yemo Hospital with persistent diarrhea were tested for the presence of HIV antibodies. One hundred seven (84%) of the 128 patients with diarrhea lasting at least 1 month were found to be HIV seropositive. HIV seropositive patients with persistent diarrhea more often had a generalized papular pruritic eruption, a genital herpes simplex infection, a history of herpes zoster, and infection with cryptosporidia ($p = 0.006$) than HIV seronegative patients with persistent diarrhea. Presently, persistent diarrhea in adults in central Africa is strongly associated with HIV infection, but the pathophysiological mechanisms causing this diarrhea remain unclear.

Curtis V, Cairncross S. (2003). **Effect of washing hands with soap on diarrhoea risk in the community: a systematic review.** *Lancet Infect Dis.* 2003 May;3(5):275-81.

This study investigated the impact of washing hands with soap on the risk of diarrheal diseases in the community. The relative risk of diarrheal disease associated with not washing hands from the intervention trials was 1.88 (95% CI 1.31-2.68), implying that handwashing could reduce diarrhoea risk by 47%. When all studies, when only those

of high quality, and when only those studies specifically mentioning soap were pooled, risk reduction ranged from 42-44%. The risks of severe intestinal infections and of shigellosis were associated with reductions of 48% and 59%, respectively. In the absence of adequate mortality studies, the study extrapolates the potential number of diarrhea deaths that could be averted by handwashing at about a million (1.1 million, lower estimate 0.5 million, upper estimate 1.4 million). Results may be affected by the poor quality of many of the studies and may be inflated by publication bias. On current evidence, washing hands with soap can reduce the risk of diarrhoeal diseases by 42-47% and interventions to promote handwashing might save a million lives. More and better-designed trials are needed to measure the impact of washing hands on diarrhoea and acute respiratory infections in developing countries.

Doherty T, Chopra M, Jackson D, Goga A, Colvin M, Persson LA. (2007). **Effectiveness of the WHO/UNICEF guidelines on infant feeding for HIV-positive women: results from a prospective cohort study in South Africa.** *AIDS.* 2007 Aug 20;21(13):1791-1797.

This study of 635 HIV-positive mother-infant pairs across three sites in South Africa assessed mother to child transmission of HIV. Three criteria were found to be associated with improved infant HIV-free survival amongst women choosing to formula feed: piped water; electricity, gas or paraffin for fuel; and disclosing HIV status. The study concludes that counseling of mothers should include an assessment of individual and environmental criteria to support appropriate infant-feeding choices.

Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM Jr. (2005). **Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis.** *Lancet Infect Dis.* 2005 Jan;5(1):42-52.

46 studies were reviewed in detail. Data were extracted from these studies and pooled by meta-analysis to provide summary estimates of the effectiveness of each type of intervention. Water quality interventions (point-of-use water treatment) were found to be more effective than previously thought, and multiple interventions (consisting of combined water, sanitation, and hygiene measures) were not more effective than interventions with a single focus.

Goldie SJ, Yazdanpanah Y, Losina E, Weinstein MC, Anglaret X, Walensky RP, Hsu HE, Kimmel A, Holmes C, Kaplan JE, Freedberg KA. (2006). **Cost-effectiveness of HIV treatment in resource-poor settings--the case of Cote d'Ivoire.** *N Engl J Med.* Sep 14;355(11):1141-53.

As antiretroviral therapy is increasingly used in settings with limited resources, key questions about the timing of treatment and use of diagnostic tests to guide clinical decisions must be addressed. This study assessed the cost-effectiveness of treatment strategies for a cohort of adults in Côte d'Ivoire who were infected with HIV. Undiscounted gains in life expectancy ranged from 10.7 months with antiretroviral therapy and prophylaxis initiated on the basis of clinical criteria to 45.9 months with antiretroviral therapy and prophylaxis initiated on the basis of CD4 testing and clinical criteria, as compared with trimethoprim-sulfamethoxazole prophylaxis alone. A strategy of trimethoprim-sulfamethoxazole prophylaxis and antiretroviral therapy, with the use of clinical criteria alone or in combination with CD4 testing to guide the timing of treatment, is an economically attractive health investment in settings with limited resources.

Grant AD, Djomand G, De Cock KM. (1997). **Natural history and spectrum of disease in adults with HIV/AIDS in Africa.** *AIDS 11(Suppl B): S43–S54.*

Survival after an AIDS diagnosis appears to be substantially shorter in African countries and this may be partly because of later diagnosis of AIDS in Africa, but may also be because of environmental factors such as increased exposure to pathogens of high virulence and lack of access to care. Tuberculosis and bacterial infections are the most important causes of morbidity and mortality among hospitalized patients. Bacteraemia is frequent, particularly due to non-typhoid salmonellae and *S. pneumoniae*. Cryptosporidia and *I. belli* are the most frequently isolated pathogens in patients with diarrhoea; non-typhoid salmonellae and *Shigella* species are also commonly isolated when stool cultures are performed. Cerebral toxoplasmosis, and meningitis due to *Cryptococcus*, tuberculosis and bacterial pathogens are the most frequent neurological infections and cognitive changes are frequently identified when specifically looked for. Individuals infected with HIV-2 progress to AIDS and to death more slowly than those infected with HIV-1, but seem to experience the same spectrum of opportunistic disease when they reach the stage of advanced disease. Tuberculosis is the single most important HIV-related opportunistic infection in African countries, but diagnosis remains difficult. More information is needed about gynaecological disease in HIV-infected women. The most important research questions concern the development and evaluation of cost-effective regimes for prophylaxis and treatment of opportunistic disease in order to prolong healthy life in HIV-infected individuals.

Hillebrand-Haverkort ME, Kolk AH, Kox LF, Ten Velden JJ, Ten Veen JH. (1999).

Generalized mycobacterium genavense infection in HIV-infected patients: detection of the mycobacterium in hospital tap water. *Scand J Infect Dis 31(1):63-8.*

Three HIV-infected patients were examined with *M. genavense* infection. The use of corticosteroids possibly favored colonization and dissemination of atypical mycobacteria in these patients with low CD4 cell counts and may have masked symptoms of infection. The fact that these patients were treated with highly active antiretroviral therapy (HAART) together with antimycobacterial therapy may explain that 1 patient was free from mycobacteria 16 months after the end of specific treatment. Hospital tap water contained *M. genavense* at a concentration of >10 bacteria/l as examined by PCR. This species caused 12% of cases of non-tuberculous disseminated mycobacteriosis in HIV-infected patients at the hospital.

van der Hoek L, Boom R, Goudsmit J, Snijders F, Sol CJ. (1995). **Isolation of human immunodeficiency virus type 1 (HIV-1) RNA from feces by a simple method and difference between HIV-1 subpopulations in feces and serum.** *Clin Microbiol. 1995 Mar; 33(3):581-8.*

This article describes a simple method to isolate and subsequently detect human immunodeficiency virus type 1 (HIV-1) RNA from feces. The method was applied on fecal specimens from 18 HIV-1-infected individuals, among which were samples that had been stored for 9 years. It appeared that HIV-1 RNA was detectable in the feces of 12 persons (67%). Viral RNA was present in the feces of persons who fulfilled the criteria for CDC class II and CDC class III HIV infection as well as in patients who were diagnosed with AIDS (CDC class IV). HIV-1 RNA is frequently present in the feces of HIV-1-infected individuals, and in some cases the HIV-1 subpopulation in feces differs from the HIV-1 subpopulation in serum.

Huang, DB, Zhou J. (2007). **Effect of intensive handwashing in the prevention of diarrhoeal illness among patients with AIDS: a randomized controlled study.** *J Med Microbiol* 56(5)659-63.

In this study, 260 patients were screened for those who had not had diarrhea in the preceding 3 months and who had received a stable highly active antiretroviral therapy regimen for at least 6 weeks prior to the study. Seventy-five patients were randomly assigned to an intensive handwashing intervention (i.e. handwashing after defecation, after cleaning infants who had defecated, before preparing food, before eating, and before and after sex) and 73 patients were randomly assigned to the control group. Patients in both groups were called weekly by telephone to determine compliance with handwashing and to determine the number of diarrheal episodes for the preceding week. Patients were observed for 1 year. Patients assigned to the intensive handwashing intervention group washed their hands more frequently compared with the control group (seven vs four times a day, respectively) and developed fewer episodes of diarrheal illness during the 1 year observation. The most common pathogens identified in both groups in patients who developed diarrhoeal illness were *Giardia lamblia*, *Cryptosporidium*, *Entamoeba histolytica* and *Shigella flexneri*. These data suggest that intensive handwashing reduces diarrheal illness in patients with AIDS.

Joloba M et al. (2000). **Determination of drug susceptibility and DNA fingerprint patterns of clinical isolates of Mycobacterium tuberculosis from Kampala, Uganda.** *East Afr Med J*, 77(2): 111-5.

This study investigated the rate of initial drug resistance and transmission patterns of *Mycobacterium tuberculosis* in Kampala, Uganda. There were no significant differences in resistance rates between patients with and without HIV infection. It shows that in Uganda initial drug resistance rates to anti-tuberculosis agents are low and similar to other sub-Saharan African countries and that multiple strains of *M. tuberculosis* have been transmitted within the community.

Kaplan JE, Hu DJ, Holmes KK, Jaffe HW, Masur H, De Cock KM. (1996). **Preventing opportunistic infections in human immunodeficiency virus-infected persons: implications for the developing world.** *Am J Trop Med Hyg* 55: 1-11.

More than 18 million people worldwide are estimated to have been infected with human immunodeficiency virus (HIV), the cause of the acquired immunodeficiency syndrome (AIDS). As immunodeficiency progresses, these persons become susceptible to a wide variety of opportunistic infections (OIs) Tuberculosis is the most common serious OI in sub-Saharan Africa and is also more common in Latin America and in Asia than in the United States. Bacterial and parasitic infections are prevalent in Africa; protozoal infections such as toxoplasmosis, cryptosporidiosis, and isosporiasis are also common in Latin America. Fungal infections, including cryptococcosis and *Penicillium marneffei* infection, appear to be prevalent in Southeast Asia. Research is needed to determine the spectrum of OIs and the efficacy of various prevention measures in resource-poor nations, and health officials need to determine a minimum standard of care for HIV-infected persons.

Lule J et al. (2005). **Effect of home-based water chlorination and safe storage on diarrhea among persons with human immunodeficiency virus in Uganda.** *Am J Trop Med Hyg.* Nov; 73(5):926-33.

This trial examined the effect of a home-based, safe water intervention on the incidence and severity of diarrhea among persons with HIV living in rural Uganda. Between April 2001 and November 2002, households of 509 persons with HIV and 1,521 HIV-negative household members received a closed-mouth plastic container, a dilute chlorine solution, and hygiene education (safe water system [SWS]) or simply hygiene education alone. Persons with HIV using SWS had 25% fewer diarrhea episodes, 33% fewer days with diarrhea, and less visible blood or mucus in stools. The SWS was equally effective with or without cotrimoxazole prophylaxis and together they reduced diarrhea episodes by 67%, days with diarrhea by 54% and days of work or school lost due to diarrhea by 47%. A home-based safe water system reduced diarrhea frequency and severity among persons with HIV living in Africa and large scale implementation should be considered.

Mata L. **Diarrhoea and AIDS.** (1988). *Dialogue Diarrhoea* (35):3.

Patients with acquired immunodeficiency syndrome (AIDS) are particularly susceptible to gut colonization or invasion by common enteroviruses, resulting in both acute and chronic diarrhea and in wasting. Bacterial overgrowth may also develop in the small intestine people living with AIDS (PLHA), causing chronic diarrhea and malabsorption. The fecal flora of PLHA and those of immunocompetent children living in deprived rural environments show many similarities in terms of pathogenic and opportunistic agents. Since gut pathogens are significantly more prevalent in developing countries, they are likely to affect AIDS more than in developed countries. Thus, efforts to improve personal hygiene and environmental sanitation should be given a high priority in less developed countries.

Meier A, Bukusi E, Cohen C, Holmes K. (2006). **Independent association of hygiene, socioeconomic status, and circumcision with reduced risk of HIV infection among Kenyan men.** *JAIDS* 43(1)117-118.

Among 150 Kenyan men recruited as sex partners of women with genital symptoms, 22 were HIV seropositive. Because male HIV infection and male hygiene were unexpectedly found to be associated with each other, this study examined the relationship of 5 hygiene variables with HIV infection in the men. By multivariate analyses, HIV infection in men was not only independently associated with previous illness and inversely associated with being circumcised, but also independently associated with a combined measure of hygiene.

Mermin J, Bunnell R, Lule J, Opio A, Gibbons A, Dybul M, Kaplan J. (2005). **Developing an evidence-based, preventive care package for persons with HIV in Africa.** *Trop Med Int Health* 10(10)961-970.

Currently, 95% of the 40 million persons with HIV live in low and middle income countries; 27 million in sub-Saharan Africa. HIV/AIDS is a leading cause of death in Africa, yet access to care and treatment considered standard-of-care in the industrialized world is extremely limited. Standardized, evidence-based recommendations on preventive measures are needed. This article lists potential interventions based, when possible, on documented efficacy in reducing morbidity or mortality among persons with HIV in Africa. Potential components included cotrimoxazole prophylaxis, safe drinking water, isoniazid prophylaxis, insecticide-treated bed nets, micronutrients, and provision of HIV counseling

and testing and condoms to family members of persons with HIV. Several additional interventions (acyclovir prophylaxis, food supplementation, hand washing, and fluconazole prophylaxis) require further evaluation before being included in a standard package of care.

Moore BE. (1993). **Survival of human immunodeficiency virus (HIV), HIV-infected lymphocytes, and poliovirus in water.** *Appl Environ Microbiol.* 1993 May;59(5):1437-43.

The potential for human immunodeficiency virus (HIV) to enter domestic sewers via contaminated body fluids such as blood has spurred interest in the survival of this virus in water and wastewater. This study focused on establishing the inactivation of HIV and productively infected lymphocytes in dechlorinated tap water. In addition, HIV survival was compared with that of poliovirus. Results indicated that either free HIV or cell-associated HIV was rapidly inactivated. In comparison, poliovirus showed no loss of infectivity over 24 h. In addition, blood from stage IV AIDS patients was introduced into tap water, and the recovery of HIV was monitored. Virally infected cells were no longer detectable after 5 min in dechlorinated tap water.

Onadeko MO, Joynson DH, Payne RA. (1992). **The prevalence of Toxoplasma infection among pregnant women in Ibadan, Nigeria.** *J Trop Med Hyg* 95(2):143-5.

The seroprevalence of toxoplasmosis in pregnant women from the inner area of Ibadan was determined by the dye test. Two hundred and seventy-three of the 352 women (78%) had dye test titres of 1/16 or greater with 165 (47%) having titres of 1/128 or greater. Social and environmental conditions indicate that the source of infection is contact with cat faeces.

Potgieter, N., Koekemoer, R. and P. Jagals. (2007). **A pilot assessment of water, sanitation, hygiene and home-based care services for people living with HIV/AIDS in rural and peri-urban communities in South Africa.** *Water Science & Technology Vol 56 No 5 pp 125–131.*

Researchers conducted a short-term assessment of water, sanitation, hygiene and home-based care services in two rural and two peri-urban communities in South Africa using specially designed questionnaires. The results indicated the shortcomings of various services to people affected and living with HIV/AIDS in South Africa. This paper summarized the assessment and outlines the inadequacies of some of these services.

Shrestha RK, et al. (2006). **Cost-effectiveness of home-based chlorination and safe water storage in reducing diarrhea among HIV-affected households in rural Uganda.** *Am J Trop Med Hyg* 2006; 74(5):884-90.

This study examined the cost-effectiveness of the Safe Water System (SWS) for HIV-affected households using health outcomes and costs from a trial in Tororo, Uganda. SWS was part of a home-based health care package that included rapid diarrhea diagnosis and treatment of 196 households with relatively good water and sanitation coverage. SWS use averted 37 diarrhea episodes and 310 diarrhea-days, representing 0.155 disability-adjusted life year (DALY) gained per 100 person-years, but did not alter mortality. Net program costs were 5.21 dollars/episode averted, 0.62 dollars/diarrhea-day averted, and 1,252 dollars/DALY gained. If mortality reduction had equaled another SWS trial in Kenya, the cost would have been 11 dollars/DALY gained. The high SWS cost per DALY

gained was probably caused by a lack of mortality benefit in a trial designed to rapidly treat diarrhea.

Short RV. (2006). **New ways of preventing HIV infection: thinking simply, simply thinking.** *PTRSLBS* 361(1469)811-820.

Five new methods are discussed to prevent HIV infection. (i) A natural microbicide; intravaginal lime or lemon juice has been used for centuries as a traditional contraceptive. The juice can also kill HIV in the laboratory, but clinical trials are needed to see if vaginal application is acceptable, safe and effective. (ii) Intravaginal oestrogen. Monkeys can be protected from Simian immunodeficiency virus (SIV) infection by keratinizing the vagina with topical oestrogen. If women take the oral contraceptive pill vaginally it retains its contraceptive efficacy, and the oestrogen it contains should thicken the vagina and protect against HIV infection. Clinical trials are needed. (iii) Male circumcision. Removal of the inner foreskin removes the main site of HIV entry into the penis, resulting in a sevenfold reduction in susceptibility to infection. The practice needs to be promoted. (iv) Post-coital penile hygiene. Wiping the penis immediately after intercourse with lime or lemon juice or vinegar should kill the virus before it has had a chance to infect. A clinical trial of efficacy is needed. (v) PhotoVoice. Asking schoolchildren in developing countries to photograph their impressions of HIV/AIDS is a powerful way of getting them to discuss the subject openly, and develop their own preventive strategies.

Sorvillo F, Lieb LE, Nahlen B, Miller J, Mascola L, Ash LR. (1994). **Municipal drinking water and cryptosporidiosis among persons with AIDS in Los Angeles County.** *Epidemiol Infect* 113(2): 313-20.

This study measured the prevalence of cryptosporidiosis among people living with AIDS (PLHA) in Los Angeles County by water service area to assess whether unfiltered drinking water could be a source of cryptosporidium infection in PLHA. One water distributor, serving approximately 60% of the county's residents (area B), has consistently employed filtration. The other company serving the remainder of the county (area A), did not institute filtration until mid-December 1986. This difference provided a 'natural experiment' in which to assess the effect of municipal water filtration on the level of cryptosporidiosis among PLHA. The data suggest that filtration had no effect on levels of cryptosporidiosis among persons with AIDS. Thus municipal drinking water does not seem to be an important risk factor for cryptosporidiosis in PLHA residing in Los Angeles County.

Taylor RH, Falkinham JO 3rd, Norton CD, LeChevallier MW. (2000). **Chlorine, chloramine, chlorine dioxide, and ozone susceptibility of Mycobacterium avium.** *Appl Environ Microbiol.* 2000 Apr; 66(4): 1702-5.

Environmental and patient isolates of *Mycobacterium avium* were resistant to chlorine, monochloramine, chlorine dioxide, and ozone. For chlorine, the product of the disinfectant concentration (in parts per million) and the time (in minutes) to 99.9% inactivation for five *M. avium* strains ranged from 51 to 204. Chlorine susceptibility of cells was the same in washed cultures containing aggregates and in reduced aggregate fractions lacking aggregates. Cells of the more slowly growing strains were more resistant to chlorine than were cells of the more rapidly growing strains. Water-grown cells were 10-fold more resistant than medium-grown cells. Disinfectant resistance may be one factor promoting the persistence of *M. avium* in drinking water.

Voss JG, Sukati NA, Seboni NM. (2007). **Symptom burden of fatigue in men and women living with HIV/AIDS in Southern Africa.** *J Assoc Nurses AIDS Care.* Jul-Aug; 18(4):22-31.

In 743 people living with AIDS (PLHA) from Southern Africa, the authors found ratings of HIV-related fatigue to be highly prevalent. The analysis focused on 538 patients who reported fatigue to investigate correlates and predictors of fatigue severity in relationship to demographic and HIV/AIDS illness indicators, as well as HIV-specific physical and psychological symptoms. Fatigue severity in Southern Africa was moderate, and the factors contributing to the perceived fatigue were most likely related to symptoms of acute HIV disease (such as fever and gastrointestinal problems). In conclusion, fatigue severity is less impacted by demographic or environmental variables but much more by co-occurring symptoms and HIV disease severity. The study results imply the need for more research to understand if improvements in water quality and access to food would prevent infection and diarrhea and whether sufficient access to antiretroviral treatments to manage the HIV infection would improve fatigue and co-occurring symptom profiles.

Walensky RP, Weinstein MC, Yazdanpanah Y, Losina E, Mercincavage LM, Toure S, Divi N, Anglaret X, Goldie SJ, Freedberg KA. (2007). **HIV drug resistance surveillance for prioritizing treatment in resource-limited settings.** *AIDS.* 21(8):973-982.

This study examined the value of resistance surveillance in influencing recommendations toward effective and cost-effective sequencing of antiretroviral (ART) regimens. A state-transition model of HIV infection was adapted to simulate clinical care in Côte d'Ivoire and evaluate the incremental cost-effectiveness of (1) no ART; (2) ART beginning with a non-nucleoside reverse transcriptase inhibitor (NNRTI)-based regimen followed by a boosted protease inhibitor (PI)-based regimen; and (3) ART beginning with a boosted PI-based regimen followed by an NNRTI-based regimen. Drug costs and treatment efficacies, but not NNRTI resistance levels, were most influential in determining optimal HIV drug sequencing in Côte d'Ivoire. Results of surveillance for NNRTI resistance should not be used as a major guide to treatment policy in resource-limited settings.