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

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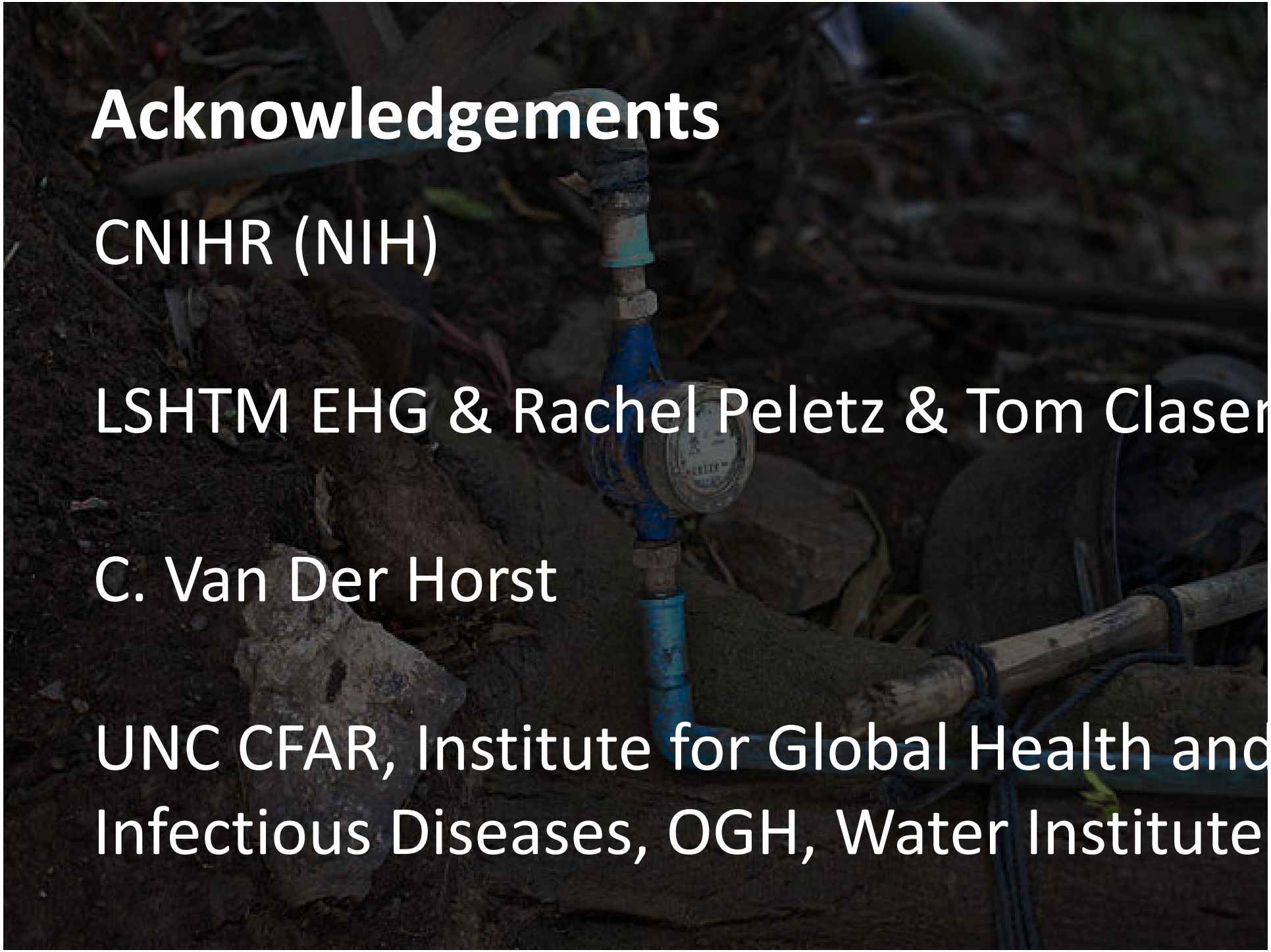

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Outline

- WASH
- WASH and HIV: **intersections**
- **Overview** of key published studies and evidence
- **Unknowns**
- Brief summary of current research in our group

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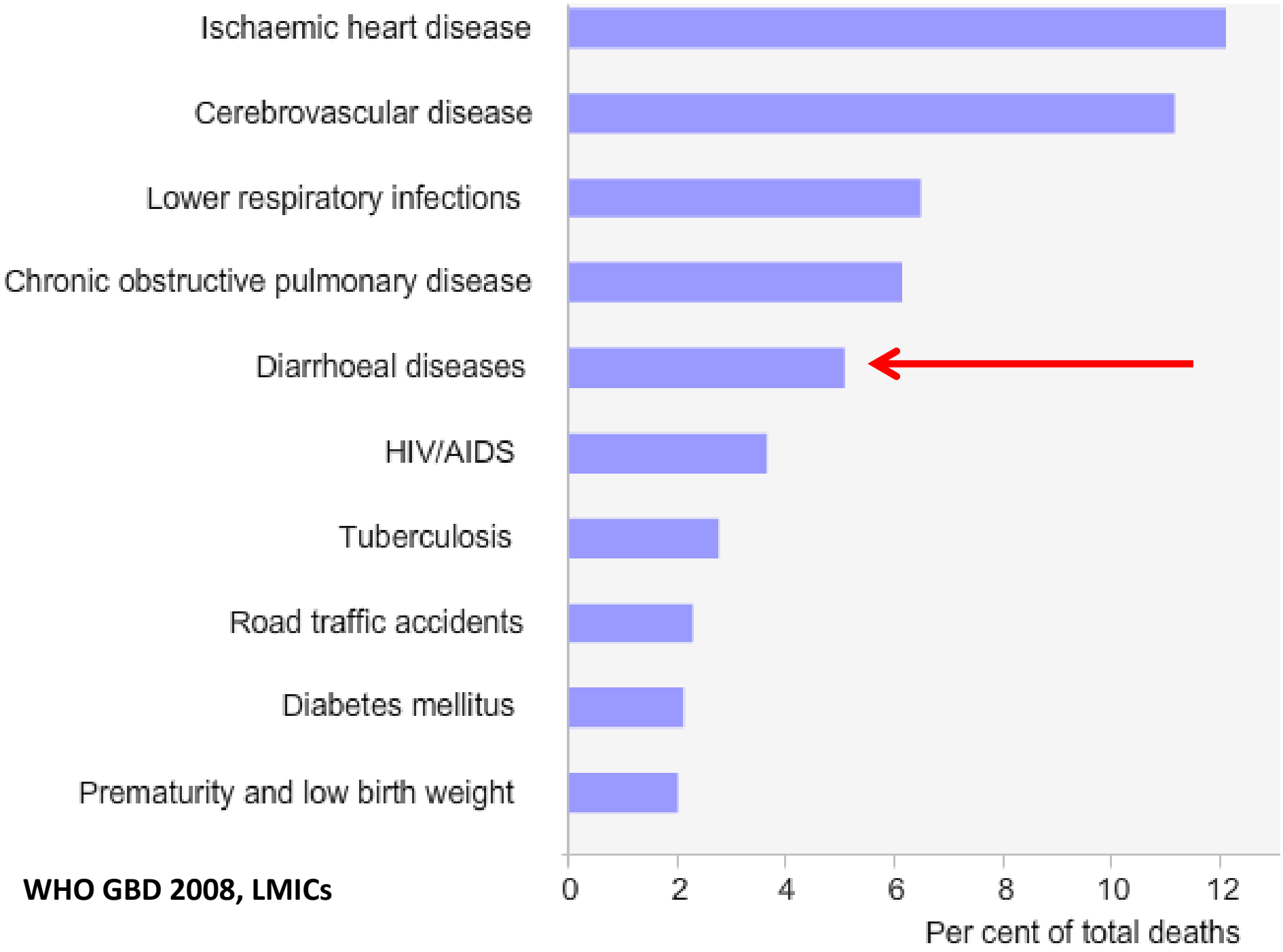
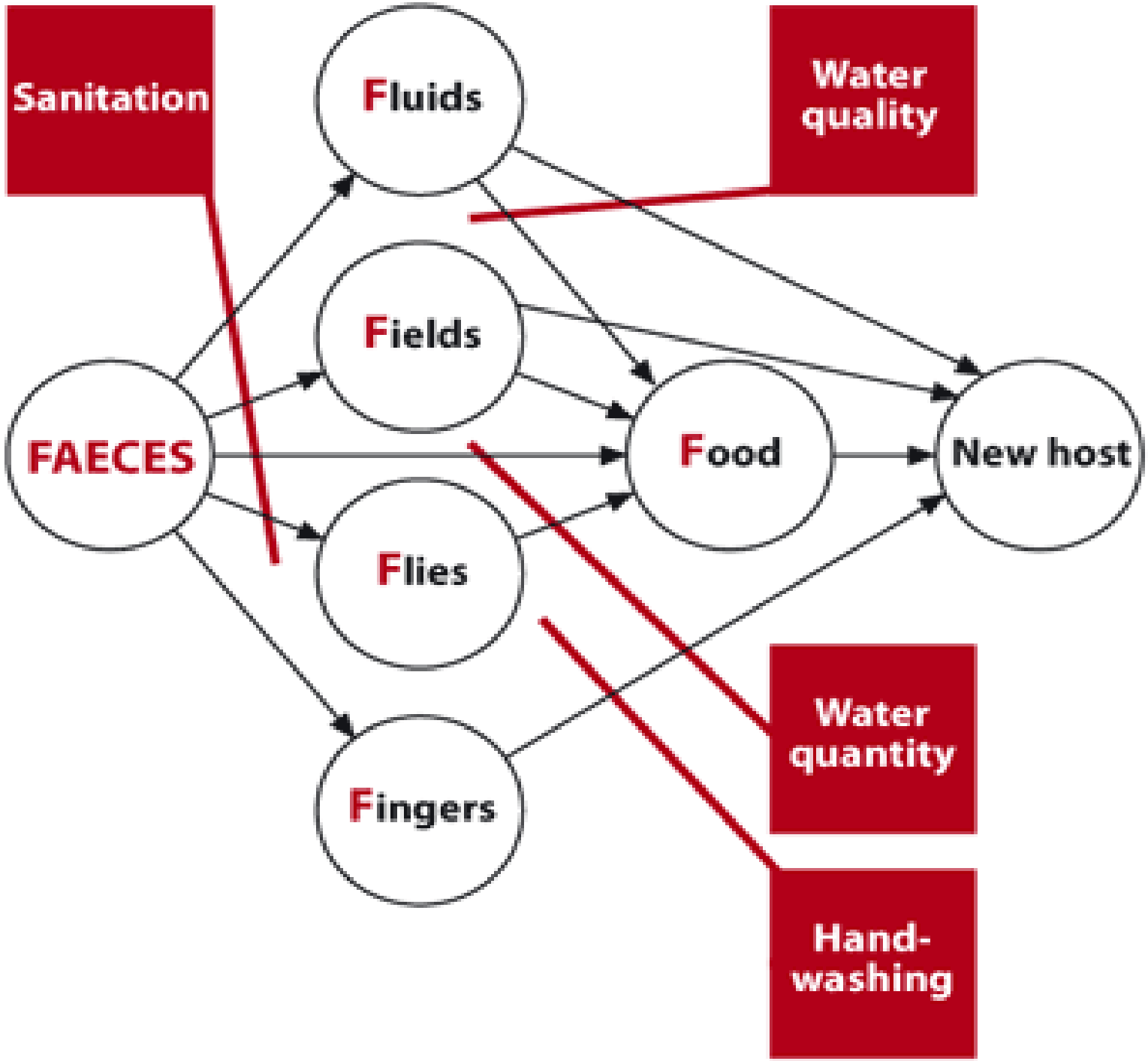


WHO GBD 2008, LMICs


Sanitation
Fluids
Water quality
Fields
FAECES
Food
New host
Flies
Fingers
Water quantity
Hand-washing

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.

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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

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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*; typoid; 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, yllw fever, malaria, trypanosomiasis, filariasis, trachoma
- **Rodent borne**
  - Leptospirosis; hantavirus, Tularemia

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WASH control measures

- **Improve water quality, water availability, hygiene**
  - Hepatitis A,E; polio; viral diarrhoeas; *Campylobacter*; cholera; ETEC; *Salmonella*; *Shigella*; typoid; 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, yllw 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

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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

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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

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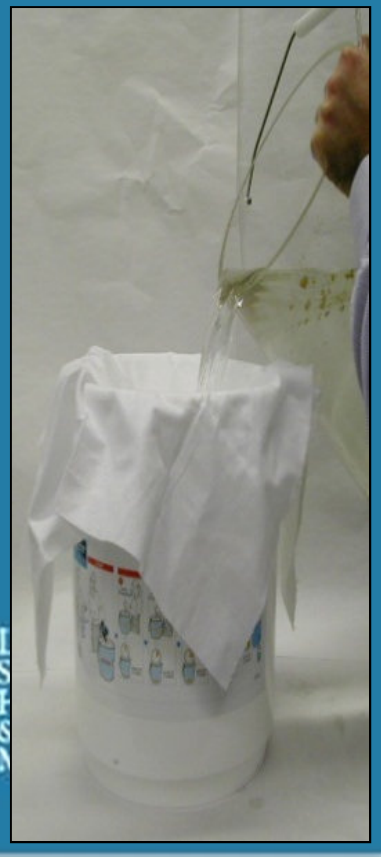
PUR
Purificador de Agua
Para 10 Litros de agua
Cont. Neto: 4g



Xue et al. 2010

- **High retention in PMTCT programming** as a result of VitaMeal and hygiene packages (soap, PUR/sodium hypochorite + 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

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Peletz et al. 2012 (forthcoming)

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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

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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), $p < 0.001$

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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

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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)

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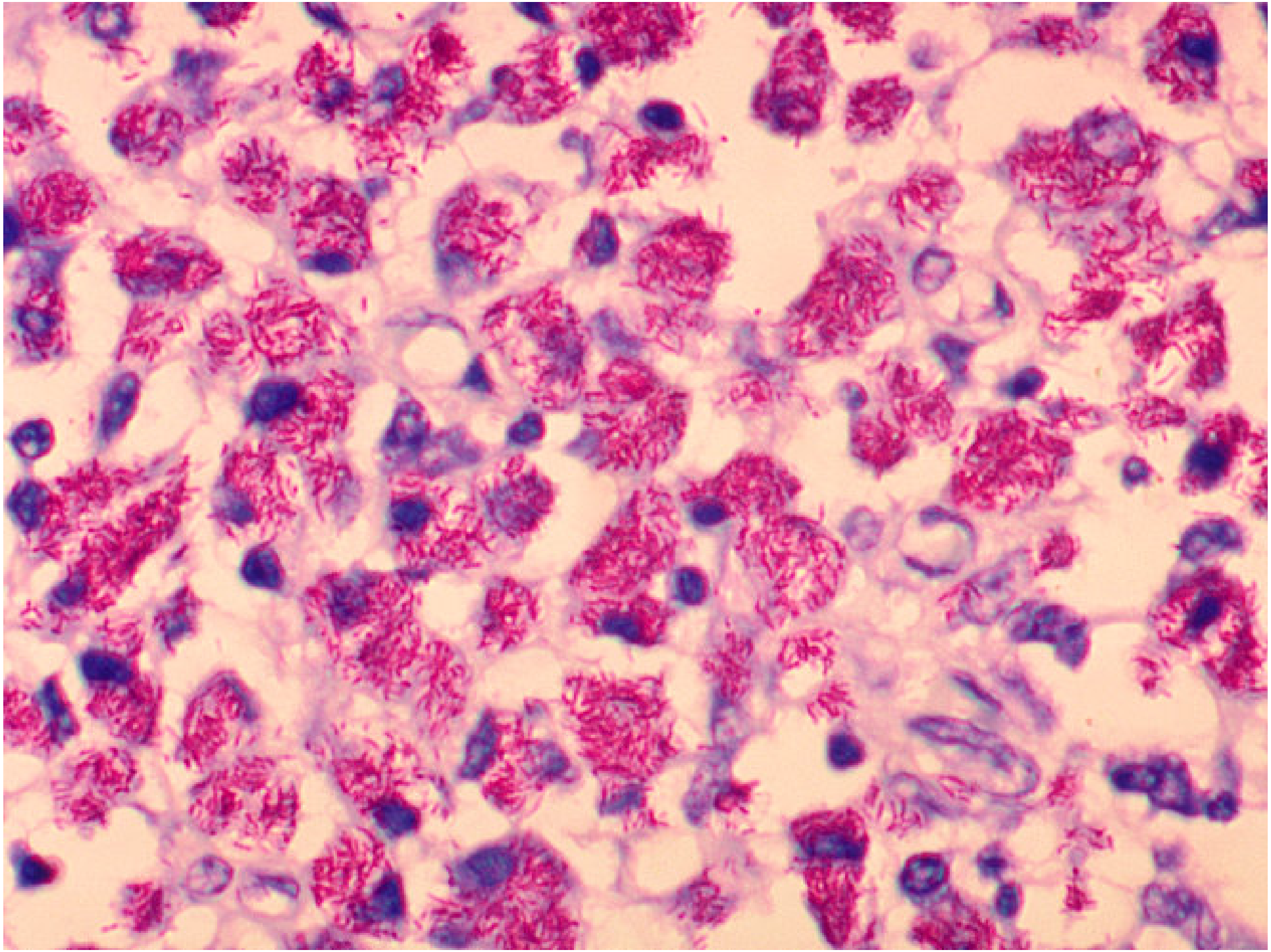

Crypto

- 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).

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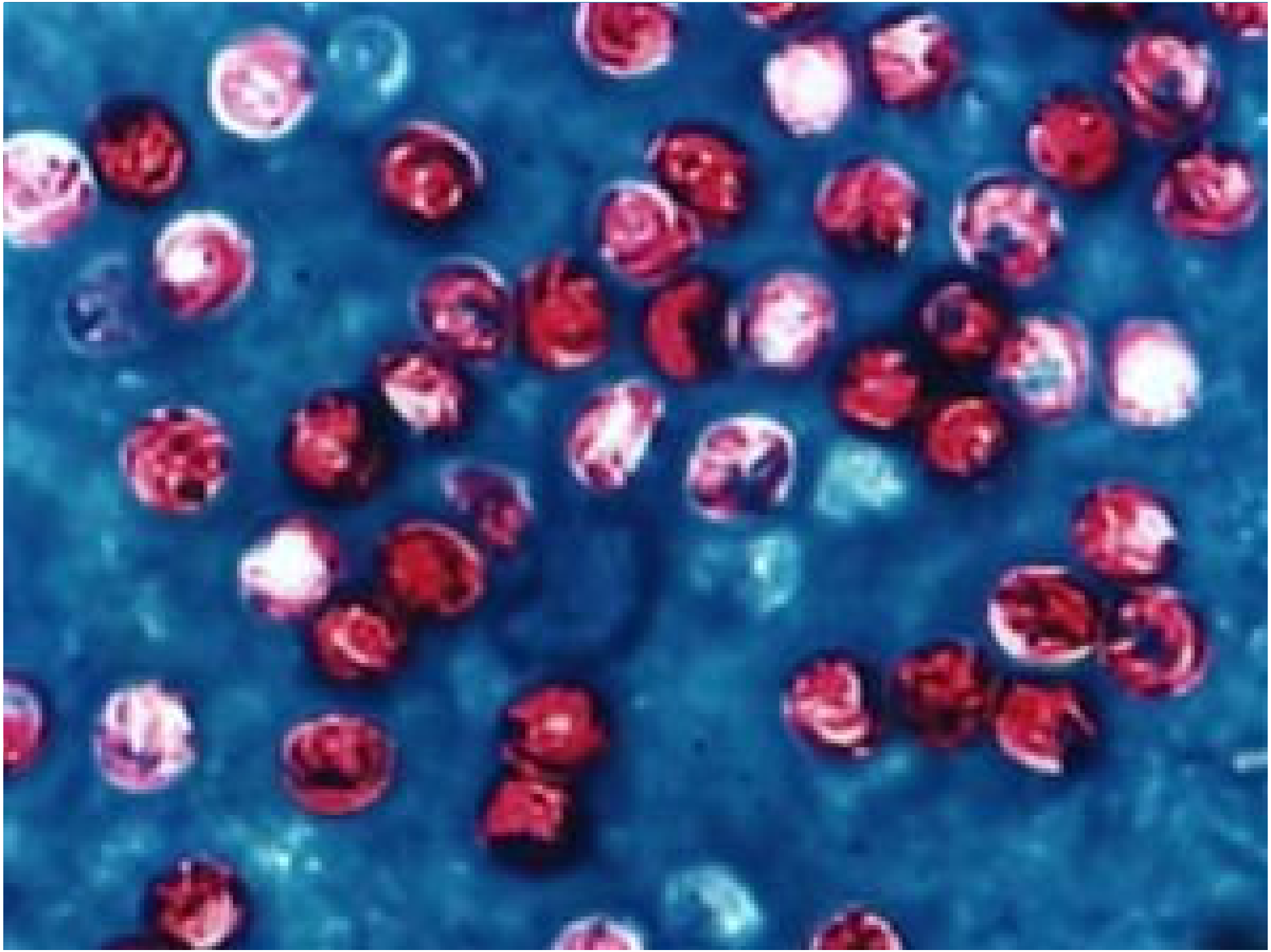

In summary

- 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

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Other unknowns

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

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Research opportunities

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

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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)

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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

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Research opportunities

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

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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

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Research opportunities

- Role in HIV programming?
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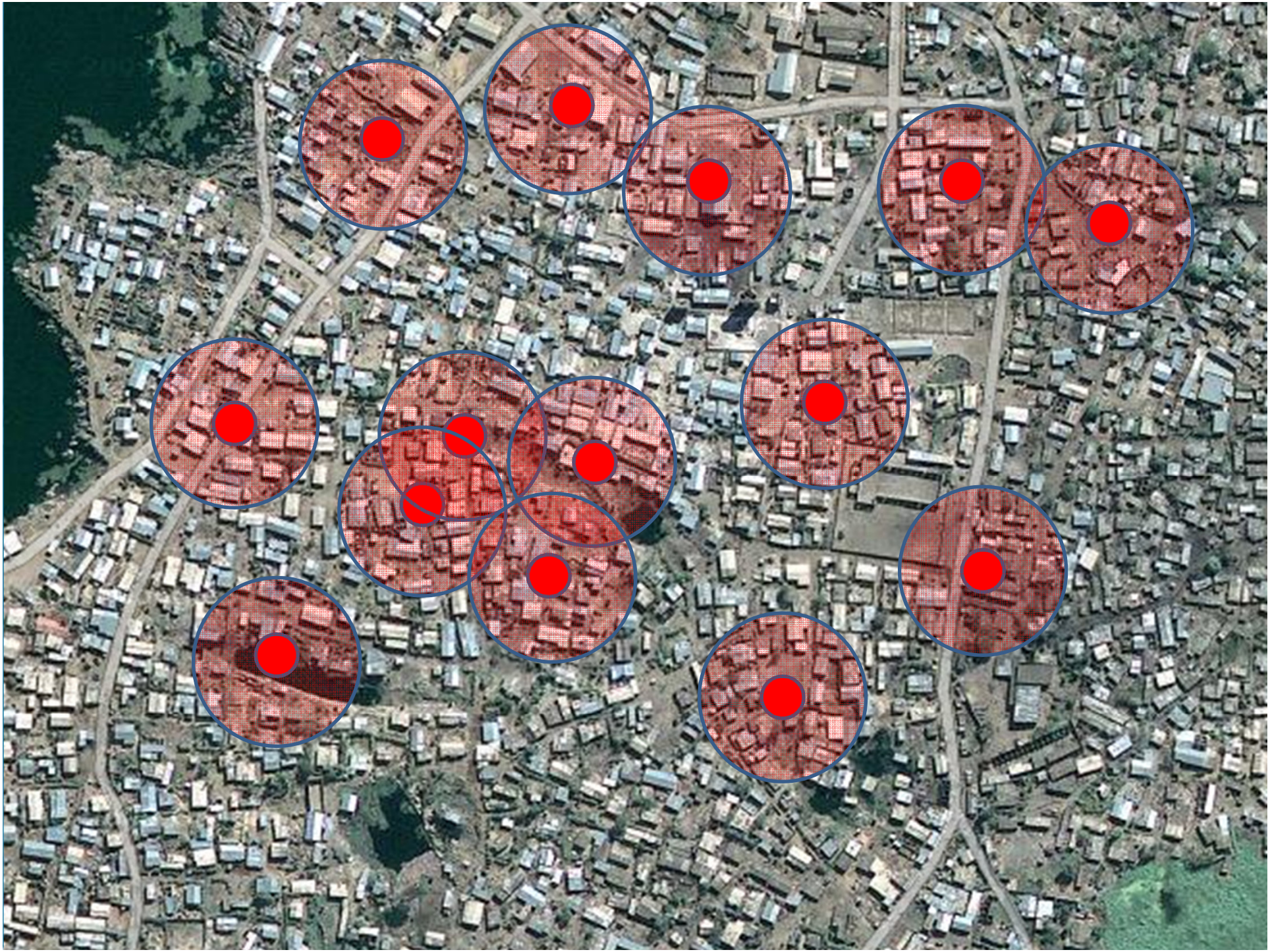
“Micro-outbreaks” and HIV

- Environment – human (1^{o} transmission), then human – human (2^{o} 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 **stigma**
  - But this has implications for targeting interventions



Our current work on WASH and HIV

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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

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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.

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