The MapSan Trial:

The effect of sanitation on enteric infection and child growth in low income informal settlements of Maputo, Mozambique

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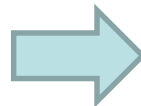London School of Hygiene and Tropical Medicine

Diarrhoeal disease in 2017

Between 2005-2015 (GBD2016):

Diarrhoeal disease mortality reduced by 32% - 1.3 million deaths
(Murray et al 2016)

Diarrhoeal disease morbidity increased by 7% - 2.5 billion cases
(Vos et al 2016)

Diarrhoeal Disease Mortality
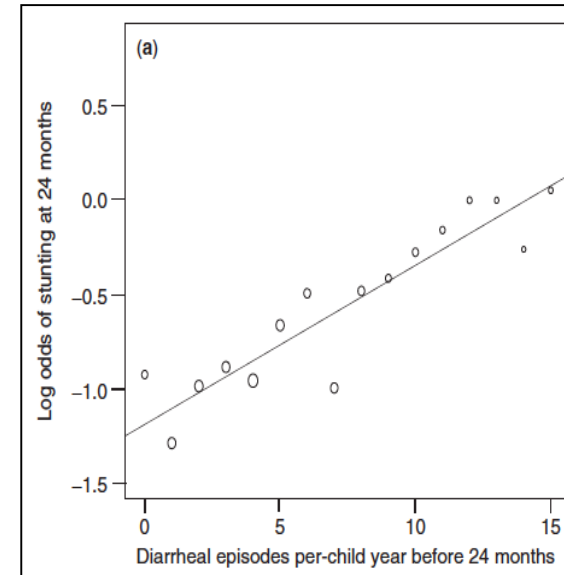
Diarrhoeal Disease Morbidity

Beyond diarrhoea –
the consequences of enteric infection

Environmental Enteric Dysfunction
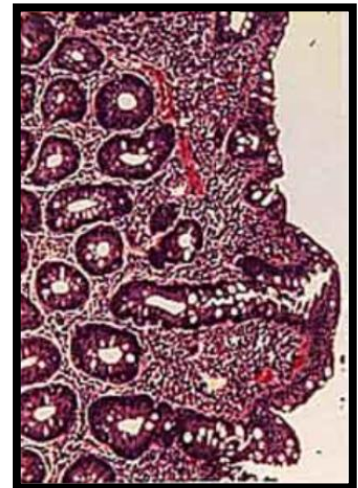(Keusch et al 2015)

Early childhood development
(Piper et al 2017)

Growth faltering
(Checkley et al 2008)

Oral vaccine performance
(Stich et al forthcoming)

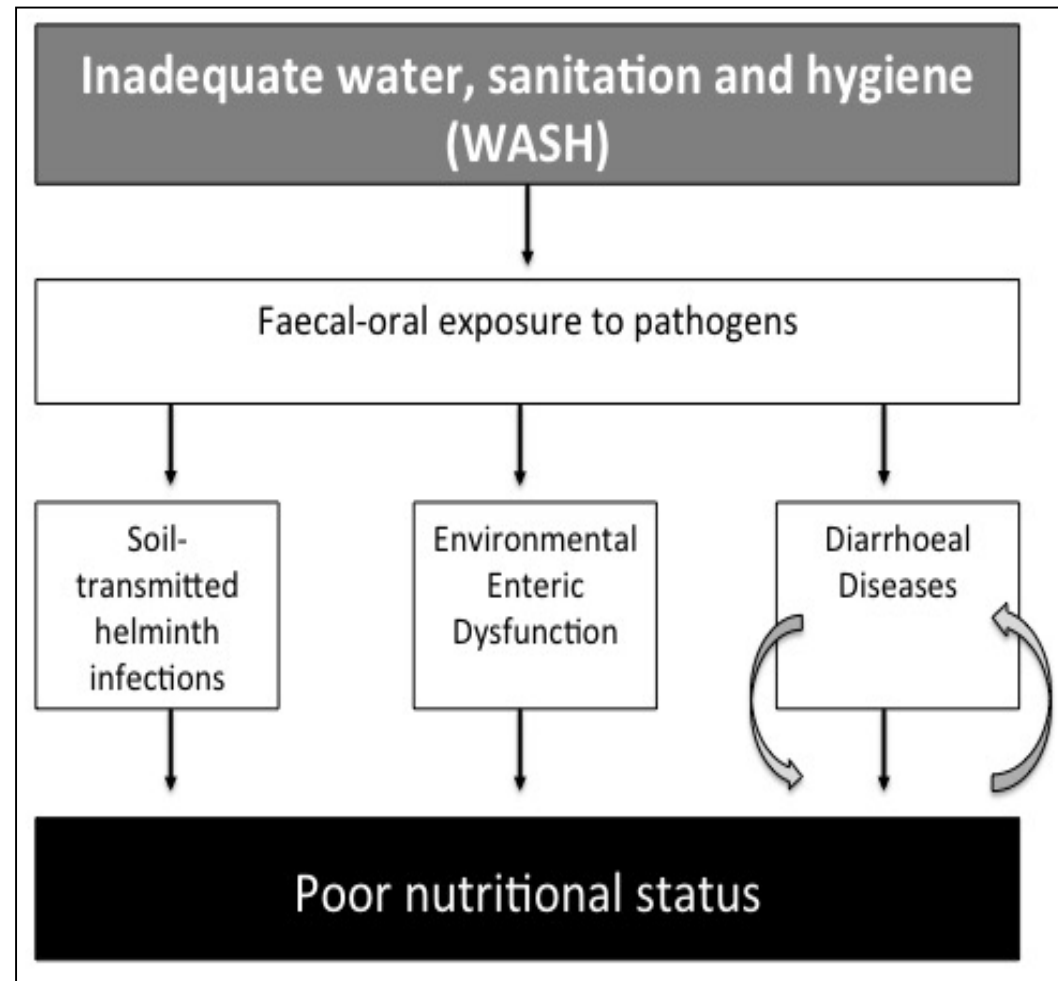SOURCE: Checkley et al 2008

SOURCE: Garcia 1968

WASH & undernutrition in low income, urban informal populations

WASH progress stagnating among many LMIC urban populations (WHO/UNICEF 2017)

High population density combined with poor sanitation creates high exposure risk

High prevalence of diarrhoeal disease, some STH (Mock 1993, Strunz 2014)

High levels of stunting and marked disparities (WHO 2016)

Inadequate water, sanitation and hygiene (WASH)

Faecal-oral exposure to pathogens

Soil-transmitted helminth infections

Environmental Enteric Dysfunction

Diarrhoeal Diseases

Poor nutritional status

SOURCE: Cumming et al 2015

Trends in urban population population growth

- By 2050, over 6 billion people will live in urban areas.

- Almost all population growth will be in LMIC urban areas

- A large proportion of the urban population will reside in informal areas

- The urban poor often underserved and underrepresented.

Major region or area	1990	1995	2000	2005	2010	2014
Developing Regions	46.2	42.9	39.4	35.6	32.6	29.7
Northern Africa	34.4	28.3	20.3	13.4	13.3	11.9
Sub-Saharan Africa	70.0	67.6	65.0	63.0	61.7	55.9
Latin America and the Caribbean	33.7	31.5	29.2	25.5	23.5	21.1
Eastern Asia	43.7	40.6	37.4	33.0	28.2	26.2
Southern Asia	57.2	51.6	45.8	40.0	35.0	31.3
South-eastern Asia	49.5	44.8	39.6	34.2	31.0	28.4
Western Asia	22.5	21.6	20.6	25.8	24.6	24.9
Oceania*	24.1	24.1	24.1	24.1	24.1	24.1

SOURCE: UN-Habitat 2016; WHO 2016

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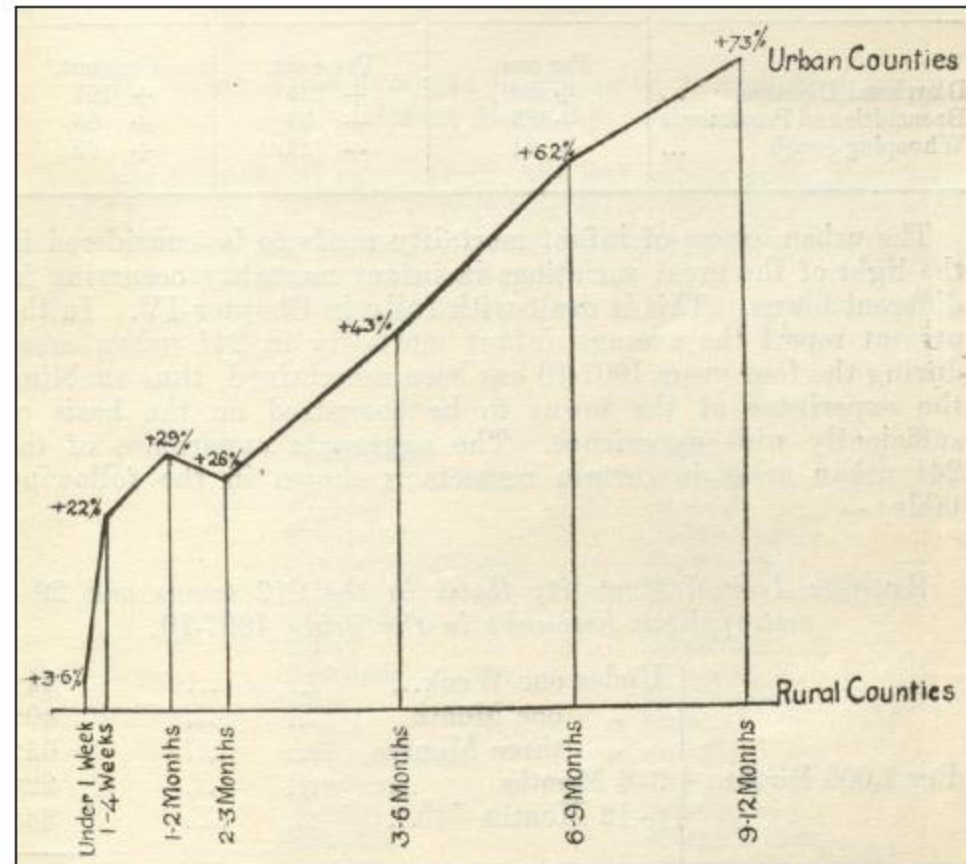SCHOOL *of*
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# Public health challenges facing informal urban populations

- High levels of poverty

- High density of people (and associated waste)

- Limited existing infrastructure and prohibitive costs for improvement

- Poor healthcare services

- Food insecurity

- Social inequalities and marked disparities in health

(SOURCE: WHO 2016)

(SOURCE: Newsholme 1911)

The MapSan Trial –
A controlled before-and-after study to evaluate the effect of an urban sanitation intervention on child health
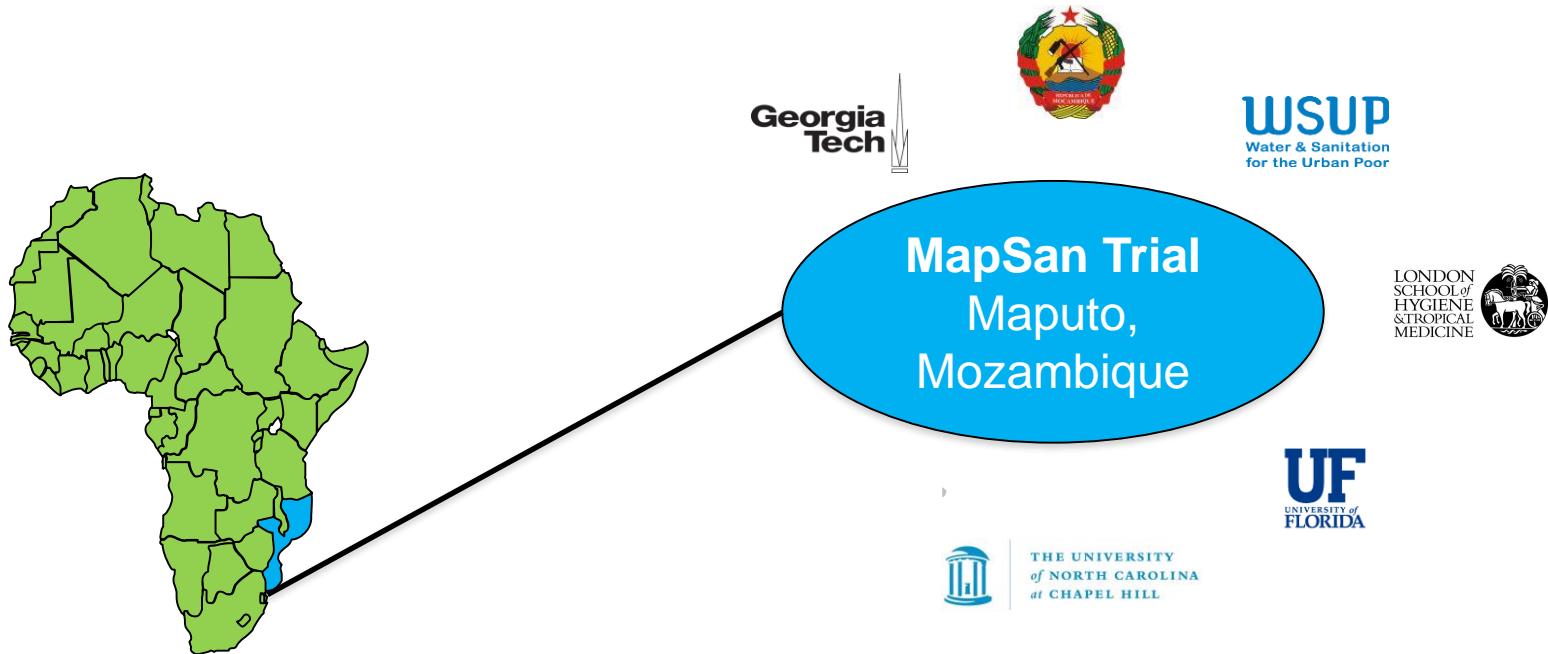
Trial Registration: clinicaltrials.gov
https://clinicaltrials.gov/ct2/show/NCT02362932

Protocol Paper: Brown et al 2015
http://bmjopen.bmj.com/content/5/6/e008215

Intervention – onsite shared sanitation delivered in low income neighbourhoods of Maputo, Mozambique

High density, highly contaminated environment

High burden of "sanitation-related" disease

Intervention to reduce entero-pathogen exposure among children

Measure effects on enteric infections and child growth

(Adapted from Wagner & Lanoix 1956; Kawata 1978)
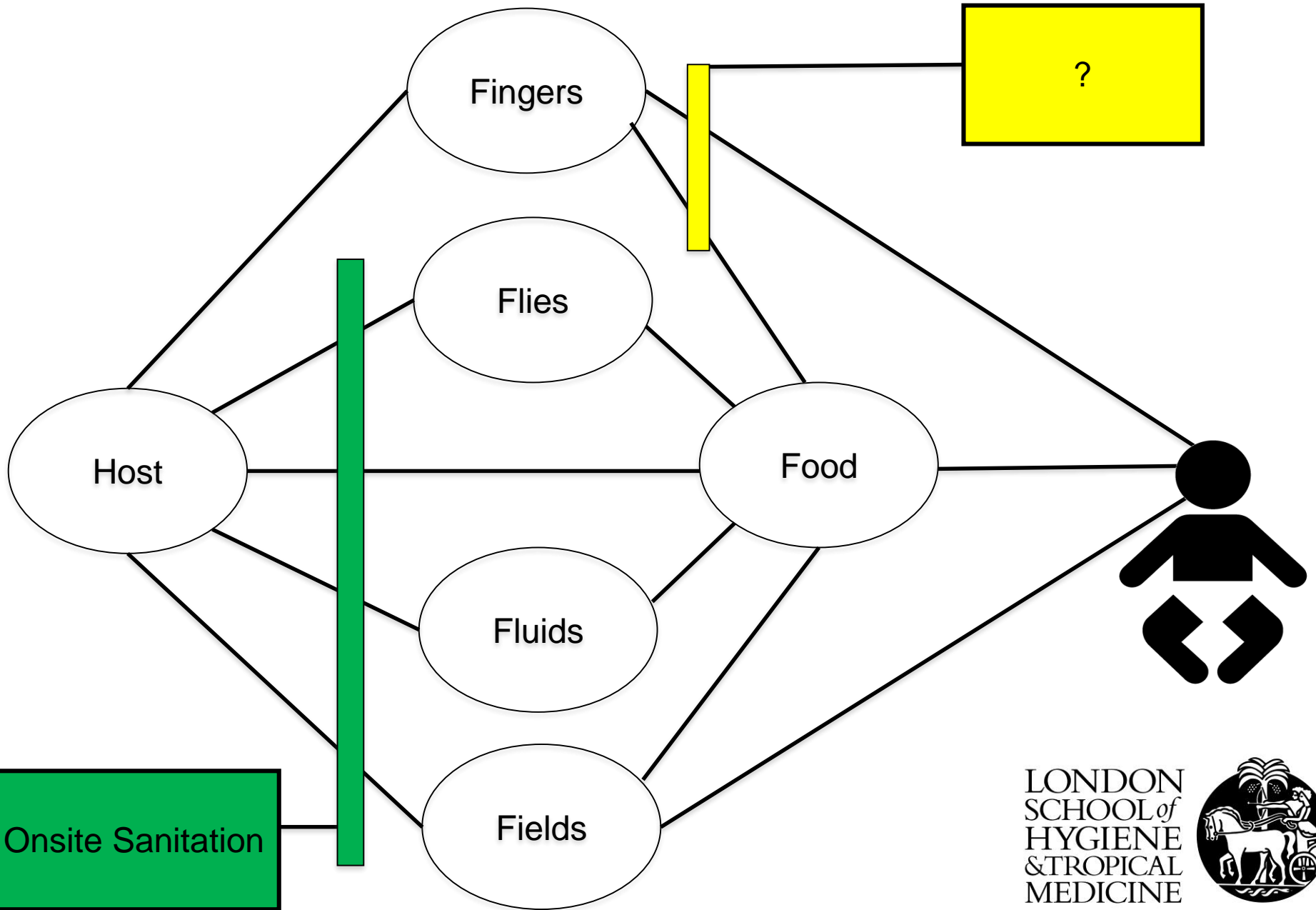
Health Outcomes

Following outcomes in children:

1.Combined prevalence of non-STH, non-viral enteric infections*

2.Combined prevalence of STH** (re-infection)

3.Anthropometry (HAZ, WAZ, WHZ)

4.Environmental Enteric Dysfunction

*Enteric infections: STH, *Campylobacter*, *C. difficile*, Toxin A/B, ETEC LT/ST, STEC; *Salmonella, Shigella, V. cholerae, Y enterocolitica,* adenovirus GI/GII, RV A, *Giardia, Cryptosporidium, E. histolytica*
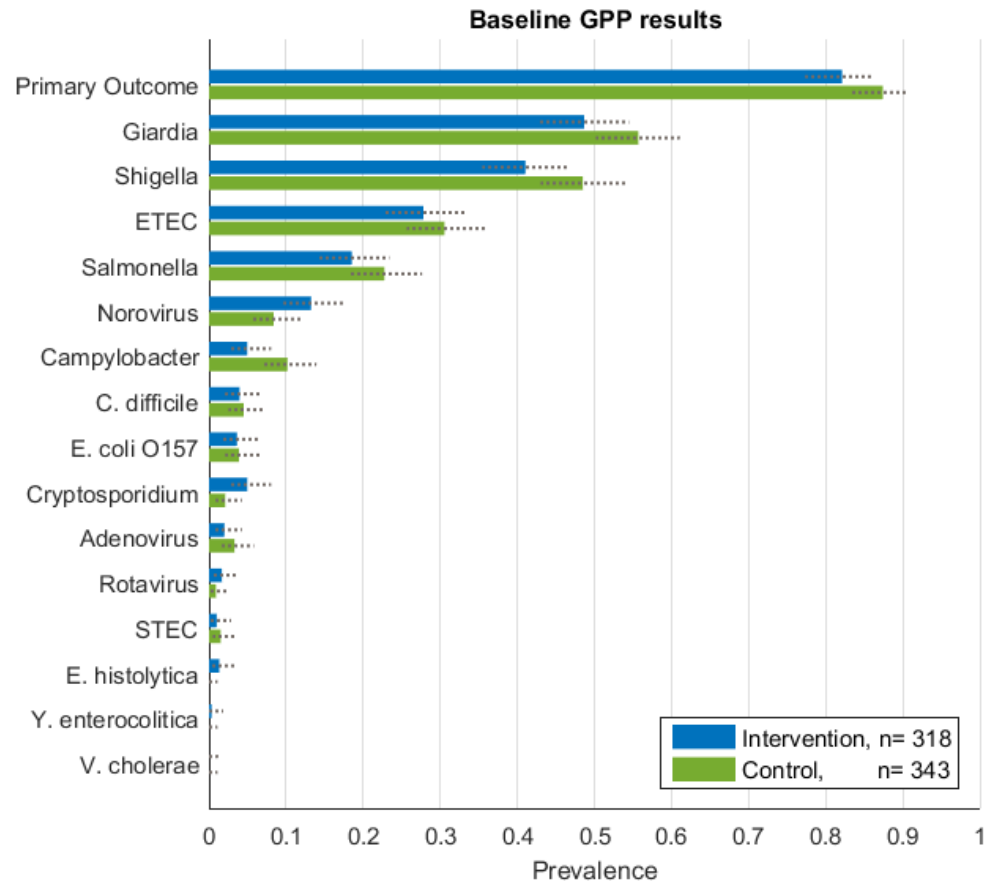
***Ascaris lumbricoides*, *Trichuris trichiura*, hookworm, *Enterobius vermiculare*, *Taenia* spp., *Hymenolepis* spp., and *Strongyloides stercoralis*

Disease burden – enteric infections and diarrhoea

MapSan (0-48 months):

85% of children have 1 or more non-viral pathogen

14% one-week period prevalence of care-giver reported

Baseline GPP results

SOURCE: Knee et al forthcoming

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Disease burden - undernutrition

High prevalence of childhood stunting:

38% 0-48 months (HAZ<-2)

Stunted associated with poorer sanitation:

Multi-variable analysis of sanitation conditions at MapSan baseline showed a 20% decrease in odds of stunting for a one point increase in index comprising 5 variables.

SOURCE: Watson et al *forthcoming*

Height vs Age in the Study Population

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Study Considerations

Intervention fidelity – ensuring consistent per protocol delivery

Intervention compliance – ensuring compliance

Migration – both secular and intervention related

Health outcome – selection and measurement of best outcomes

Follow-up period - 12 versus 24 months

Non-randomised allocation of treatment – prone to confounding

CONCLUSIONS

Mean statistics for urban poverty, infrastructure and health mask acute public health problems and marked disparities between wealth groups

Environmental conditions in informal urban areas generally bad and combined with high population density, poverty and limited healthcare access

Need to intervene early as prevalence of infections high even among very young children

Intervention design complicated by physical constraints and need for effective behavioural interventions

Studies needed but rigorous health impact evaluations very challenging

Thank you

PROTOCOL REFERENCES
Brown et al (2015): http://bmjopen.bmj.com/content/5/6/e008215.short
Trial registration: https://clinicaltrials.gov/ct2/show/NCT02362932