Development of a protocol for assessing the role of WASH in AMR distribution in the environment

Tracy Morse, Kondwani Chidziwisano, David Musoke, Derek Cocker, Nick Feasey

The Situation

- Antimicrobial resistance (AMR) is an internationally recognized threat to human health, with the greatest burden of drug resistant infections predicted to occur in low and middle income countries (LMICs).
- In Malawi and Uganda there is already a high incidence of severe bacterial infections from bacteria that are resistant to first and second line antibiotics.
- Given the limited availability of reserve antibiotics, these infections are often untreatable, and it is therefore essential to identify the drivers of AMR that are responsible for these drug resistant infections
- Exposures associated with WASH are integral to enteric bacteria and AMR transmission[1, 2]. AMR elements have been found in water, faeces and wastewater in LMICs, and this is compounded by a lack of fecal management (e.g. open defecation, lack of access to fecal sludge management) and multiple uses of water (e.g. washing, irrigation, animal management and drinking). These factors contribute to community borne AMR transmission, and must be considered across multiple exposure pathways (Figures 1 & 2).

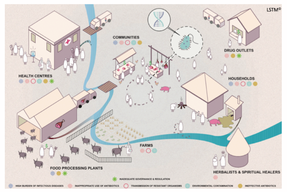

Figure 1: DRUM aims to take a one health and interdisciplinary approach to AMR in low income contexts © LSTM

Figure 2: Challenges settings in low income countries make AMR difficult to control

Objectives

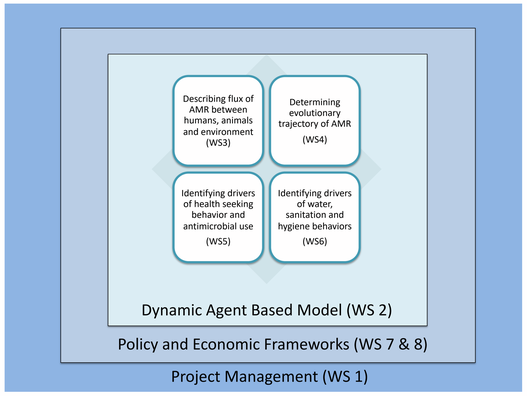

Figure 3: Outline of the Work Strands included in the overall DRUM program

Focused in urban, peri-urban and rural settings in Malawi and Uganda, the **Drivers of Antimicrobial Resistance in Uganda and Malawi (DRUM)** consortium is an interdisciplinary program (Figure 1) funded by the Medical Research Council (2018 – 2021) which takes a one health approach to examining specific AMR contexts for low income countries.

Overall, the study aims to address three key questions :

(1) What are the drivers of ESBL *E. coli* and ESBL *Klebsiella pneumoniae* transmission in Uganda and Malawi?;

(2) What are the critical points at which efforts to interrupt human AMR acquisition are likely to have the greatest impact?; and

(3) Which strategies are likely to be most affordable and feasible to societies and how far is this specific to context?

With a specific focus on the WASH component, the work strand aims to identify:

(1) Sources of fecal contamination in the environment;

(2) Potential exposure pathways for fecal-oral transmission; and

(3) Drivers of WASH behaviors at specific critical points

Study locations and populations

The study is taking place in Malawi (Blantyre and Chikwawa Districts) and Uganda (Kampala and Hoima Districts) across a range of rural, peri-urban and urban settings (Figure 4).

These have been chosen to provide a diverse range of environmental and household settings, allowing a holistic picture to be developed of AMR drivers within these locations.

Recruitment began in April 2019, and field work will continue till October 2020.

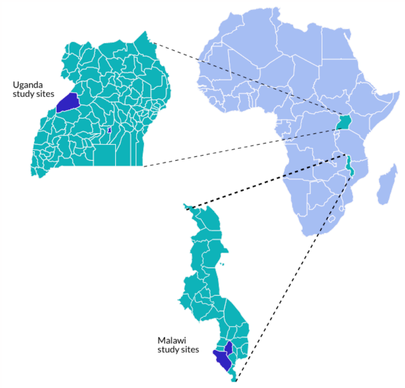

Figure 4: Outline map of study districts within Malawi and Uganda representing urban, peri-urban and rural settings

Method outline

Overall, data will be collated on a range of issues including: antibiotic use; antibiotic availability; illness; household demographics; and environmental contamination using both qualitative and quantitative methods. These will be sourced at all levels to provide a full picture of community dynamics and how these affect the presence or absence of ESBL *E. coli* and ESBL *Klebsiella pneumoniae* in each setting (Figure 5).

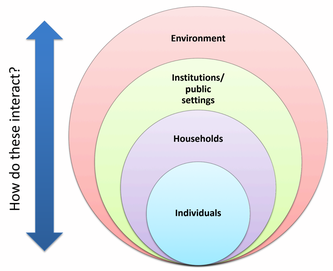

Figure 5: Levels of WASH and AMR interaction to be examined

Working hand in hand with the environmental sampling examining the flux of AMR in the environment, the WASH component will examine a series of contexts to develop a clear understanding of WASH infrastructure, practices and behavioural determinants in both domestic and institutional settings.

For the general environment settings, each study area (n=5) will be surveyed to using recorded transect walks, geolocating important settings and potential areas of fecal contamination.

In the case of institutional settings (Figure 6), each study area (n=5) will geolocate ten settings for more in depth examination including health facilities, schools, early childhood development centres and markets. These will be assessed using checklists (n=50), observations (n=50) and focus group discussions (n=100).

Figure 6: Institutional settings being examined within each study area

At household level, we are conducting a longitudinal survey of WASH infrastructure and practice across all five sites. A total of 100 households will be sampled across each site, of which n=65 will be selected for longitudinal surveillance over a 6 month period. Of these 65 households, 15 will be intensively sampled and 50 will be sparsely sampled (Figure 7). All 100 households will participate in a Risks, Attitudes, Norms, Abilities and Self Regulation (RANAS)[3] questionnaire focussed on critical practices observed in intensive households.

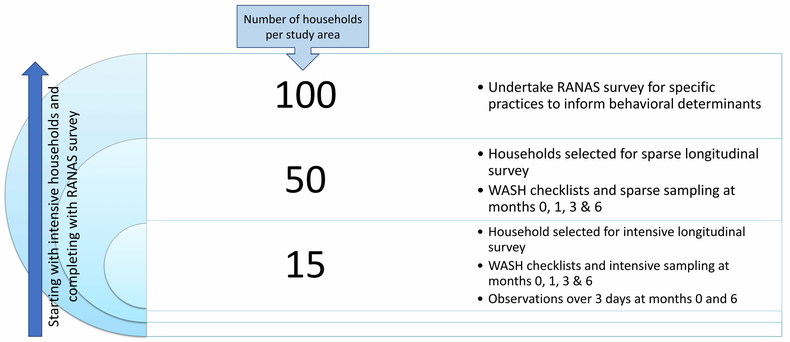

Figure 7: Summary of household sampling frame to be completed over 18 month period

This data will be collected in conjunction with environmental sampling which will focus on human, animal and environmental sources of ESBL *E. coli* and ESBL *Klebsiella pneumoniae* in the household, including hand contact surfaces, food, and water 9Figure 8). The combination of these findings with the in depth observations, and wider environmental data will allow us to effectively model the potential paths of transmission. With the additional findings from the RANAS survey, we aim to be able to develop interventions to interrupt these pathways in the future.

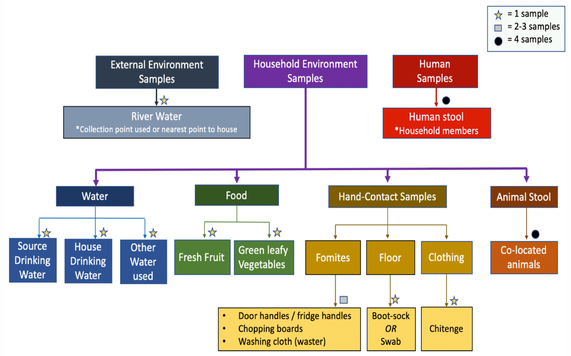

Figure 8: Household level sampling program for intensive households at months 0, 1, 3 and 6

More information

Contact details:

DRUM Principal Investigator
Prof. Nicholas Feasey
Nicholas.Feasey@lstmed.ac.uk

WASH workstrand lead:
Tracy Morse
tracy.thomson@strath.ac.uk

Follow us on @DRUM_consortium

[1]Holmes AH et al. (2016) Understanding the mechanisms and drivers of antimicrobial resistance *The Lancet*, 387:10014, 176 - 187

[2]Wuijts, s., et al. (2017) Towards a research agenda for water, sanitation and antimicrobial resistance. *J Water Health* 15 (2): 175–184.

[3]Mosler, H. J. (2012). "A systematic approach to behavior change interventions for the water and sanitation sector in developing countries: a conceptual model, a review, and a guideline." *Int J Environ Health Res* 22(5): 431-449.