Water, sanitation, & hygiene (WASH) and HIV: current research and opportunities

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4 May 2012
Acknowledgements

CNIHR (NIH)

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Outline

• WASH
• WASH and HIV: intersections
• Overview of key published studies and evidence
• Unknowns
• Brief summary of current research in our group
WHO GBD 2008, LMICs

- Ischaemic heart disease
- Cerebrovascular disease
- Lower respiratory infections
- Chronic obstructive pulmonary disease
- Diarrhoeal diseases
- HIV/AIDS
- Tuberculosis
- Road traffic accidents
- Diabetes mellitus
- Prematurity and low birth weight
WASH importance to HIV

• Quality of LIFE
• Co-infections can lead to disease progression and early death
  – OIs related to WASH disproportionately affect PLHIV
  – Infections result from and increase a weakened immune status:
    – Stakes are higher for PLHIV: increased morbidity & mortality
      • 1.8m deaths per year (2009), HIV infects 0.6% of world pop.
Other HIV links with WASH

- **Diarrhoeal disease** and intestinal infection may cause individuals on antiretroviral therapy (ART) **not to absorb therapeutic dosages of the medication** (Isaac 2008, Brantley 2003, Bushen 2004).

- Children who are HIV+, as well as those who are HIV- but cared for by mothers that are HIV+, are at **greater risk of poor nutritional status** and health which can be caused or aggravated by enteric infection (Filteau 2009).
  
  — Malnutrition
Some common co-infections that may be prevented or reduced with WASH

• Faecal-oral
  – Hepatitis A,E; polio; viral diarrhoeas; *Campylobacter*; cholera; ETEC; *Salmonella*; *Shigella*; typhoid; paratyphoid; *Crypto*; *Giardia*; Amoebas; *Toxoplasma gondii* and other opportunists

• Water-washed
  – Trachoma; scabies; conjunctivitis; louse-borne infections

• Soil helminths and tapeworms
  – *Ascaris*; hookworm; *Taenia*

• Water-based
  – Cholera; *Legionella*; Leptospirosis; *Schisto*; Guinea worm

• Insect vectors
  – Dengue, yellow fever, malaria, trypanosomiasis, filariasis, trachoma

• Rodent borne
  – Leptospirosis; hantavirus, Tularemia
WASH control measures

• Improve water quality, water availability, hygiene
  – Hepatitis A,E; polio; viral diarrhoeas; *Campylobacter*; cholera; ETEC; *Salmonella; Shigella*; typhoid; paratyphid; *Crypto; Giardia*; Amoebas; *Toxoplasma gondii* and other opportunists

• Improve water availability and hygiene
  – Trachoma; scabies; conjunctivitis; louse-borne infections

• Sanitation, hygiene, treatment of excreta before re-use
  – *Ascaris*; hookworm; *Taenia*

• Reduce contact with contaminated water, sanitation, treatment of excreta before re-use
  – Cholera; *Legionella*; Leptospirosis; *Schisto*; Guinea worm

• Drainage, reducing breeding sites, insecticides/nets
  – Dengue, yellow fever, malaria, trypanosomiasis, filariasis, trachoma

• Rodent control, hygiene measures
  – Leptospirosis; hantavirus, tularemia
Intervention studies
CDC Safe Water System
Lule et al. 2005

- RCT of **Safe Water System (SWS)** & hygiene education among PLHIV in Uganda (n = 509 HIV+, 1,521 HIV-)
- Controls received hygiene education only
- After 5 months, all PLHIV received cotrimoxazole prophylaxis and followed for 1.5 years
- PLHIV had **25% fewer episodes of diarrhea** (and less blood/mucus in stool) with the SWS, with or without cotramoxizole
Barzilay et al. 2011

• “Before and after” trial of the SWS among HIV+ women (“about 187 women”) in Nigeria

• Diarrhea reduction of 46% from baseline among those whose drinking water contained residual free chlorine at 85% of more follow-up visits (p = 0.04) over 15 weeks
Harris et al. 2009

• Infants of HIV+ mothers experienced high rates of diarrhea at weaning in the KiBS (Kenya)
• Two cohorts of infants, one before and one after the intervention (SWS)
• No difference in diarrhea risk at early weaning (at 6 months), but lower diarrhea in the intervention cohort both before and after
• But different feeding practices between cohorts and other methodological issues
Xue et al. 2010

• High retention in PMTCT programming as a result of VitaMeal and hygiene packages (soap, PUR/sodium hypochlorite + filter cloth + storage container) offered to mothers in Lilongwe

• Also reported “99.4% usage” of water treatment at 3 month follow up visits, versus 12% (disinfectant use among mothers with young children) or 20% (all households in Malawi)

• Russo et al. 2012, Malawi: benefits of hygiene and safe water program extend beyond antenatal beneficiaries to include friends and relatives
Peletz et al. 2012 (forthcoming)
Colford et al. 2005

- Small (n = 50) triple-blinded RCT of household water treatment (UV+filter) of piped water in San Francisco among PLHIV
- aRR 3.34 (95% CI: 0.99-11.21) for sham over active intervention
Water Supply ?
Sanitation ?
Hand hygiene

• One RCT found that hand washing reduced the incidence of diarrheal episodes in PLHIV (Huang and Zhou 2007).
  – 2.92 episodes per year (control) to 1.24 episodes per year (intervention), p <0.001
WASH implicated in HIV co-infection studies

• Couple examples: MAC and Crypto
• Many studies exist, but WASH-related routes of transmission are not often characterised
  – Causality is difficult: complex aetiology and diffuse transmission through multiple pathways
MAC

- Evidence that MAC spread through hospital water to patients, including PLHIV (e.g., Hillebrand-Haverkort, M. E. et al., 1999).
  - Increased risk of “induced disseminated mycobacteremia” rather than bacteria restricted to the lungs,” in PLHIV with MAC
  - MAC is ubiquitous in soil and water and highly resistant to chlorine (Biet, F. et al., 2005)
Crypto

• Importance of *Cryptosporidium* spp. In PLHIV:
  – Severity of infection, the lack of pharmaceuticals currently available to treat infection

• Documented *Crypto* exposure among PLHIV: hospitals (Martins, C. A. P., 1995) and in home tap water supplies (e.g., Aragon, T. J. et al. 2003)

• A Cochrane review conducted on the prevention and treatment of Cryptosporidiosis in HIV/AIDS:
  – No studies on prevention and few treatments that worked effectively (Abubakar, I. et al., 2007)
In summary

- We know that many OIs are also **WASH-preventable**
- A *handful* of WASH intervention studies have presented results stratified by PLHIV
- A *handful* of WASH studies have compared rates of infection/disease and/or gut pathogen prevalence in HIV +/- people
- A *handful* of HIV co-infection studies have implicated WASH
- BUT: We have no explicit evidence that specific WASH interventions can improve the long-term health and survival of PLHIV, or necessarily prevent OIs
- **So what role can WASH play in the long-term survival and well being of PLHIV?**
  - A question with real implications
Other unknowns

• Role in HIV programming
• Impact on disease progression/mortality?
• Importance of PLWHA in persistent secondary transmission
Research opportunities

• Role in HIV programming
• Impact on disease progression/mortality?
• Importance of PLWHA in persistent secondary transmission
Links with programming

• Hygiene/water packages, especially for HIV+ mothers with children
  – What goes in them: what works, what doesn’t
  – How to implement

• Retention and follow up (e.g., PMTCT)
Separate or together?

• “Inexpensive interventions that prevent diarrhea could be important components of a care package for [PLHIV] whether or not ART is available” – Lule et al. 2005

– I don’t know if there’s anywhere where this statement would apply, since delivering adequate WASH may be as expensive as ART
Research opportunities

- Role in HIV programming?
- Impact on disease progression/mortality?
- Importance of PLWHA in persistent secondary transmission
Disease progression

- Anecdotal evidence that CD4 count over time may be associated with safe water interventions
- Other markers indicative of blood infections and weakening immune system may be related to WASH
  - Bacterial translocation: TNF, c-reactive proteins, IL6, CD163 (due to weakening of epithelium in gut)
  - “AIDS defining diseases” (Cryptococcal meningitis, cerebral toxoplasmosis, PCP)
- Markers are associated with mortality risk
- Markers associated with viral load and therefore infectivity
  - The healthier you are, the less infectious you are
Research opportunities

• Role in HIV programming?
• Impact on disease progression/mortality?
• Importance of PLWHA in persistent secondary transmission
“Micro-outbreaks” and HIV

- Environment – human (1\textdegree transmission), then human – human (2\textdegree transmission)
- Chronically ill as reservoirs for secondary transmission
- We’re seeing this in Zambia
  – Forthcoming study
- We have to be careful with this as we don’t want to contribute to \textit{stigma}
  – But this has implications for targeting interventions
Our current work on WASH and HIV
RCT of POU filtration/storage among PLHIV

- 600 households in Misisi, Zambia
- 30% prevalence of HIV
- Outcomes:
  - CD4 pre/post
  - WAZ in kids under 5
  - Self-report and clinic-reported diarrhea
  - Drinking water quality
  - Protozoans/helminths in stool
  - Salivary antibodies – samples anyway
Other current studies: EHG, LSHTM

- Assessing the integrated delivery and health impact of household water treatment among people living with HIV/AIDS
  - Clasen, Peletz, Filteau, Brown, Kelly, others

- Spatial analysis of WASH, HIV, and risk
  - Brown, Simuyandi, Kelly

- RCT of POU with mortality as outcome
  - Peletz, Clasen, et al.

- RCT of WASH interventions on Crypto
  - Brown et al (in planning)

- Systematic reviews
  - Peletz, Clasen, others; Brown et al.