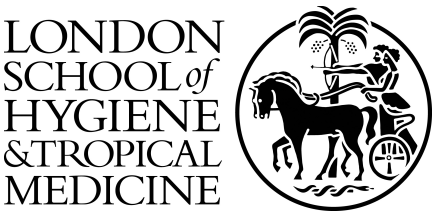

Making AMR in an unequal (research) world: an ethnography of transnational research between the UK and Uganda

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'I, Esther Sophie Rottenburg, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis'.

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Abstract

Anti-microbial resistance (AMR), or the ability of microbes to resist the effects of drugs designed to kill them or inhibit their growth, has taken a central stage within global health institutions, with predictions of resistant microbes spreading ever more widely in the coming years. The making of evidence that forms the basis of such warnings has received little attention. Despite AMR's inherently context-dependent nature - local environments provide not only varying possibilities of diagnosis and care, but they also mould the very microbes and their resistance-encoding genes -, AMR continues to be framed and evidenced as a coherent condition.

Building on scholarship in medical anthropology and science and technology studies on global health research, this thesis explores how evidence on AMR is made. Empirically, the work is based on three years of non-continuous ethnographic research conducted between 2020 and 2023, in-person and remotely in Uganda and the UK. In both places, I engaged with researchers working on AMR as part of a transnational global health research collaboration, here called D-Lab. I also carried out documentary analysis of their published and unpublished materials and conducted interviews with experts on infection prevention in one of the project's field sites. Paying particular attention to the perspective of Ugandan research staff, I analyse and contextualise the workings of this transnational research collaboration.

The evidence on AMR that D-Lab produced, reflects the set-up of the research collaboration, and broader structures within global health research. D-Lab's research apparatus did not pick up on the local social, historical, and political conditions of the place in which the research unfolded. The hierarchical set-up of D-Lab additionally did not invite reflection of the Ugandan research staff on the project's methods, practices, and tools, and their relation to the project's field sites. Overall, I argue that by attempting to produce a global, coherent object of AMR that can be managed through existing global health policy frameworks, D-Lab, and global health research more generally, obfuscates the very conditions that shape AMR.

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List of Figures and Photographs

Abbreviations and Acronyms

AMIS	Antimicrobials in Society research group
AMR	Anti-microbial resistance
AMU	Anti-microbial use
DALY	Disability adjusted life years, a common metric in global health
D-Lab	The pseudonym I chose for the research collaboration at the centre of this thesis
ESBL *e. coli* (ESBL-E) and ESBL *k.pneumoniae*/ (ESBL-K)	D-Lab's target organisms. ESBL stands for extended-spectrum beta lactamases, which are enzymes that destroy beta lactams (a certain class of antibiotics) and thereby constitute a specific form of resistance. *Escherichia coli* and *Klebsiella pneumoniae* are two bacteria.
GLASS	The WHO's 'Global Antimicrobial Resistance and Use Surveillance System'
HIV/AIDS	Human immunodeficiency virus/ acquired immunodeficiency syndrome
IMF	International Monetary Fund
IPC	Infection prevention and control
LIC	Low-income county
LMIC	Low- and Middle-Income Country
LSHTM	London School of Hygiene and Tropical Medicine
MDG	Millennium Development Goal
NAP	National Action Plan
NHS	National Health System
NWSC	National Water and Sewage Cooperation
PI	Principal Investigator
SAP	Structural Adjustment Programme
SDG	Sustainable Development Goal
WaSH	Water, Sanitation, and Hygiene
WHO	World Health Organization

Introduction: researching research on AMR

Ivan and I first met in March 2020, during D-Lab's[1] pilot testing week. When we met three years later, both D-Lab's data collection had ended, and I had mostly completed my fieldwork. That week, I had come back to Kampala for D-Lab's dissemination meeting, and a couple days after the meeting, Ivan and I met at Mulago Hill. He showed me around three different laboratories, one focusing on pharmacokinetics, one on microbiology, and one on immunology. He was currently working in the microbiology lab. Knowing that I would be curious to see the laboratories from the inside, he made a plan to show me around. The laboratories were part of the Mulago hospital, where clinical work and research work was conducted side by side. Ivan was familiar with this space, having worked in one of the laboratories almost continuously for four years, greeting people wherever we went. In the microbiology laboratory where he was currently working, he showed me blood culture machines (they are used to establish whether there are bacteria in blood samples) and a film array machine (to establish what kind of bacteria there are in a sample, and whether they carry specific resistance encoding genes). There were working benches, with containers, pipettes, and microscopes. One wall of the laboratory was lined with fridges containing samples. Ivan opened one, took out an agar plate from a high pile of plates, quickly inspected its content and label, and then held it up so I could see it well. “These are gonorrhoea bacteria”, he said, and then added that they had been found to be resistant to a ciprofloxacin. This was a mundane encounter for him. We both used some hand sanitiser afterwards and kept on talking.

During his time within D-Lab, Ivan had been working in another microbiology laboratory at Mulago. He had processed the samples of water, soil, faeces, and swabs from food, clothes, and often-touched surfaces that his colleagues had collected within the homes of study participants. With other laboratory-based colleagues, he cultured the samples on media, identified colonies of resistant bacteria, and extracted their DNA. The bacterial DNA was then shipped to an institute in the UK for genome sequencing, which Ivan explained to me would give more

[1] D-Lab is a pseudonym for the research collaboration that is the focus of my PhD.

insights than the little film array machine that could only scan for specific genes.

After the tour of laboratories, Ivan and I walked past Mulago hospital's entry gate, and then further down the hill, across the parking lot. We chatted about the work he was doing for his Master's project (where he was building on skills and connections he had acquired by working in D-Lab), and then about D-Lab's dissemination meeting we had attended a couple days before. When we reached the little campus restaurant, it was lunch time and bustling. Students and university staff were coming in and out, eating large plates of staple food, matooke, rice, posho, with bowls of hot stew. At one of the tables, we found two empty chairs and continued talking.

During the dissemination meeting, David, D-Lab's former field work coordinator had given one of the presentations. He was still involved with the data and was writing his Master's thesis around them. David showed the audience of policy makers, regional representatives, and fellow researchers, slides with bar charts indicating the frequencies with which D-Lab had found resistant bacteria in different kinds of samples in their two field sites, and then photos of water sources with broken pipes, boreholes that had not been maintained well. On other slides, David presented data on hand washing frequencies. The audience in this large conference room followed along, gasping at the high rates of resistant bacteria in the samples, and at the low rates of people washing their hands. What David was suggesting was that low frequencies of hand washing would increase the likelihood of resistant bacteria traveling within the household. Residents would have to wash their hands more frequently and with soap to reduce the chances of development and spread of resistant bacteria.

Despite the time I had spent with D-Lab, I was still surprised about this focus on the practices of individuals, particularly since he had just shown photographs of broken water pipes, and data on the presence of resistant bacteria in water samples. While having lunch with Ivan, I raised the issue again. It was not complicated, his face seemed to suggest; and laughing, he said: “yea, if you wash your hands with contaminated water, your hands will become more contaminated”. Then he added, not really laughing anymore, 'But Esther, IPC [infection prevention and control] is all we can do here', alluding to the possibility that

> I might not realise what it means to navigate a setting that is resource deprived, and where systemic changes are difficult, or at times impossible, to achieve. Where basic public health is at least a starting point.
>
> [Fieldnotes, Kampala, 27.3.2023]

Why study research on AMR?

Ivan's work on resistant bacteria in Mulago's laboratories, and the D-Lab project he had worked in, are part of a global effort to study anti-microbial resistance (AMR). AMR is broadly understood as the ability of microbes (including viruses, bacteria, and fungi) to resist the intended action of antimicrobials (including anti-viral and anti-fungal medicines as well as antibiotics), so that these drugs no longer treat or prevent infections. Global health researchers and policy makers cast AMR as a major threat to our health. Microbes that no longer respond to the drugs we have at hand may lead us to 'once again die from simple infections', as many reports suggest (O'Neill 2014; World Health Organization 2023). There is no biomedical solution in sight, the discovery of new antibiotics would buy us time but resistance will eventually develop as it has for all antibiotics that are in use, often within months of their first use (Center for Disease Control and Prevention 2019). Even the fastest and most accurate diagnostic tool will not solve the problems that ensue when there is no drug available that works against the disease-causing microbe. Complicated procedures such as organ transplants or chemotherapy all depend on the working of antimicrobials, most of all antibiotics (Kirchhelle et al. 2020). Since antimicrobials are also employed in treating or preventing diseases in livestock (Kirchhelle 2018b, a; Kayendeke et al. 2023; Fortané et al. 2015) and in agriculture (Urapeepathanapong, Hutchison, and Chuengsatiansup 2022), AMR also affects these areas. Resistant microbes are expected to cause devastating effects across the globe, where effective drugs are not or no longer available.[2]

According to Podolsky (2018), drug resistance was met with optimism up until the early 1960s, when scientists found out that bacteria transferred

[2] Apocalyptic imaginaries of AMR are very common and have been compared to similar imaginaries of climate change (Brown and Nettleton 2017; Brown and Crawford 2009).

resistance encoding genes also horizontally to other bacteria and even across species of bacteria (and not just vertically, to the next generation of bacteria), dramatically increasing the estimated likelihood of the spread of resistance. Since the early 1990s, AMR has increasingly been framed as a global problem requiring coordinated action, with scholars noting that it was causing significant death and disability (e.g. Landecker 2016; Podolsky 2018; Gradmann 2011, 2013). Research funding to investigate AMR, its drivers and effects has increased massively over the past two decades, including the surveillance on AMR (World Health Organization 2023). The Medical Research Foundation in the United Kingdom has invested 4 million GBP in a programme that has funded the work of two cohorts of PhD students working on AMR across 14 universities in the UK, including the work for this thesis. National and international guidelines and action plans have been implemented (World Health Organization 2015; Government of Uganda 2018).

AMR's global reach does not equate to an evenly distributed risk of infection with resistant microbes globally. The burden of disease linked to bacterial AMR has been estimated to be highest in African countries in a global comparative analysis published in the Lancet in 2022 (Antimicrobial Resistance Collaborators 2022). This unequal distribution of the disease burden most likely relates to a higher share of infectious diseases of the overall disease burden in Africa compared to other continents, and more limited access to pharmaceuticals, in particular to newer classes of antibiotics (Adebisi et al. 2022). An infection with a strain of bacteria resistant to amoxicillin is only untreatable where there are no next line drugs available. However, public health scholarship and policy on AMR suggests that if it is not intervened upon, the burden of disease from resistant infections will grow substantially over the next decades in wealthy countries in the Global North too. Indeed, the push of funders and global health institutions to research and intervene on AMR has increased substantially since it became framed as affecting the NHS (Bud 2007) as cited in (Gradmann 2013). As such, the current drive to research AMR stems less from a concern about the current disease burden which seems to mostly affect mostly low- and middle-income countries (LMICs) and more from projections of a potential future in which AMR will have far reaching effects globally. According to such projections, AMR might not only be causing large

numbers of deaths, it might be halting progress and development, and endanger our modern ways of living (World Health Organization 2015).

Studies, like the one cited above on the global disease burden of AMR, rely on patchy data for many regions of the world, and particularly for those where the disease burden is estimated to be high. There is a paucity of data regarding many of the indicators that help estimate the burden of AMR in many LMICs (Chandler 2019). This includes for example, limited data on the surveillance of infections, limited data on antimicrobial prescription and usage, as well as limited laboratory capacities for microbiological testing (see for example, Gulumbe et al. 2022). The numbers reported in the Lancet study for areas with limited surveillance data are estimations based on the collation of a large number of smaller data sets. Resources for clinical work as well as research and surveillance of pathogens are unevenly distributed; the estimated inequality in disease burden is mirrored by an inequality in resources and research opportunities.

For global health, inequality in both disease burden and resources present not only 'a form of suffering to be addressed' but also 'a professional, knowledge-generating, opportunity to be exploited' (Crane 2010, 78). While global health purports to advance health globally, and has been described as an 'endeavour which seeks to define health problems and set up interventions at a global scale' (Ehrenstein and Neyland 2018, 60), these inequalities are the very reason this field exists. Global health research or science, though focussing on the production of evidence rather than the alleviation of illness and disease, often overlaps with other more interventionist forms of global health, e.g. when researchers are involved in clinical work too (Crane 2020, 189). Much like these other forms of global health, global health research also depends on the health and resource inequalities for its existence.

The most common modus of conducting global health research reflects these inequalities too. Global health research happens often in North-South collaborations, with one institution based in a high-income country in the Global North and one or more institutions based in LMICs in the Global South (Geissler and Okwaro 2015; Wendland 2017). In these constellations, which are sometimes aspirationally called partnerships (Crane 2020), funding mostly

comes from the Global North, and with it often power over research agendas and even power over defining what counts as global health and research (Crane 2011). There is an inherent hierarchy of knowledge, expertise, and evidence typically woven into these constellations and into global health research more generally. Insights regarding the local context of the place in which a research project unfolds are essential for the project to work, yet are under-appreciated, while biomedical research skills are highly valued. In these set-ups, there is less interest in understanding local phenomena in their very context, and instead a drive for scalable evidence, which Véra Ehrenstein and Daniel Neyland (2018, 59) describe as 'the ability to expand without changing'. Scalability comes with the aspiration that evidence made from data from one place at a certain time can be valid in other places, at other times.

AMR, however, is highly context dependent (Kirchhelle et al. 2020). Specific environments provide not only varying possibilities of diagnosis and care, but also mould the very microbes and their resistance-encoding genes, e.g. through varying patterns of use of antimicrobials that exert pressure on microbes to find ways to evade their effect. Antimicrobial-rich environments, like hospitals, make for breeding grounds for resistant microbes (Landecker 2016). At the same time, AMR is global in scope; resistant microbes travel across bodies, species, households, communities, nation-states, and continents. Hannah Landecker, in her pathbreaking work on the biology of history, argues that human intervention into microbial worlds left traces before the large-scale use of antibiotics in the 1940s and 50s; and that the microbes of our world, that live in our environments and in our bodies are different to the microbes that lived on this planet at any other time (Landecker 2019, 2016). Through microbes' ability to share resistance encoding genes, and humans' use of antimicrobials in human, animal, and agricultural contexts, AMR is a large-scale problem concerning human health, animal health, and environmental health, and their intersections. AMR thus breaches categories that usually divide issues in global health and structure its funding, research, and policy apparatus. Its global reach with its local, continuously changing manifestations, make it challenging to grasp.

AMR's context dependence, and evasion of global health's rigid categorisation has been widely acknowledged by critical social scientists –

Hinchliffe (2021, 17) even understands AMR as a 'signal to think about assumed norms of global health'. However, it continues to be perceived, studied, and governed as a coherent condition in much of global health policy and research. This rendering of AMR into a global, coherent object that forms the basis for AMR policies has received little scrutiny. The urgency of the issue of AMR on the one side, where not only health, but our ways of living in this world are endangered, and the complex, unequal configurations that shape the very microbes, our means of responding to them, and our means of knowing them, provide the rationale for this thesis interrogating the making of evidence on AMR.

Guiding question and main argument

This thesis explores how we make evidence on AMR in the context of global health research. Throughout, I engage ethnographically with one global health research collaboration. This research collaboration, that I call D-Lab, was working on identifying drivers of AMR in LMICs in between the UK and Uganda. I take the historically grown intricate web of global inequalities, regarding both the conduct of global health research, as well as the objects of its inquiry, as conditions shaping the study, its rollout, and the evidence made. Paying particular attention to the perspectives of Ugandan research staff, I follow how they built D-Lab's research activities in the project's field sites. My overarching question in this thesis is: how did D-Lab make evidence on AMR in between Uganda and the UK? Throughout the thesis, I attend to frictions between the study's framings implicated in the study apparatus, including its protocol and data collection tools on the one side, and the conditions the researchers found themselves in on the other. I follow how standardised notions of e.g. AMR, the study's field sites, and practices were written into the study, and how Uganda-based researchers found ways of bridging them to the realities they were working in.

Overall, I argue in this thesis, that by attempting to produce a global object of AMR that can be managed through existing global health policy frameworks, D-Lab, and global health research more generally, obfuscates the very conditions that shape AMR. D-Lab's research apparatus was designed not to pick up on the local social, historical, and environmental conditions and

infrastructures of the place in which the research unfolded, that shape its microbial landscapes. Instead, the study's templates produced standardised places and factors, validating rather than critiquing assumptions woven into them. The Ugandan researchers had insights into the spatial-temporal context of D-Lab's field sites, but their insights did not feature in the project's evidence. The hierarchical set-up of D-Lab, and the unequal labour conditions across the UK-based and Ugandan researchers did not invite reflections of the Ugandan research staff on the project's methods, practices, and tools, and their relation to the project's field sites. The evidence on AMR that D-Lab produced, reflects the set-up of the research collaboration, and broader structures within global health research.

Ethnographic approach

Empirically, this thesis is based on three years of non-continuous ethnographic research that I conducted between 2020 and 2023, in-person and remotely in Uganda and the UK. The focus of my research was the D-Lab collaboration, which unfolded across multiple field sites in Uganda and Malawi, between 2019 and 2021. Over multiple follow-up visits in the study participants' households, the field teams collected data in various forms, including observational data and biological samples, in order to identify factors that explain the development and spread of resistant bacteria within households. The laboratory-based teams processed the samples, extracted bacteria and tested them for resistance. Most of the data analysis happened outside Uganda, including statistical analysis as well as whole genome sequencing of the DNA of a subset of the bacteria that had been found in the samples.

Over the course of my fieldwork, I engaged in a variety of activities that together elicited the empirical work for this thesis. Throughout, I focussed on the Uganda part of the D-Lab study. In March 2020, I joined D-Lab's Ugandan teams for a week in Hoima, where one of their field sites was located, and where they pilot-tested their data collection tools. I accompanied the researchers to the households of potential study participants, to the laboratories, and attended their daily meetings. The onset of the COVID-19 pandemic soon after my arrival in Uganda (first measures were taken on March

20th, and the country's borders closed on March 23rd 2020 (Laing, Mylan, and Parker 2024)) made me leave the country, and rendered my fieldwork into a 'patchwork' of multiple threads to be woven together. This major shift changed my field, fieldwork, and modes of engagement. Throughout the thesis, I try to write 'with the disruptions, rather than against them', as put forward in the proposal for patchwork ethnography; breaking with the heroic narratives of ethnographers' uninterrupted fieldwork in remote places (Günel and Watanabe 2023).

During the following months, I remotely engaged with the Ugandan researchers via WhatsApp, as well as phone interviews. When I returned to Uganda in October 2021, D-Lab had completed data collection for the project. Between October 2021 and April 2022, I carried out and recorded ethnographic interviews and spent less structured time with the research staff after the end of their working contracts. I met the researchers in their new places of work, in offices and laboratories, and across Kampala in restaurants and cafés, and in their homes. Former field assistants have also guided me through the project's former field sites, including the compounds of a small number of D-Lab's former study participants. In D-Lab's western Ugandan field site, I also carried out a series of interviews with experts working in the area of water, sanitation, and infection control. Additionally, I interviewed D-Lab researchers based in the UK, and I remotely attended higher level project meetings. In March 2023, I travelled back to Uganda for the project's dissemination meeting where the researchers presented some of their findings to regional representatives, policy makers and fellow researchers. Running alongside this work, I carried out documentary analysis of their published and unpublished materials, such as the study protocol, data collection tools, and the COVID-19 risk mitigation plans that I was given access to.

My ethnographic engagement with D-Lab focused on the Ugandan part of the D-Lab study, and the end of the project rather than its unfolding. Inevitably, the COVID-19 pandemic, shaped this focus in important ways. Although I had planned to conduct most of my fieldwork in Uganda, I had envisioned it to circle around D-Lab's data collection rather than the ending of the project. The COVID-19 related shift in timelines also came with changes in my empirical focus. Had I done my fieldwork during D-Lab's data collection

in non-pandemic times, researchers based in the UK might have been more directly involved with the project and would consequently have played a more prominent role in my ethnographic work. D-Lab's funding deadlines meant that some researchers who had been involved in the project from its inception were not involved at the later stages of the project. Additionally, some of the researchers (for instance most of the UK-based modellers) became involved in COVID-19 related research, since their expertise in infectious disease modelling was unexpectedly of crucial public health and political importance.

My focus on the perspective of the Ugandan researchers, and the spaces in which they worked shaped my empirical work beyond the geographical angle. My fieldwork and analysis circle around the perspectives of field assistants and laboratory assistants, and not the perspectives of those researchers at higher levels of the collaboration. These researchers, at higher levels of the collaboration, worked for the most part outside Uganda (for more details on the distribution of research labour, see chapter 4). A more comprehensive engagement with researchers at the various different hierarchical levels of the collaboration, based in different countries and working as part of the different work streams, would have undoubtedly produced a more comprehensive account. Triangulating accounts of researchers working in different parts of the project would have solidified my findings. However, my in-depth empirical work with Ugandan researchers after the end of their contracts also came with upsides. This set-up opened up spaces of inquiry that due to the hierarchical nature of the collaboration might not have made it to the surface. I was able to build relationships of trust with field assistants and laboratory assistants, who spoke openly about their work. In this way, my focus on the Ugandan part of D-Lab shifted the blind spots of my analysis. It allowed for a more in-depth understanding of the perspectives of Ugandan field assistants and laboratory assistants, while constraining my understanding of other researchers' perspectives, in particular those at higher levels of the collaboration and based outside Uganda.

Throughout the thesis, I aim to protect the identity of the researchers I have been fortunate to spend time with. I use pseudonyms for the research collaboration, and for all the names of researchers. I have also altered some contextual factors to this end. This is to ensure that their generous opening up

about their work in D-Lab, and in global health research more generally, does not impinge upon their future careers. I only use the real names of people that I interviewed outside of the research collaboration and who explicitly expressed that they would like to be mentioned by name, and only where my writing is unlikely to impose them to harm.

The use of pseudonyms is, undoubtedly, an imperfect solution, as 'It assumes that the academic currencies of recognition and intellectual property are not relevant to our interlocutors. This assumption is problematic and reproduces class and ethnocentric hierarchies that are out of step with our current disciplinary ethics in other areas', as Erica Weiss writes in an essay on pseudonyms as anti-citation (2021). It is at least questionable whether this 'inherited disciplinary custom' actually serves those we claim to protect (Weiss and McGranahan 2021). By using pseudonyms, I take away the opportunity for the research staff to be recognised for the work they do, which is a very high price to pay - particularly given that their contribution is so often downplayed and written out of the research projects in which they work. In the context of my research on global health research, anonymisation might also not be successful. Readers who know the context of AMR research well may be able to find out which collaboration I refer to, and those who know the Ugandan research context, may even be able to figure out who it is that am writing about. Aware of these pitfalls, I have strived to provide the reader with enough contextual information for the evidence to be well anchored, while making sure that some details are removed so that I do not harm the researchers' reputation.

Thesis overview

The **first chapter** serves to embed this thesis in the existing literature, providing context, laying out the theoretical commitments and the different ways in which this work contributes to bodies of literature. I build on the work of scholars in the fields of anthropology, history and STS on a) global health in particular in Uganda; b) evidence making in global health and its historical precursors; and c) on AMR in Uganda in global health.

My **second chapter** is entitled 'Making evidence: reflecting on methodologies and fields'. Here, I provide an overview of the approach and

methods I have employed in the making of evidence for this project. I also describe the approach and methods of D-Lab. I lay out how I came to work with this particular collaboration, and how I patched together pieces of evidence, as well as describe the bureaucratic processes that allowed this project to unfold. I work through the disruptions caused by the COVID-19 pandemic, and how they have shaped my fieldwork and field. I also reflect on my positionality as a white European woman doing research mostly with a group of Black African researchers.

The **third chapter** is entitled 'Standardising evidence: the recursive making of field sites, communities, households, and AMR'. In the context of critical global health, scholars have critiqued assumptions around the exchangeability of context, where standardised evidence, interventions, or technologies are expected to travel seamlessly across place and time. In this chapter, I look at what it takes to produce evidence on the drivers of AMR that is not bound to any particular place but that is meant to be meaningful across different contexts. Empirically, this chapter is based on ethnographic insights as well as documentary evidence - including maps at different scales, - focussing on the construction of D-Lab's field sites, communities, and households as (bounded) units of analysis. I attend to how standard places and a standard object of AMR emerged through D-Lab's work. I argue that these units of analysis do not only cut off the socio-economic, historical, even biological context and narratives in which the evidence has been made but they also construct new contexts (e.g. standard communities as sites of analysis and intervention). These new contexts recursively shape our concept of AMR, and our ideas about how best to intervene.

The title of my **fourth chapter** is 'Distributing research labour: adaptation and exclusion in the making of AMR'. In this chapter, I attend to labour inequalities in global health research and their effects on the evidence produced. Scholars in critical global health have provided ample evidence for the continuing inequalities of global health research that relies on and yet marginalises the expertise of often precariously employed local field teams and technical staff. In this chapter, I follow how locally hired research staff in Uganda, tasked with data collection for D-Lab, managed to build the project activities during the early phases of the COVID-19 pandemic. I lay out how

their extensive adaptive labour enabled the project's roll out despite substantial shifts in the social, political, and legal conditions of conducting research in Uganda and globally. Tracing the precarity of the Ugandan researchers' labour both to institutional and project logistics and to epistemological assumptions around data and their making, I argue that the precarious labour conditions are central to global health modes of operation which relies on adaptation and exclusion. Within D-Lab, there is little interest and no infrastructures for reporting adopted adaptations. The Ugandan staff are largely excluded from the preceding steps of designing the project or the following steps of analysing and interpreting the data. This set-up precludes iterative adjustments of research procedures and enables the maintenance of existing scientific modes of engagement, stabilising rather than questioning the assumptions they are built on.

My **fifth chapter** is entitled 'Drawing pathogenic risk: the One Health framework in AMR research'. In this chapter, I trace D-Lab's framings of human-animal-environmental relations around AMR, attending to One Health's 'holistic aspirations', as well as to inherited logics of sanitation. The D-Lab project aimed to inscribe risks of transmission of pathogens through drawings and maps. I analyse these graphic representations and build on my ethnographic engagement with D-Lab's researchers. I argue that D-Lab, and global health more broadly, rely on a logic of separation, representing (and understanding) One Health as three-healths: human, animal, and environmental. The representations that allocate humans, animals, and the environment to different zones foreclose the ability to reimagine health as 'one'. D-Lab's emphasis on the interlinkages between humans, animals and the environment created possibilities for identifying future interventions to reduce bacterial transmission between the three spheres. In so doing, D-Lab took microbial interlinkages not as proof of the inherent porosity of boundaries, but as a hurdle to be overcome.

The **sixth chapter** is entitled 'Water, sanitation, and hygiene: behavioural approaches in contaminated landscapes'. Within global health, there is a strong focus on interventions targeting the practices and behaviours of individuals instead of the infrastructures that shape the landscapes in which they live. AMR is known to relate to its ecological environment, where bacteria

travel through water, and respond to e.g. metals and other residues they come in contact with. In their quest to identify what drives the development and spread of AMR, D-Lab investigates residents' practices around Water, Sanitation and Hygiene (WaSH). In this chapter, I describe D-Lab's approach to WaSH, and I attend to the spatial-temporal context of D-Lab's western Ugandan field site in Hoima in which a part of D-Lab's data collection happened. Building on ethnographic insights from visits to the field sites, and a series of interviews with water and sanitation specialists who work in the region, I draw out a space that is subject to registers of contamination, through a historically grown web of ecological, social, economic, and regulatory factors. By investigating the practices of individuals, e.g. whether or not they are washing their hands before preparing food, D-Lab shifts the focus away from the context in which the residents' behaviours occur. In so doing, the project, and the wider global health community, stabilises not only a terrain of intervention, but also the very landscape including its physical infrastructures and biological compositions that shape its microbial composition.

In the conclusion, I summarise my main argument, link the chapters, demonstrate the significance of the study, and provide a direction for future research.

Chapter 1: Literature review

This chapter serves to embed my thesis in the scholarship that it emerged from and that it aims to contribute to. To this end, I weave together bodies of scholarship in anthropology, history, and science and technology studies on global health. Particular attention is given to scholarship on global health research and evidence making, focussing especially on Uganda, and on AMR as an object of global health research. There are three major sections. Section one provides a short historically informed account of Uganda's role in global health research. Section two is about evidence making in global health.[3] Here too, I relate an account of contemporary global health research to its colonial precursor, and I focus on the Ugandan context. The third section embeds scholarship on AMR into the preceding sections.

(1) Global health in Uganda

Colonial Medicine as a precursor to global health

As part of the British colonial project, the British built a public health infrastructure in most former colonies. In the UK, missionary work presented the building and sustaining of the health infrastructure in the British colonies as an act of charity; but in practice it served mainly to secure the health of the labour force to enable uninterrupted economic extraction, as well as to protect the health of the settlers and thus the wealth and power of the Empire (Marks 1997, 216; Vaughan 1991).

For the British, Uganda was a valuable colony. The production and export of cash crops grown on the country's fertile land, mainly of cotton and later also of coffee, rendered it economically attractive. British colonisers also described it as easy to govern; Buganda became a British ally representing

[3] As mentioned in the introduction, the distinction between section one on global health and section two on global health research is not always clear in the literature and in practice. Though, as Crane writes, 'Global health science differs from other forms of global health in that its focus is the production of knowledge rather than aid provision or medical education' […] in practice, these different types of global health activities often overlap (for example, university-run global health research may provide scientific evidence to support clinical and humanitarian interventions), and it is not uncommon for a US university to be involved in all of them'(Crane 2020, 189).

British interest and colonising its neighbouring kingdoms on their behalf (Doyle 2009; Okoth 1992).[4] Over the course of the British colonial presence in Uganda, the British established infrastructures around public health, such as hospitals, laboratories, and research stations, many of which are in use to this day (Vaughan 1991; Doyle 2000, 2014, 2016). This includes the Hoima Regional referral hospital, that was built in the 1930s (Uganda Ministry of Health 2024), and which features in the D-Lab study, and this ethnography.

Colonial research started as a means to secure wealth but soon brought about scientific discoveries that transformed science and academic institutions in Britain. Sir Patrick Manson, who had been employed by the UK colonial office, published the first edition of *Tropical diseases: Manual of diseases in warm climates* in 1898 (Manson 1898; Worboys 2003). The manual soon became the basis for a degree in tropical medicine. Manson founded the London School of Hygiene & Tropical Medicine in 1899. Tropical medicine came to be conceived as a new academic discipline to be studied in its own right (Clarke 2007). Research in the colonies served the colonial project in an immediate way, providing resources to find out how best to handle public health issues (such as the spread of infectious diseases, which had often been aggravated by the colonial regime itself) (Geissler 2015; Tilley 2004). By the 1950s, the purpose of research in public health in the colonies shifted to providing British scientists with data. Colonies were turned into testing grounds of ideas and concepts conceived of in Britain.[5] Data analysed by colonial scientists converted into prestigious publications became a new commodity feeding into the wealth and prestige of the UK.

[4] Buganda colonised most of Bunyoro in the 1890s, the first of which is centrally located in what is now Uganda, and includes Kampala where one of D-Lab's field site was located, and the latter of which is located in what is now western Uganda, and includes the region of Hoima, where another of D-Lab's field sites was located (Doyle 2009).

[5] Christophe Bonneuil places the 'birth of the developmentalist state in tropical Africa in the 1930s' where 'colonial governments […] intervened more directly in the economy, and took steps towards planning and state regulation' (2000, 259). *Development* of African states became part of the British colonial agenda. And, 'science for development' changed into 'development as experimental science' (2000, 259). This change towards understanding development as an experimental science allowed for the extraction of data, in addition to the extraction of agricultural resources.

Contemporary global health

Later in the 20th century, after the end of the second world war, and then the formal end of colonisation – most African colonies gained independence in the late 1950s and early 1960s, Uganda in 1962 – there were structural transformations in the objects and objectives of transnational health policy making (Gorsky and Manton 2023). Colonial health and tropical medicine were restructured into 'international health' emphasising health concerns that exceeded national boundaries (Brown, Cueto, and Fee 2006). Around the turn of the 21st century, 'global health' became the most common label for this field, to 'draw attention to the global connectedness of diseases and of the people and institutions that govern and respond to them. It was driven by the spread of new technologies - some of which were facilitating rapid global transit, exchange, and communication' (Yates-Doerr and Maes 2019).[6] Richard Horton described global health in 2009 as involving the 'chaotic tumbling, rumbling and knocking together of ideas and aspirations', where 'the hope must be that the outcome will be the highest attainable standard of health for all if not the perfectibility of humankind' (Horton 2009, 26).

Despite the re-naming and apparent new focus on global interconnectivity, and the pronounced goal or 'hope' of 'health for all',[7] global health as a 'field of expertise' (Yates-Doerr and Maes 2019) built on its colonial precursors in many ways. This included the scientific expertise of tropical medicine, as well as the institutional and knowledge infrastructures, and with it infrastructures of aspirations, ideas, and framings. In their article 'Global

[6] During that time, funding for global health increased substantially, Ehrenstein and Neyland wrote in 2018 'Over the last three decades, overseas aid spending on health has experienced a significant increase (from an estimated total of US$7.2 billion in 1990, to US $11.7 billion in 2000 and US$36.4 billion in 2015; Dieleman et al., 2016). (Ehrenstein and Neyland 2018, 60).

[7] This proclaimed aim of ensuring 'health for all' goes back to the Alma Ata conference, of which Pfeiffer and Chapman wrote, 'In 1978, the concept of Primary Health Care (PHC) was embraced by 134 countries (including the United States) attending the landmark World Health Organization (WHO)/UNICEF Alma Ata conference in the former Soviet Union (now Kazakhstan) (Paluzzi 2004). The PHC concept promoted "Health for All" by 2000 through a package of basic health care services made available to all, especially the poor, through a public tiered health system. The package included vaccination, maternal-child health services, family planning, endemic and epidemic disease control, first aid, and referral systems for complex cases. It recognized the importance of multisectoral development to public health, and celebrated community participation as a core principle.' (Pfeiffer and Chapman 2010, 151).

Health' published in the *Cambridge Encyclopaedia of Anthropology*, Yates-Doerr and Maes argue that 'attention to the field's historical formation shows that much of what is presented as 'new' echoes colonial-era patterns of consolidating wealth, exacerbating global inequality, and monitoring sickness and health for the sake of empire and/or corporate profit (Packard 2016; Trouillot 2003)' (2019, 2). Global health often continues to work in the interest of power and wealth.

Global health, like its precursor, revolves around 'its quintessential spaces, namely "resource-limited" or "resource-poor settings"' (Brada 2011, 285), that it finds in the Global South. 'Global South' - a term used in this thesis - denotes a political category rather than a geographical space and makes reference to colonial pasts; 'Within postcolonial studies, the terms metropole and postcolony or "the Global North" and "the Global South" are used to indicate a deterritorialised geography where "Souths in the geographic North and Norths in the geographic South" are entangled.' (Isin and Ruppert 2019, 210). Global health does not only build on and re-enforce Global North - South distinctions, and the power differences that shape these, it has also become a tool to protect national security. For wealthy, powerful nations, monitoring disease outbreaks elsewhere serves to better protect the health of their own citizens (Yates-Doerr and Maes 2019, 3). Allen and Parker (2023) illustrate this with reference to Ebola and COVID-19. In the context of AMR research, global efforts regarding the surveillance and management of AMR have also become more pronounced when AMR came to be framed as an issue affecting the NHS (Bud 2007) as cited in (Gradmann 2013).[8]

Newly emerging institutional configurations shaped global health. The World Health Organization (WHO), mostly aligned with the interests of the West,[9] was founded in 1948, and focused on 'flagship technically-oriented global disease campaigns' (Birn 2014, 8). In the following decades, many other leading organisations, including the World Bank and the International

[8] An example of a major surveillance effort is the Global Antimicrobial Resistance and Use Surveillance System (GLASS) (World Health Organization 2023).

[9] For a detailed account of the institutional developments of international health across the 20th century, including during the cold war, see for example Birn (2014).

Monetary Fund (IMF) followed (Birn 2014, 8).[10] Especially since the turn to the 21st century, philanthropic foundations, most prominently the Bill and Melinda Gates Foundation, have shaped the field of global health research (Brown, Cueto, and Fee 2006; Reubi 2018; Birn 2014). According to Birn, the Gates foundation's power has made it 'a de facto leader in the global health field', where 'Business models have proliferated […], with Gates Foundation efforts emblematic of an overall trend towards for-profit style management, leadership training, and goal-setting, as well as the privatizing of public health activities' (Birn 2014, 2). Birn describes Bill Gates (as well as Rockefeller) as the 'richest, most ruthless and innovative capitalist of [their] day', drawing a direct line to their foundations that act in the interest of capital. Gates continue to advance a narrative in which their foundation, and philanthrocapitalism in general, are supporting those in need through 'big business-style strategies' (Birn 2014, 2).

The World Bank as well as the IMF, among others, implemented neoliberal policies including structural adjustment programmes (SAPs), as 'practical tools […] at country level to promote […] market fundamentalism (Pfeiffer and Chapman 2010, 150). SAPs force recipient countries to forgo some of their sovereignty in exchange for loans and they 'redirect foreign aid to NGOs and away from governments' (Pfeiffer and Chapman 2010, 151). Pfeiffer and Chapman understand SAPs in a historical line with colonialism, 'The advent of structural adjustment came on the heels of colonialism and independence in much of the developing world, especially Africa, and signalled a definitive shift in the relationship of the West to its former colonies; a shift characterised by novel tools of extraction and new strategies of abandonment' (2010, 150). Similarly, Adams describes a continuity in which 'universal standards of measurement and audit were redeployed and reinvented by economists and politicians and formed into architectures of debt

[10] In her article on philanthrocapitalism, Birn describes these developments as follows, 'In the decades following WWII, a dizzying array of organizations connected to international health were founded or revamped, from bilateral aid and development agencies, to the World Bank and International Monetary Fund (IMF), to United Nations (UN) agencies including UNICEF, the Food and Agriculture Organization and the United Nations Development Program, to numerous international and local nongovernmental organizations (NGOs), humanitarian and advocacy movements, research institutes, private foundations, business groups, and so on' (Birn 2014, 8).

and finance that transformed former colonies into recipients of development aid' (Adams 2016a, 20). SAPs have broadly been shown to have negative effects on economies and on the health of recipient countries. Pfeiffer and Chapman cite multiple examples, including 'Schoepf's (2001) review of anthropological research on HIV/AIDS [which] highlights how the inequality and economic insecurity created by SAPs promotes HIV transmission' (2010, 155).

Uganda's prominence in contemporary global health

Global health's focus on the Global South typically comes to denote Africa rather than Asia or Latin America (Vaughan 2018; Yates-Doerr 2019; Marsland 2021), and Uganda holds a prominent place in the field. The country fits well into an imaginary of what a 'typical' African country is like: its climate is mostly tropical and indicators of health such as life expectancy (on average 62.7 years in 2021), maternal mortality (284 per 100 000 live birth in 2020) and wealth (GDP per capita 2670 USD in 2022) rank near the median for countries south of the Sahara[11]; infectious diseases such as malaria, tuberculosis, and HIV[12], as well as neglected tropical diseases (e.g. lymphatic filariasis, schistosomiasis, trachoma) which continue to be central to global health operations, are widespread (The World Bank 2024; Uganda Ministry of Health 2022). Its location also means that the country 'is considered a "hot spot" for emerging and re-emerging infectious disease epidemics' (Buregyeya et al. 2020). Global health researchers consider Uganda easily accessible. The country's health and research infrastructures, many of which were built in the colonial era, such as laboratories, hospitals, and educational institutions are mostly well functioning, there is a pool of trained researchers, and English is one of the official languages – all of which make it convenient for foreign researchers to work in the country. Additionally, for over three decades since

[11] The data were retrieved from *World Development Indicators*, made available by the World Bank (https://databank.worldbank.org, last accessed 12.4.24). Among the 48 countries south of the Sahara, Uganda's average life expectancy ranks 17th (i.e., 16 countries have higher life expectancies), the maternal mortality ranks 23rd (i.e., 22 countries have lower rates of maternal mortality) and the GDP per capita (in PPP) ranks 18th (i.e., 17 countries have a higher GDP).

[12] According to the *World Development Indicators*, Uganda's incidence of malaria is 284 per 1000 population at risk (the country's rank is 33, i.e. 15 countries out of the 48 countries have a higher incidence); incidence of tuberculosis is 198 per 100,000 population (rank 26, i.e. 22 countries have a higher incidence); HIV prevalence is 5.2% among ages 15- 49 (rank 37, i.e. 11 countries have a higher prevalence).

Museveni came to power in 1986, international aid organisations and global health funders have labelled Uganda as politically stable (USAID 2024).

Neither a war raging in the north of the country until 2007, nor Museveni's authoritarian regime, known to 'pursue[d] a policy of threatening, beating up and imprisoning members of the opposition (Parker, MacGregor, and Akello 2020) has deterred global health funders from labelling the country as politically stable, and from financing and conducting global health research and interventions in Uganda.[13] The country has been receiving large amounts of foreign aid[14], some of which relate to global health interventions. A recent article in *The Independent*, a large English language Ugandan newspaper, cited the head of the National Malaria Control Division at the Ministry of Health as saying that 'the cost of malaria control in public health has been 95 percent donor-dependent' (2024). Despite Uganda's political state, global health funding has been flowing into the country affecting the country's policies and the lives of most of its citizens.

(2) Making evidence in global health

Scholars in science studies working alongside scientists have long shown that science, contrary to its claims of objectivity and rationality, is shaped by the context of its production. The work of scientists emerges from historically contingent conditions, including infrastructures, normative assumptions, and aspirations. This applies not only to the contemporary context, but also to past science, and past science impacts contemporary science. Understanding how scientific evidence reproduces the conditions of its production has long been a focal point of science studies (Hacking 1992; Knorr Cetina 2007; Latour 1987; Pickering 1992; Shapin 1994). This thesis too is a study on the making of scientific evidence.

[13] Epstein argues that broader political interests shape this set up. In a *New York Review of Books* article in 2021, she described Museveni has 'one of the Pentagon's closest partners in sub-Saharan Africa'; who in exchange for military operations e.g. 'funnelling weapons to Sudanese rebels […] fighting [an] Islamist-dominated government' and providing his forces 'as guards under US command in Iraq […] has received tens of billions of dollars in foreign assistance from the US, UK, European Union, and other donors' (Epstein 2021).

[14] According to some estimations the country has received about 11 per cent of its annual GDP in foreign aid between 1990 and 2006 (UNU-WIDER 2013).

Making evidence in the colony

Science is closely tied to Empire.[15] Sir Ronald Ross, a British doctor who had been working in malaria research, wrote in 1899, that 'in the coming century, the success of imperialism will depend largely upon success with the microscope', as cited by Deb Roy in an essay on decolonising science (2018). Scientific progress, the 'success with the microscope', was not only a tool of colonial expansion, but it also came to legitimise colonisation in the first place. Scientific knowing, supposedly objective, rational, and fact-based, has been celebrated as an outcome of the European Enlightenment. This new form of rationality emerged in contrast to a past previously regarded as backwards and irrational. Thereby, it co-created a 'civilizational and racial hierarchy', classifying non-Europeans as irrational and to-be-enlightened (Appiah 2019). The ostensible superiority of scientific knowledge thereby came to justify the colonisation of the rest of the world. '[I]t implied that scientific insights could be redeployed to promote superior health, hygiene, and sanitation among colonial subjects. Empire was seen as a benevolent, selfless project' (Deb Roy 2018).

What counts as 'scientific' was defined by European scientists. Historians of science Chambers and Gillespie, argued in 2000 that '[w]hen historians sought richer, deeper, "thicker" accounts of science in non-European localities, they soon became dissatisfied with analyses in which every standard of truth and rationality was set in Europe, and in which the very meaning of "rationality," "enlightenment," "progress," and "useful knowledge" had been defined on that distant continent' (Chambers and Gillespie 2000, 222). These standards that had been defined in Europe and then held to be valid everywhere, discounted other ways of knowing. Achille Mbembe has formulated this critical insight in a poignant way. In his lecture on

[15] Historians have provided nuanced analysis on the relation between science and Empire. Tilley (2018), in her article on 'The History and Historiography of Science' published in the *Oxford Research Encyclopaedia of African History* highlights work that traces topics further back in time anchoring it in pre-colonial contexts. In a book review, Chakrabarti (2014, 289) summarises that 'Historians have persuasively argued that scientific knowledge (such as in tropical medicine and ecological and geographical sciences) at the height of Victorian imperialism was built on an understanding of and engagement with local conditions and knowledge systems', breaking with the dominant narrative of the exclusion of local knowledge systems in imperial science.

'Decolonizing Knowledge and the Question of the Archive' in 2015 in Johannesburg, he argued that (western) scientific knowledge's sophisticated technologies of falsifying hypotheses, self-declare to be the only valid way of generating knowledge, a knowledge 'that claims[s] detachment of the known from the knower', that is 'supposedly objective, […] universal and independent of context'. Scientific knowledge, not just in the context of global health research, marginalises, silences and sometimes oppresses other kinds of knowing, 'it actively represses anything that actually is articulated, thought and envisioned from outside these frames' (Mbembe 2015).

Colonial science produced a specific kind of evidence, one that reflected the premises it was building on. Bonneuil (2000, 260) summarised this point as follows, '[…] recent scholarship has viewed "colonial science" not merely as a science practised in the colonies […] but as a kind of knowledge specifically colonial both in the way it was crafted and in that it represented a discourse that conceptualized European domination and shaped the subjectivity of the colonized people.' Not only the ways in which scientists worked in colonial times but also the very evidence they made, reflected and reproduced the inequalities that their scientific endeavours took as a starting point.

Between the 1940s-60s, colonial research both expanded considerably and became increasingly centralised. A research fund and a development grant of unprecedented volume were issued in 1940, both to be distributed by the Colonial Office in London (Clarke 2018, 143). This grant supported 'fundamental research' - the notion of fundamental research highlighted the freedom of the researcher; Clarke (2013, 340) explains, that 'freedom in this case meant the absence of interference from those who lacked experience of carrying out research themselves'. Researchers were understood to be 'free' when not collaborating with people who were familiar with the local context. In 1945, the Colonial Research Committee was founded, which Clarke (2013, 340) understands as an attempt 'to marginalise the input of doctors and scientists based in East Africa [...]'. Notions of fundamental research became tied up with the exclusion of those who knew the spaces in which the research unfolded. This set-up marginalised the expertise, knowledge, and skills of potential collaborators in the colonies, minimizing their agency in the research about conditions that affected them. It also featured an image of scientific knowledge

that is not - and ought not to be - locally contextualised and would therefore be more easily generalisable. In fact, in a more recent publication, Clarke describes 'fundamental research […] as the investigation of widely occurring, general problems that occurred on such a scale that local supervision by individual technical departments would be inappropriate' (2018, 144). Through the centralisation of colonial research, and its focus on 'fundamental research', local specificities became increasingly devalued and universal models of diseases grew in significance (Clarke 2007; Moore-Sheeley 2018).

Colonial health research in what came to be Uganda

During the colonial period, scientists built research infrastructures and conducted health research in what is now Uganda. One pertinent driver was an epidemic of African trypanosomiasis (sleeping sickness) in the early 20th century, that broke out in Uganda in 1901. Imperial governments sent scientific specialists to study this threatening disease that might weaken or reduce the labour force (Hoppe 1997). During a mission in 1902 'Aldo Castellani, a bacteriologist and student of Manson at the London School, established a small laboratory at Entebbe on Lake Victoria, where he identified several pathogens in the cerebrospinal fluid of sleeping sickness victims' (Headrick 2014, e2772). Soon after, during a subsequent mission, David Bruce and colleagues identified the precise protozoan that caused the disease as well as found out that the tsetse fly was responsible for transmission (Headrick 2014). The colonial scientists also linked the human disease to an animal disease called nagana (Tilley 2004).

Capacity for health research was further expanded in the following decades. Institutional capacity building included *The Uganda Virus Research Institute* (UVRI) that was funded under the name of *Yellow Fever Institute* by the Rockefeller Foundation in 1936 as one of two Virus Research Institutes located in Entebbe and in Lagos, Nigeria. Both institutes were subsequently taken over by the British colonial office in 1945, and from then on the Entebbe-based institute was called *Virus Research Institute* (Clarke 2007), and then from 1977 *Uganda Virus Research Institute* (Sempala 2002). The institute is still active today

(see below, under 'Making evidence in the post-colony' for examples on HIV research).[16]

Hailey, writing in 1957 as part of his large and influential *An African Survey: A Study of Problems arising in Africa South of the Sahara*, described the agenda of the Virus Research Institute at Entebbe as follows: 'It has been chiefly concerned up to the present with the distribution of Yellow Fever and its incidence in the forest monkeys of Western Uganda and of other areas. At the suggestion of the WHO a number of samples of human blood from the Belgian Congo, Angola, Tanganyika, Northern Rhodesia, and Nyasaland have been examined with the aim of delineating the southern limit of the disease in Africa' (Hailey 1957, 1080). The geographical distribution of Yellow Fever among colonised countries in Africa south of the Sahara is an example of a concern relevant for colonial governments (who might use this information to predict epidemics amongst their labour force), which is not relevant for the people affected by the disease. Hailey, writing five years before Uganda's independence, did not try to present an image of an independent institution working in the interest of the local population. He even added that the suggestion of this study had come from the WHO, thereby fostering the impression that the institute was working in line with international rather than local interests.

Colonial scientists not only produced scientific evidence on infectious diseases in the region, but also on non-communicable diseases. Mika, in her book *Africanising Oncology*, describes how cancer research in the late colonial period opened up broader health inquiries, '[M]uch of the research conducted at Mulago from the 1940s onward was characterized by the desire to articulate the specific disease ecology of East Africa and also to consider the ways rapid urbanization and changing patterns of food and material goods consumption reshape patterns of illness' (Mika 2021, 29). Cancer research further contributed to the stepping up of capacities to conceptualise disease geographies in what is now Uganda.

[16] As of today, UVRI is a Ugandan government institution (see https://www.uvri.go.ug, last accessed 22.3.24), as well as part of the MRC/LSHTM collaboration (see https://www.lshtm.ac.uk/research/units/mrc-uganda, last accessed 22.3.24).

Uganda's largest educational and research institution, Makerere University, was also founded in colonial times. According to the 'History' page of the institution's webpage, it was founded in 1922, and by 1935, it had established itself as a leading educational institution in East Africa (Makerere University 2024). Sicherman describes the role of Makerere in the time after its opening as a training institution for 'medical assistants, surveyors, school teachers and similar auxiliary personnel for the colonial service'. From 1949 to 1963, Makerere was part of the University of London, 'which granted their degrees and ensured adherence to the "international gold standard"' (Sicherman 2002, 92).[17] Despite the direct colonial ties, there were also critical voices at Makerere. Frank Girling and Okot p'Bitek, both Oxford-trained anthropologists, had positions there. They shared 'not least an antipathy for European attitudes to Africans, very mixed views about the teaching of anthropology and the experience of being forced out of their positions in Uganda' (Allen 2019, 12-13).

Making evidence in the post-colony

The colonial legacy of global health research continues to shape the field's current research practices. Some describe global health research as neo-colonial science (Horton 2013; Boshoff 2009; Birn 2014). However, Yates-Doerr and Maes highlight that to 'foreclose global health as an inevitably colonialist project risks another erasure given that scholars located in the so-called Global South have been busy using – while simultaneously remaking – global health's infrastructures in powerful ways' (Yates-Doerr and Maes 2019).

Funded and led by northern institutions, the most common mode of conducting contemporary global health research has been through transnational collaborations. These consist of a collaborator (e.g. an institution, or a group of researchers) in the Global North and one or more in the Global South (Geissler and Okwaro 2015; Wendland 2017). These 'collaborators' are sometimes also referred to as 'partners', labels that, according to Crane, work

[17] On the Makerere's webpage, the end of this arrangement in 1963 is euphemistically described without reference to the country's impendence, 'With the establishment of the University of East Africa in June 29, 1963, the special relationship with the University of London came to a close and degrees of the University of East Africa were instituted' (Makerere University 2024).

as a (rhetorical) strategy to 'confront the deep inequalities', and are a 'reaction to post-colonial anxieties' (2010, 90,82). The collaborators come to the projects from vastly different starting points: many institutions in former colonies depend on the collaborations to sustain their research endeavours, while for many collaborators in the Global North they present a dispensable, even if prestigious, addition (Mika 2017). There is a 'scramble for Africa' among northern collaborators, with American elite universities leading the way, who can choose which institution to work with, and if convenient, can easily change and move on to the next one (Crane 2011). In these unequal collaborations, funding and administration of research grants comes with a 'continued domination of collaborative agendas by the interest of Northern donors and scholars' (Bradley 2008, 674; Crane 2020).

The responsibilities of the researchers within these collaborations often differ substantially. Researchers at northern institutions continue to take a leading role in designing studies, and researchers at institutions in the Global South often are responsible for data collection only, implementing protocols devised without their input. A stark difference in available resource, in particular relating to e.g. laboratory equipment or computing power further aggravates the inequality. Though often framed as 'interchangeable cogs in the machinery', ethnographer Cal Biruk shows in their work on survey projects on HIV in Malawi the crucial translational labour of field assistants that enable global health projects to work, despite their precarious status in the projects and their ostensibly marginal role (Biruk 2018, 28; 2012).

The continuing dependence of Global South research institutions (and researchers) on their Northern counterparts came to be criticised in the 1970s and 1980s as part of a wider discourse on development (Li 2007). In response, capacity building initiatives have been in vogue since the early 1990s;[18] these come with the promise of providing lasting contributions in the country where

[18] In a talk given at the Carnegie Corporation in New York in 1989, Adetokunbo O. Lucas, a Nigerian doctor and 'global health leader' as per the LSHTM webpage (https://www.lshtm.ac.uk/newsevents/blogs/2021_/professor-adetokunbo-o-lucas, last accessed 11.4.24), presented colonial research in a very positive light, praising the 'courage and ingenuity' of colonial scientists. According to him, colonial era tropical medicine came with only two problems, one of which was the lack of capacity-building. The other one was the lack of attention paid to general health concerns (Lucas 1989, 18).

the research is being conducted and purport to have independence and equality as their goals. Capacity building is framed in opposition to what came to be called parachute research, whereby a parachute researcher is 'the one who drops into a country, makes use of the local infrastructure, personnel, and patients, and then goes home and writes an academic paper for a prestigious journal' (The Lancet Global Health's International Advisory Board 2018, 593). The promise of eventual independence helped to shape global health 'as a morally unambiguous but fundamentally apolitical enterprise' (Geissler and Tousignant 2017, 349). Contributions to the special issue 'Capacity as History and Horizon: Infrastructure, Autonomy and Future in African Health Science and Care' published in 2016 problematise the notion of capacity building and bring to the fore that there are 'incapacities that global health capacity-building initiatives are rooted in, thrive on, reinforce or reproduce'; (Geissler and Tousignant 2017, 349). This critique of capacity building initiatives is much in line with critiques of global health in general (Crane 2010).

Infrastructures in formerly colonised places continue to reproduce their colonial histories too. In their recent article on 'Imperial remains and imperial invitations', Kimari and Ernstson (2020) argue that 'colonial processes continue to scaffold contemporary infrastructure projects in East Africa', (2020, 827), including those funded through South-South relations. Relatedly, in their work on two contemporary railway projects, one in Kenya and one in Tanzania, Enns and Bersaglio (2019) place these projects in their colonial histories. This lens allows them to 'illustrate how the spatial visions and territorial logics of colonial administrators are reappearing in the discourses, documents, and visions surrounding these corridors today' (2019, 104). In their work on sanitation infrastructure in Kampala, Lawhon, Nsangi Nakyagaba, and Karpouzoglou (2022) discuss how modern infrastructure in the city was 'built for white residents in the urban core' (2022, 7) impacting today's sanitation landscape. The authors present evidence on the patchwork nature of contemporary sanitation infrastructure in Kampala, and centre alternatives to the – as they argue - unachievable ideal of flushing toilets for everyone.

Infrastructures produce occasions for intervention and measurement, in other words – for research. The ways in which e.g. a sanitation system functions, and fails to function, produces the very objects that research studies,

such as D-Lab investigate. At the same time, international research programmes, including clinical studies where the trialling of interventions becomes part of routine care and observational research, such as D-Lab's, provide infrastructural work in their field sites. In D-Lab's case examples for infrastructural work included the strengthening of laboratory capacities and the training of researchers, as well as the labour of field staff who provided health education and as well as screened their research participants for COVID-19 (see chapter 4, on the distribution of research labour). While such labour is often framed as part of 'capacity building' (see above), this outsourced *maintenance labour*[19] leads to persistent deficits. In post-colonial contexts, the landscape of research and clinical practice is commonly patched up by international projects. D-Lab, in this way, exemplifies these historical trends. By becoming part of infrastructures relating to both research and clinical work, D-Lab becomes a case to understanding how such infrastructures function.

Research in post-colonial Uganda

After the end of the colonial period in Uganda, and in particular since 1986 when Museveni came to power, Uganda has been central for global health research. In particular, the early HIV epidemic in Uganda has brought global health interest into the country. The director at the time of the Uganda Virus Research Institute (UVRI)[20] described this development in a published profile of the institute in 2002; 'efforts were mounted to revive research activities at UVRI after blood samples from patients with the "slim" disease in Uganda were tested in the UK and found to be positive for antibodies to HIV, a disease which at the time was already common in the USA and Europe' (Sempala 2002, 347). The spread of a virus that was causing substantial harm in donor countries made Uganda particularly appealing to work in. A few years later, Kuhanen inferred 'that becoming a testing ground for AIDS interventions is the price Uganda has had to pay for deciding, in the face of rising AIDS death figures

[19] Doherty (2019) analyses waste management in Kampala as a lens to understand infrastructural maintenance work. Focussing on maintenance and cleaning work in this urban space, he writes that maintenance work is 'undervalued by a culture that fetishizes growth, innovation, and entrepreneurialism', and argues that it is 'necessary to understand its [*referring to maintenance work*] spatial and political effects' (2019, 25).

[20] UVRI's history goes back to colonial times, see above in the section on colonial research.

and HIV infections, to open its doors wide to the international aid organizations in the early 1990s' (Kuhanen 2008, 302).

Global health funders including the Gates Foundation, the Rockefeller Foundation, the World Bank, and the Global Fund as well as an increasing number of universities in the Global North currently fund large scale global health research programmes and develop research institutions in the country. In 2023, for example, the Makerere School of Public Health received a 100,000 USD donation from the Rockefeller Foundation for the construction of a new building on the university's main campus. While this may sound like an investment in local educational infrastructure, the announcement of the donation on the webpage of the Rockefeller Foundation references global implications. The short article includes a quote of the Dean of the School of Public Health, Dr. Rhoda Wanyenze, highlighting that Ugandan public health also means global health security; 'Given its location within a region prone to infectious disease outbreaks of epidemic and pandemic potential, this building will accommodate a Centre for disease outbreak prevention, preparedness and response research in addition to other Centres of Excellence, […] We are extremely grateful to The Rockefeller Foundation for their generosity. Your past financial support has been invaluable to the growth of public health in Uganda, in Africa and globally' (The Rockefeller Foundation 2023). The Rockefeller Foundation, by citing this passage, show that they are not concerned with presenting an image of selflessness, and rather frame their investment in a Ugandan institution as potentially benefitting the security of the Global North.

Contemporary research in global health continues to reflect the colonial logics it emerges from, not only in the distribution of research resources and modes of conducting research work but also in the science it promotes. Numerical evidence with its apparent objectivity and neutrality plays a prominent role in the field.

Standardisation and metrics in global health research

In the introduction to the edited volume *Metrics: What Counts in Global Health*, Adams lays out the extent to which metrics permeate and shape the

field of global health. Powerful global health institutions such as the Gates foundation or the World Bank,[21] she writes, 'all envision using a form of global knowledge that is based on universals (biology, disease, vaccines, etc.), in which multiplicity is visible only in and through global (that is, universal) forms of data production that get lumped together as "metrics"` (Adams 2016b, 6). Adams describes the role of metrics as offering the ostensible possibility of apolitical global health evidence. She writes that metrics are meant to 'transcend politics altogether. […] Metrics will, once and for all, get us talking about evidence instead of politics.' (Adams 2016a, 23). Metrics more generally purport a sense of neutrality as well as objectivity (Porter 2020 [1995]). Numbers on spreadsheets, more than narrative or other forms of evidence convey a distance between the researcher and their object of inquiry by 'conceal[ing] their conditions of production' (Moats 2016). Birn describes both the Gates and the Rockefeller foundations as 'deeply political animals' who are 'all the while claiming the technical and purportedly neutral scientific bases of their efforts' (Birn 2014, 1).

Global health also employs universal goals that are tied to specific metrics. The United Nations developed the Millennium Development Goals (MDGs) to be achieved until 2015, and subsequently the Sustainable Development Goals (SDGs) (United Nations Development Programme 2024). These universal standards and goals guide much of global health's work. In order for a global health intervention to be funded, researchers need to prove its measurable impact and its cost-effectiveness, often in relation to these universal goals. This proof of impact happens through a set of metrics. One important metric here is disability adjusted life years (DALYs). These 'provide a common […] metric, of health loss that accounts for the duration and severity of health conditions in order to measure the overall burden of disease'. They were introduced by the World Bank in 1993 'as a measure of health and promoted the principle of cost-effectiveness to guide health investment.' (Pfeiffer and Chapman 2010, 151). Interventions that come with higher returns for less money are more likely to be funded. DALY and other such metrics

[21] The World Bank has 'alongside its direct lending, […] positioned itself as a self-described "Knowledge Bank", producing expertise on health policy and financing, and has taken on new roles within global health partnerships and trust funds' (Tichenor et al. 2021, 2).

function as 'performance metrics' of global health interventions (Ehrenstein and Neyland 2018, 60).

Universal goals and metrics build on universal definitions of diseases, as well as 'a uniform set of social and economic determinants of health' (McCoy et al. 2013). Conditions and diseases are made to exist independent of their particular social, economic, political, or ecological context. To produce evidence on such universal conditions, researchers employ pre-validated tools, with which they measure pre-identified indicators. Knowledge of the specific contexts in which a research projects unfolds is thereby of little interest. Such evidence on universal conditions strives to be valid in general and not tied to any specific context. This kind of research, that intends to produce universally valid evidence can be seen in a historical line with the colonial 'fundamental research' described by Clarke, which deliberately wrote out the input of 'local' research staff (Clarke 2018).

The universal goals and the accountability requirements shape how global health problems are defined and what kind of solutions are devised, and the timeframes in which said solutions need to be proven effective. Rather than funding research and development of broad infrastructural interventions that are likely to pay off in the long run (but whose effect is difficult to measure), there is a tendency for vertical, disease-specific programmes and technological solutions (Gimbel et al. 2018). The tendency persists despite warnings that 'disproportionately concentrating funds into disease-based initiatives in developing countries may compromise health systems and fragment complex interventions' (Béhague and Storeng 2008, 644). Instead of strengthening health care systems, or investing in water and sanitation systems, global health research rather funds eradication campaigns of specific infectious diseases.[22] The discussion around vertical versus more holistic, or horizontal approaches is also tied to evidence – the impact of vertical programmes can be assessed through experimental designs, e.g. randomised controlled trials (Béhague and Storeng 2008). Through global health work, vaccines, bed nets, water filters,

[22] For an extensive critique of eradication, see Taylor (2016).

and other technological devices are distributed, while health systems are rarely strengthened (see e.g. Redfield 2016).

Global health metrics categorise people, conditions, or places, and the act of categorising has a performative effect – it brings into existence populations, diseases, symptoms, as well as places that otherwise would not have existed (Reubi 2020; Erikson 2012; Barad 2003). Adams et al. (2024) illustrate the performativity of metrics with the example of the making of COVID-19 pandemic as a political event through anticipatory metrics. Categorisation through counting and measuring is a tool of governing on supposedly neutral terms. Adams summarises an argument made by historians of science, on metrics as 'a morally aspirational undertaking', that offered possibilities 'for creating policies for governing that took ethical questions out of the hands of the priests and colonial rulers and put them into the morally neutral hands of scientifically minded experts.' (Adams 2016a, 20). The 'scientifically minded experts' of today can be found in the leading global health institutions, as laid out above, who implement their programmes and assess them through supposedly universal metrics.

One example of such a performative category featuring prominently in global health research is the 'household'. An early colonial invention, households have been a central demographic category, shaping development work (and by extension resource allocation) in many parts of the world to this day. In the D-Lab study, households represent the main unit of analysis, and the study authors hypothesise that they play a central role in the development and spread of AMR. In D-Lab, households refer to co-residing groups of kin, as well as to the space (such as a compound or an apartment) the group inhabits; for more details on the making of the households in D-Lab, see chapter 3.

In her chapter on households and hearth-holds, Ekejiuba (2005, 42) argues that 'the assumptions of a simple household model do not fit African residence, production, decision-making and consumption patterns'. Building on her work in rural west Africa, in particular in Nigeria, she contends that households, which are understood to be headed by men, are flawed and unstable units and instead suggests an alternative: hearth-holds. Hearth-holds

are women-centred social units which link a mother and her dependants. Relating households, and hearth-holds, she elaborates that households might contain more than one hearth-hold, and men might 'oscillate[s] between several hearth-holds, that of [their] wives, mother and mistresses' (Ekejiuba 2005, 43). She argues 'that the hearth-hold creates a more internally coherent, tightly bound entity with more clearly defined and hence less contestable social relations. Thus, it is more socially, economically and emotionally stable over time. The incidence of divorce, separation, and vertical or horizontal multiple marriages makes the household a more volatile unit.' (Ekejiuba 2005, 44).

Ekejuba explains that common definitions of households which refer to them as 'capitalist institution[s] […] project middle-class, western capitalist gender relations on pre-capitalist and non-western emerging capitalist systems' (2005, 42). These colonial units of administration undermine the active role of women, framing women as marginalised and passive. Relatedly, previous work on domesticity in several African contexts has focussed on gender relations in colonial and post-colonial contexts. In her article on domesticity in Belgian Africa, Nancy Rose Hunt (1990) presents an account of the making of gender roles within idealised nuclear families. Taking the institutions of *foyer sociaux* as the starting point, she traces the colonial making of monogamous nuclear families, in which women are meant to 'radiate moral standards and behavior for men and children' (Hunt 1990, 451).

Nakanyike Musisi (1992), in a similar vein to Hunt, traces back the development of educational institutions for girls in the first half of the 20th century in Uganda. Drawing on archival data, she shows that education at the time lay in the hands of Christian missionaries, interweaving colonial ideas of 'civility' with that of Christian ideology. Girls' education, much like in the pre-colonial period, she underlines, was geared towards training in domestic labour, such as cultivating plants, preparing food, and raising children. The missionaries' vision, shared in parts with that of chiefs, was that girls were to become good housewives to men with ideally a high status. These schools, catering to aristocrat families, shaped and sharpened ideals of girls' and women's domesticity.

More recent work continues to complicate narratives of supposedly patrilineal, monogamous societies across Africa. In their article, Kusimba, Yang, and Chawla (2016) analyse relational networks through mobile money transfers in Kenya. They find that women hold a central position in these networks. Mobile money relationships are 'intimate and private investments in the hearthhold', they argue, and thereby avoid 'threatening widely held ideals of patrilineal solidarity' (Kusimba, Yang, and Chawla 2016, 267). Kusimba, Yang and Chawla describe networks of care through mobile money transfers that centre women and their children and grandchildren, and where men feature less commonly as fathers but rather as children, or mothers' brothers. In the South-African context, Knight, Hosegood, and Timæus (2016) explore how families care for their relatives living with HIV in South Africa. Networks of kinship and care extend beyond nuclear family relations, and reciprocal support 'is driven both by a sense of personal or conditional obligation and by a concurrent expectation and desire to be seen to be acting in a socially acceptable way' (2016, 23).

Households, and the supposedly nuclear, monogamous families headed by men - as idealised by colonial administrators and Christian missionaries - continue to serve as administrative categories and to have far-reaching effects. Ekejiuba (2005, 43) makes it clear that critiquing this categorisation is far from being only a theoretical concern, she writes '[T]he gap between reality and theory has had disastrous consequences for women's livelihood, national well-being and food security since women have hardly been targeted as beneficiaries of mainstream development […]'.

(3) AMR in Uganda and in global health

This section serves to embed social science scholarship on AMR into the literature presented above, as well as to provide a short overview of AMR research and policy in Uganda. Since I discuss some of the AMR literature in the introduction, this section is relatively brief.

In response to rising international concern around AMR, the Uganda National Academy of Sciences published a report on AMR in Uganda (Uganda National Academy of Sciences et al. 2015). A few years later, in 2018, the

government of Uganda published a National Action Plan (NAP) (Government of Uganda 2018). Around the same time, 'The National One Health Strategic Plan' was launched that emphasises AMR as one of its key issues (Uganda Ministry of Health 2018).[23] A relatively small number of clinical studies have investigated the presence of resistant bacteria in humans and in animals in Uganda. Kajumbula et al. (2018) documented high rates of resistance in bacteria isolated from blood cultures at a tertiary hospital in Kampala**,** particularly in relation to first line antibiotics. In their studies with pastoralist communities in the southwest of the country, Iramiot and colleagues found high rates of resistant bacteria in the guts of people (Iramiot, Kajumbula, Bazira, Kansiime, et al. 2020) and indications of transmission of resistant bacteria between animals and humans (Iramiot, Kajumbula, Bazira, de Villiers, et al. 2020).

Much in line with global health's attention to (seemingly malleable) behaviours over infrastructures, discourse on AMR often centres around antimicrobial usage (AMU). AMU - often framed as misuse, overuse, or irrational use - features as an important driver of AMR, blaming patients (and in some cases providers) for their ostensibly irresponsible behaviours (Hinchliffe, Butcher, and Rahman 2018). In contrast, anthropologists, who worked in Ugandan contexts, have shown how antimicrobials serve as their own infrastructure (Chandler 2019), enable livelihoods (Nabirye et al. 2021; Nayiga et al. 2022) and act as a 'quick fix for care, productivity, hygiene and inequality' (Denyer Willis and Chandler 2019). Accusations of 'irrationality' not only blame those who supposedly lack rationality, they also legitimise interventions (Denyer Willis, Kayendeke, and Chandler 2023). Further studies on AMR have analysed the scientific discourse on the topic, e.g. investigating the war-themed vocabulary through which scientists describe AMR (see for

[23] In their article on operationalising the One Health approach in Uganda, Buregyeya et al. describe the institutional collaboration that led to the strategic plan, mentioning that it was U.S. American funds that enabled the work; 'In 2016, four main government entities: health (MoH); agriculture (MAAIF); Uganda Wildlife Authority (UWA) – an agency under the Ministry of Tourism Wildlife and Antiquities; and Water and Environment (MWE), formed a collaboration (with financial and technical support from The U.S. Agency for International Development Emerging Pandemic Threats 2 Program (USAID/EPT-2) Preparedness and Response (P&R) Project). These sectors established the One Health Framework (OHFW), a document that legalizes their formal collaboration and guides their operations' (Buregyeya et al. 2020, 251).

example, Nerlich and James 2009; Walker 2020),[24] as well as the apocalyptic narratives that often surround it (Brown and Crawford 2009; Brown and Nettleton 2017).

Despite AMR's common framing as a global health concern, and the dominance of transnational global health collaborations in the field, there are, to my knowledge, no studies investigating the making of evidence on AMR in that context. AMR mirrors as well as reproduces the inherent inequalities of global health research. And AMR's context-dependency, messiness, and complexity are ill-fitting for the rigid frameworks and quantitative methodologies of the field. Neither of these concerns have held researchers back from making 'scalable' evidence (Ehrenstein and Neyland 2018) on AMR within transnational global health research collaborations. The frictions that occur in this process provide the substance of this thesis. Each subsection below deals with one aspect of global health research and how it relates to AMR. For each subsection, there is a corresponding data chapter.

Standardising AMR (→ chapter 3)

Global health research builds on standardised, quantitative evidence, that is not tied to the context of its production. To this end, diseases, conditions, places, and contexts get flattened into countable indicators. The messiness and multiplicity of AMR renders this process particularly challenging (Chandler 2019). The very biological reality of AMR changes over time and place, and so do diagnostic and therapeutic resources, as well as surveillance efforts (Landecker 2016, 2019). In chapter 3, 'Standardising evidence: the recursive making of field sites, communities, households, and AMR', I attend to the ways in which researchers standardise the object of AMR through a standardisation of the spaces and practices from which it emerges.

[24] In his article on antibiotic resistance between 1900-1940, Gradmann quotes scientist Paul Ehrlich who in 1906 called the possibility of antimicrobials '"magic bullets" that killed germs but not host cells', a very early example of the employment of military metaphors in the context of antimicrobials (2011, 310).

Grappling with global health research inequalities that shape AMR (→ chapter 4)

Global health research is an unequal endeavour, and AMR mirrors as well as amplifies in-built inequalities. In part, this is evidenced by the continuing dominance of researchers from the Global North, many of whom impose their agendas and framings while working under considerably better circumstances to their collaborators at Global South institutions (Crane 2010; Biruk 2018). In chapter 4, 'Distributing research labour: adaptation and exclusion in the making of AMR', I attend to the unequal labour conditions within transnational global health collaborations and analyse how they shape evidence on AMR, in particular through the exclusion of local knowledge.

AMR in humans / animals/ the environment (→ chapter 5)

Global health policy, funding, and expertise often cuts along the lines of human, animal, and environmental health. Microbes and antimicrobials travel across these three spheres, challenging these neat distinctions, and AMR has therefore been labelled a 'One Health' problem. This framing highlights the intersections and interdependencies between the three spheres (Cañada, Sariola, and Butcher 2022), and renders AMR into a problem of connectedness (Chandler 2019). However, global health continues to centre separation, aiming to cut off microbial connections rather than taking them as a starting point. In chapter 5, 'Drawing pathogenic risk: the One Health framework in AMR research', I follow the One Health framework in research on AMR, and trace how in an attempt at employing the framework, researchers instead accentuate perceived boundaries between these domains.

AMR as a product of individual practices (→ chapter 6)

Global health's neoliberal outlook and focus on small scale interventions with measurable, short-term impacts, diverts attention away from structural concerns. Typically, emphasis is given to the beliefs and behaviours of people, which are understood as malleable through e.g. awareness campaigns. This also applies to the area of water, sanitation, and hygiene (WaSH), where global interventions often focus on behaviour change instead of improving water and waste infrastructures. Despite AMR's complexity, - Landecker (2016) describes it as an ecological event emerging from past approaches to managing microbes

- global health institutions continue to falsely 'suggest narratives of mastery and eventual control' (Hinchliffe 2021, 3) and it has also been understood as an issue of WaSH. In chapter 6, ''Water, sanitation, and hygiene: behavioural approaches in contaminated landscapes', I attend to the focus on individual practices around water and sanitation in the making of evidence on AMR, shedding light on how this focus flattens the ecological and political context in which said practices occur.

Conclusion

Scientific evidence emerges from and reflects its historical, social, and political context. Colonial legacies of global health research continue to shape the field, which thrives on health inequalities (Crane 2010). These legacies become apparent in the health issues the field addresses, which often are in the interest of Global North researchers and funders, e.g. because they relate to global health security (Yates-Doerr and Maes 2019). Global health's preferred mode of evidence making, highly unequal partnerships between Global North and Global South institutions also reflects the field's past (Crane 2011). Quantitative evidence, that is not tied to the specific places in which it was made, but instead aspires to be scalable, is valued the most. Global health funders present this kind of evidence as scientific, objective, and apolitical (Birn 2014).

AMR is considered an urgent global health problem, estimated to have far-reaching effects on health globally in the near future, including in well-resourced countries in the Global North (Gradmann 2013). While often framed as a global issue, the biological reality of AMR, as well as diagnostics and possibilities of care differ widely across place and time (Landecker 2016). AMR's multiplicity renders efforts of producing quantitative evidence particularly challenging (Chandler 2019). The perceived global urgency, and in particular fears of northern governments of the predicted effects of AMR makes it a prominent topic in global health. Despite its multiplicity and context-dependency, AMR continues to be studied as a coherent condition. This thesis contributes to our understanding of the processes that allow for AMR to be made into a global health object, that reinforces its (post-)colonial histories.

Chapter 2: Making evidence: reflecting on methodologies and fields

After a day in the field with the D-Lab team, Ivan, Francis, and I were waiting at the door of the large white van in which we had been travelling around all week. We moved between the households where they pilot-tested their tools, the little guesthouse we stayed at, and the restaurant where we went for breakfast and often also for a meal after long days of work. The sun had just set, it had got dark quickly, but the streets were still busy. We chatted about the day, both Ivan and Francis seemed curious about me and what I was doing there. Francis asked me whether I knew much about STATA or R,[25] in a tone that suggested to me that he was certain that I would be very skilled at using them and that I could maybe share some resources with him. My status of being a PhD student in a well-resourced country seemed to suggest that. I replied I had rudimentary skills but nothing very advanced. Surprised, Ivan and Francis got interested in how else I would do my data analysis for my PhD. I told them about how I was not going to count or measure but how I was working to understand what it means to work in a research collaboration such as D-Lab, and what that says about the evidence that comes out. In other words, I was working to understand what they were up to.

I had tried articulating what my project was about before, in numerous introductory rounds and also in conversations with team members, but in that moment, I felt like I had been more successful than before. I told them that it is their work, and their insights that I am interested in, and that that is what I will write about. Before other team members joined us in the van, and we set off to the restaurant, Ivan asked me a seemingly innocuous question that stuck with me for a long time: who is it then, that is studying you? I was struck by how on point the question was, and how it pointed to the lack of reciprocity that our relations came with, reflecting the histories that brought all of us to this place. I awkwardly suggested that they could study me. Ivan responded with laughter, and our conversation got swallowed in

[25] These are two software packages designed for the analysis of quantitative data.

the group chatter of the rest of team who had just joined us in the van.

[Fieldnotes, Hoima, 4.3.2020]

This thesis is an ethnography of global health research, and the making of AMR. As Wenzel Geissler stated in the introduction to his edited book, *Evidence, Ethos and Ethnography: The Anthropology and History of Medical Research in Africa*, 'Ethnography allows for 'tracing relations and separations that shape social space. [...] ethnography implies both studying social relations across domains and levels of scale, and beyond locality, and understanding people's, including scientists', lives; both fascination with 'global assemblages' and attention to intimate social encounters and engagements' (Geissler 2011, 8). In this chapter, I lay out how I worked ethnographically, my attempt at attending to relations at various different scales through which the scientific object of AMR gets made.

In the first section, I introduce the ethnographic starting points which led me to ask these kind of questions. I also describe how I set up the research. In the second section, I describe the D-Lab study. Here, I reflect on both D-Lab's and my own rationale to work in Uganda. In the third section, I provide a chronological account of my fieldwork around D-Lab. This is followed by a discussion of the impact of the COVID-19 pandemic on my field work and on D-Lab's, and my concept of field. The last section deals with the ethics of doing this research, including the formal procedures for research clearance, and reflections on my positionality. The blended description of my study and of D-Lab's serves to contextualise the rest of the thesis, while also opening up the reflective process of evidence making. The following four empirically grounded chapters build on this chapter, presenting the evidence I have made and providing a fine-grained analysis of the processes of evidence making in D-Lab.

Ethnographic starting points

Abigail Neely and Alex Nading prompt us to consider 'how the situation of our own knowledge as critical social scientists shapes the kinds of stories we tell about global health' (2017, 55). They refer explicitly to our institutional

embeddedness. The London School of Hygiene and Tropical Medicine (LSHTM) has been the institutional home for this PhD and it served as a starting point for my interrogation of global health work, shaping my questions, concerns, and ideas of what global health is. LSHTM provided me with an insider perspective that I would not have had in a more conventional anthropology department. At LSHTM, my fellow PhD students who I shared offices with, almost exclusively worked on projects that fitted comfortably within the realm of global health research. They were working, for example, on cost-effectiveness analyses, or on studies around 'barriers' and 'facilitators' to preventive, diagnostic or curative care. Apart from the spaces that anthropologists and historians have carved out, the logics of global health governed the discourse around me.

Funding for my PhD, including a stipend and research costs were covered by the Medical Research Foundation's *National PhD Training Programme in Antimicrobial Resistance Research.*[26] The programme also provided me with a network of researchers and colleagues that came to inform this work. The programme funded two cohorts of about 15 PhD students - each across a wide network of universities in the UK. All of the PhD students were working on different aspects of AMR and we met either in-person or virtually three times per year for workshops or conferences. Although it was set up as a multi-disciplinary programme, there were a large majority of students in the natural and medical sciences, and the academic as well as administrative staff leading the programme were laboratory scientists too. At our meetings, I gained insights into how PhDs in the sciences work. The more time that passed, the better we got at asking each other meaningful questions about our respective PhDs. I learnt about the science of AMR as it was unfolding in the UK. As part of the programme, I also attended scientific conferences on AMR, and excursions as part of the regular workshops led us to UK dairy farms and large hospital laboratories. These experiences helped me to make sense of AMR as a

[26] For more detail on the programme that funded this research see: https://amrtraining.ac.uk (last accessed 26.3.2024) or at the funder's website: https://www.medicalresearchfoundation.org.uk/projects/national-phd-training-programme-in-antimicrobial-resistance-research (last accessed 26.3.2024)

global concept, and to contextualise what I was seeing in the Ugandan context of D-Lab's research.

My status as an outsider in this group of PhD students became particularly evident at conferences where we presented our work to each other. I was usually placed in sessions on 'behaviours'. This referred to how the 'behaviours' of people explain AMR. It implied that their behaviour needed to be changed, which is what social science to the scientists was about. Typically, the session came at the end of the conference - after the scientists had presented their findings. Their slides were full of peptides and long names of enzymes, experimental conditions, and concerns about the potential contamination of whole sample sequences, and their last slides showed photos of their laboratory teams - large groups of students, post-doctoral researchers, and professors, all working on aspects of the same overarching questions. None of them had to figure out what it *actually* was that they were working on. On my slides, I would show photos from fieldwork, and complicate concepts such as 'contamination'. Before starting, I always felt the need to warn people about how different my presentation was going to be from theirs. This set-up pushed me to reckon with the epistemic differences between work in the natural sciences and my own ethnographic work. It also helped me to articulate what it was that I was doing to a group of people whose questions, methods and answers did not provide space for the critical engagement I was after. Over time, these conversations became fruitful, particularly with my fellow PhD students, who were open minded and much less rigid when it came to engaging with what it was I was trying to do.

At LSHTM, I was affiliated with the Antimicrobials in Society (AMIS) research group co-led by Clare Chandler. She introduced me to D-Lab, which seemed like a project where I could study how global health scientists made evidence about AMR. Clare knew the scientists who were running the project and was on the project's advisory committee. A part of AMIS's work was also taking place in Uganda. There were thus colleagues on the ground who not only knew the research landscape and the administrative research procedures, but they also were experts on AMR research. At an AMR conference that I attended through the MRF training programme, I met D-Lab's principal investigator. He spoke very highly of Clare Chandler and the work of the AMIS

group on people's use of antimicrobials. I have no doubt that my acceptance into D-Lab was influenced by this connection.

The D-Lab study

The research study that became the focus of my ethnographic enquiry is a large collaboration working across Uganda, Malawi and in the UK with researchers from all three countries involved and funded through a major British research funder. D-Lab's main aim was to identify drivers of anti-microbial resistance in low- and middle-income countries (LMICs). The study employed a range of methods and tools to collect data and make evidence on factors that contribute to the emergence and spread of resistant bacteria, with a focus on households. To pursue this aim, D-Lab worked at five sampling sites, two in Uganda and three in Malawi. These were categorised into in urban, peri-urban and rural environments.

In each field site, D-Lab recruited up to 100 households over the timespan of 12 months. In each household, they collected both biological samples and observational data. The selection of the households happened through the employment of an algorithm using GPS data to achieve an even distribution of households within the field sites (for a more extensive description of the selection of households, see chapter 3). After obtaining consent, the field teams collected biological samples of water, soil and faeces from human and animals as well as swabs from around households (such as often touched surfaces, cloths, as well as of food items). Additionally, they administered questionnaires relating to household demographics as well as access to, and use of, water and sanitation facilities and associated hygiene behaviours. In a randomly selected subset of households, the field teams engaged in extensive observations of practices relating to water, sanitation and hygiene within the households, e.g. hand washing (for a more extensive analysis of the observational data and the WaSH theme, see chapter 6). The biological samples were sent to the laboratories where the laboratory teams extracted the project's pre-selected two target organisms *e.coli* and *k.pneumoniae* bacteria, and identified resistant bacteria, specifically Extended Spectrum Beta

Lactamase (ESBL) resistance[27] (ESBL-E and ESBL-K). Further analysis on a selection of samples occurred in the UK, focusing on whole genome sequencing. The study had a longitudinal component, with three to four follow-up visits spread out over a period of about six months at each household.

D-Lab researchers used data servers for the collation of different kinds of data from the project's field sites. The collation and analysis of data happened mostly after the formal end of the study, when the contracts of almost all Uganda-based researchers had come to an end. The idea put forward in their protocol and taken up whenever the researchers presented the project, was to design agent-based models to predict the drivers of resistance in the context of LMICs, based on their various data sources. The models were meant to identify where to interrupt the transmission of resistant bacteria most efficiently. In the time I spent with D-Lab, these models were only ever referred to as something that will be done in the future.

The D-Lab Uganda team with whom I worked, employed four field assistants at each of the two sites, one coordinator for all the field activities, and four laboratory assistants - one of whom had a coordinating role, as well as one data manager, and one overall project coordinator. Senior researchers served as advisors to the project. They were consulted at several points before and during data collection, as well as during data analysis. In terms of timelines, the data collection began in July 2020, and lasted until September 2021. At the end of September 2021, all staff contracts ended apart from the field team coordinator. He remained on the project for a further month to ensure that the data had been appropriately collated on the data servers. (This process took substantially more time than initially anticipated, and the field team coordinator ended up

[27] Beta-lactams are a group of antibiotics, including penicillins and cephalosporins that inhibit cell wall formation and thereby kill bacteria. Beta lactamases are enzymes that destroy beta lactams. Bacteria that produce beta lactamases can usually not be killed by antibiotics from the class of beta lactams. Extended-spectrum beta lactamase (ESBL) producing bacteria are resistant to multiple beta lactams. Infections with bacteria that produce ESBL range from urinary tract infections to sepsis (Mancuso et al. 2021). Treatment options are limited, they include combination therapies of beta lactams and beta-lactamase inhibitors which have been developed to overcome resistance from beta lactamases. Where and when available, for ESBL e.coli infections carbapenems are the drug of choice, but resistance is also on the rise (Ssekatawa et al. 2018). Other classes of antibiotics such as vancomycin can also be given. Accessibility of these next line drugs is severely limited in the areas under investigation by D-Lab.

working with the data months after his contract had ended, see chapter 4). The project in Malawi started before the Ugandan one. In fact, it was well underway by the time the Ugandan one began. The project coordinator, the laboratory lead and the field teams coordinator all travelled to Malawi to learn from the Malawian team, in particular about the specific laboratory procedures that the project employed. The different timelines between the two countries were partly due to delayed research approval procedures in Uganda, and partly due to the COVID-19 pandemic, which occurred when D-Lab was about to start data collection in March 2020. This mismatch between Uganda and Malawi increased the pressure on the Ugandan teams to adhere to the protocol as closely as possible, ensuring the data from the two countries could be analysed together.

D-Lab's researchers worked across multiple UK universities, and in Uganda and Malawi they worked with implementing partner research institutions which hired staff on the project grant.

Uganda as the study setting

In D-Lab's protocol, the authors describe the countries in which the data collection for the D-Lab study was going to take place as 'LIC [Low-income countries] with high incidence of neonatal sepsis and malaria, high prevalence of HIV, poorly regulated antimicrobial markets, and inadequate WASH infrastructure' (Cocker et al. 2022, 4). These descriptions hint towards higher levels of infection, and in particular higher levels of resistant microbes circulating (suggested by the poorly regulated antimicrobial markets) relative to other contexts that are not mentioned. To D-Lab researchers, this list of attributes rendered Uganda and Malawi into appropriate study countries. The briefness of their rationale for the choice of countries relates to ideals of scalability (Ehrenstein and Neyland 2018). The field sites serve as a placeholder for an imagined larger space in which the evidence is meant to be valid (for more detail on the writing out of the specific socio-economic contexts in which research occurs, see chapter 3 on standardisation).

Figure 1. Administrative Map of Uganda (One World - Nations Online 2023)

Since my fieldwork revolved around the Uganda part of the D-Lab study, I shall now focus on the choice of this setting. Within Uganda, D-Lab worked in Kampala, the capital city, and in Hoima, in the western part of the country. (Further details on their - rather pragmatic - choice of field sites, as well as the ways in which D-Lab defined the field sites' boundaries is provided in chapter 3 on standardisation). Above, I provide a map of the country, in which both Kampala and Hoima are situated. The region of Hoima lies in the west of the country within the Kingdom of Bunyoro,[28] and Runyoro is the main language spoken. It is situated at the border to the Democratic Republic of

[28] Hoima denotes a western Ugandan district and its capital.

Congo, at Lake Albert. Population mobility is high, due to migration both from within Uganda and from across the border. Since oil has been found (see Photograph 1 below on Hoima Pipeline building plans) two decades ago, the local population have been growing rapidly (see chapter 6 on water scarcity and population growth). Bunyoro was colonised in the 1890s, through their neighbouring kingdom Buganda that had become a British ally (Doyle 2009). The field team that was hired to work in Hoima spoke Runyoro (or Rutooro, a language spoken mostly in the neighbouring districts, but that is similar enough to Runyoro to be understood by speakers of the other language). The field teams working in the Kampala field site did their surveys in Luganda, which is the main language spoken in the Kingdom of Buganda, which includes Kampala.

Photograph 1. Map entitled 'Affected villages in Hoima District' of the Hoima region with plans on building the East African Crude Oil Pipeline corridor, attached to a wall in Hoima's district offices (2.12.2021)

My own choice to work in Uganda is entangled with D-Lab's, since I followed the project to its field sites. Besides, to study global health evidence

making, Uganda seemed like an apt place (for more detail on Uganda's prominence in global health, see chapter 1). The same reasons that made it convenient for large USAID or British funded projects to happen in Uganda also made it convenient for me. I, too, depended on the English-speaking researchers, and I also benefitted from the country's relative political stability. The fact that AMIS was also working in Uganda, and I had colleagues on-site made Uganda more accessible to me, and my colleagues provided a softer landing in this space - not least by offering crucial advice along the way. The expertise of my supervisors and advisors also made Uganda a more straightforward option. The complexity of the ethical approval procedure (laid out in the last section of this chapter) removed the possibility of splitting my time between Uganda and Malawi, even before the COVID-19 pandemic came along.

Chronological account of my fieldwork

I registered for a PhD in September 2018. Inevitably, my ethnographic research has not unfolded in a linear way. In this section I provide a chronological account of the main fieldwork activities.

February - March 2020: starting fieldwork, D-Lab pilot testing week

After a short trip in the first year of my PhD in October 2018 and a month-long preparatory trip early in my second year in November/ December 2019, I travelled to Uganda in February 2020. I had just gained ethical approval from LSHTM (more detail on this process, see the section on ethics below) and had planned that that would be the start of a long stretch of fieldwork. Before the start of this trip, I met the overall Principal Investigator (PI), and the Uganda-based senior investigators of D-Lab. They both agreed that I could work alongside the Ugandan D-Lab teams.

Photograph 2. View from the Hoima office of the implementing institute with roof of white van in foreground (2.3.2020)

Although the trip ended up being only one month long, it was very productive, and I often refer in the thesis to events and discussions that occurred during this time. In early March 2020, I joined the entire Uganda D-Lab team (including the field teams and the laboratory teams from all field sites) for a trip to Hoima. We travelled together and spent one week in Hoima. During this week, the team was meant to pilot test their data collection tools. This included practicing consenting procedures and going over the surveys. The latter involved checking whether the translations into Runyoro of questions in the questionnaires worked, and documenting the length of time it took to administer the questionnaire. They also did exemplary observations of WaSH practices (they tried out how to best position themselves within the household, and what to record, etc). They practiced working with the tablets, servers, and GPS tracking devices, and sorted out technical problems arising in the process. For the biological samples, they took exemplary samples of water, soil and animal faeces; and they practiced explaining the research to study participants. This included how study participants should take a sample of their own faeces[29] (the swabs they needed for the rest of the biological sampling

[29] D-Lab handed out plastic containers in which the participants were meant to collect scoops of faecal matter. The researchers were then meant to come and pick up the filled containers the following day. During the pilot testing week, we were standing in a half circle, when Jamil demonstrated how to collect the faecal samples. He opened the plastic container, bent down towards some half-dried up cow dung and with a little plastic spoon that was

had not yet arrived).[30] Over the course of the week, they also tested out whether the compensation they offered their study participants was deemed appropriate (for more detail, see chapter 6). After visits to the households, the teams also sorted out important details such as where to store the samples in the Hoima laboratory, and how to ship them to the Kampala laboratory.

Photograph 3 & 4. D-Lab researcher taking an environmental sample in a rural household in Hoima (5.3.2020); Plastic bag with plastic containers for sample collection on back seats of the white van (4.3.2020)

attached to the inside of the lid, he scooped in two spoonsful of faeces into the container. The residents watched him carefully. They were meant to do this with their own faeces before the next morning.

[30] For more detail on delayed shipments of laboratory tools and their impact on the study's rollout, see chapter 6 on precarity.

Photograph 5. D-Lab researchers in exemplary household, sorting out forms (4.3.2020)

I joined the team for all of their encounters. This included their trip to the city's administration offices (where additional approval to do the research needed to be granted) as well as trips to the households of residents, and the laboratories. The data collection team (both field assistants and laboratory technicians) had been hired a few weeks prior to this week and had undergone training, and the staff were familiar with the protocol, procedures and their roles. During that week in early March, the researchers tried out the tools in an area that they would not later collect data from (so as not to 'contaminate' the data)[31] but they tested them in households that were similar enough to enable

[31] I came across this formulation of the risk of 'contaminating' the data frequently. According to this logic, piloting the tools in the exact areas where D-Lab was going to collect the data might alter the findings during the actual period of data collection. This could happen, for example, when residents in exemplary households tell their friends, relatives, and neighbours about the group of researchers who are observing practices around water, sanitation, and hygiene. Those contacts might then be recruited into the actual study, but might change their behaviours in anticipation of the researchers. Therefore, D-Lab chose to pilot test their data collection tools in areas that were close to the actual field sites, but not in the field sites. Any potential intervention into the data came to be framed as a risk of making the data less objective, less clean. As a field assistant, one had to observe carefully, to be present in the households, but to be as unobtrusive as possible. At no point was there a space for the field assistants to reflect on their presence and its effect on what they were observing, although they had plenty of stories about residents changing their behaviour accordingly. The method alone, where they stayed in the household for extended periods of time was meant to ensure the field assistants were merely observing, and not contaminating their data.

them to learn how the tools worked in practice. After each day of pilot testing, there was a meeting in the evening where they brought up challenges and discussed solutions. Throughout this week, my role as an outsider was welcomed. I was asked to contribute to the daily meetings, and to share observations. The team included me in their work plans as well as their plans outside work. My interest in D-Lab including their roles and responsibilities opened up conversations, similar to the one foregrounded in the opening to this chapter.

This first stretch of fieldwork involved D-Lab not only doing the work I wanted to participate in and observe (that is, collecting data) but it also involved a considerable degree of self-reflection. As such, it felt like a very smooth and rich start to fieldwork. I wrote many pages of notes, jotting down words whenever I found a moment; in the car between household visits, bending over a table in the laboratory, in the hope I would remember as much as possible. During that week however, some of the residents in Hoima already asked us not to shake hands and to keep a distance, as the COVID-19 pandemic was getting closer. Through radio stations and networks of village health workers, the news of this new virus and its rapid spread had already reached this part of the world. There were now confirmed cases of COVID-19 in neighbouring East African countries, and national borders were closing without prior notice. This early phase of fieldwork came to a close fairly soon. After coming back to Kampala, the atmosphere was quickly changing, numbers of COVID-19 infections were rising in many parts of the world, and the uncertainty of what this would bring became palpable on the streets. I abruptly left the country in mid-March, three days before Uganda closed its borders for the coming six months (Laing, Mylan, and Parker 2024).

April 2020 - October 2021

The next stretch of fieldwork could not have been more different from that which had been planned. I lived in Berlin, my hometown. In stark contrast to my smooth entry to doing fieldwork, and the possibilities (and joys) of observing and participating in D-Lab's evidence making procedures, I no longer shared a space with the researchers. I hardly shared space with anyone anymore. During this time, I had to shift my mode of enquiry and its focus

along with it. I applied for, and was granted, approval from LSHTM's ethics committee to conduct interviews over the phone. During this stretch of remote fieldwork, I spoke with the Ugandan-based D-Lab researchers, and exchanged messages. I conducted ten remote interviews with D-Lab staff lasting between 45 mins to an hour and transcribed them verbatim afterwards. In these interviews, I asked the staff about their daily lives under COVID-19, and about their working lives in the pandemic, e.g. how they had adjusted the field work or laboratory work to the new circumstances. I also asked them how the lives of their study participants had changed, and we reflected on how these changes might influence the data they were making.

In addition, I engaged with UK-based D-Lab staff during this time. They were difficult to reach because many of the researchers, in particular the modelling team, were involved in COVID-19 projects. Between November 2020 and February 2021, I conducted a written interview with Isabelle, who worked on her PhD as part of D-Lab's modelling team. Isabelle chose this format, clearly preferring to take her time to answer questions over email. I cite this interview with Isabelle in chapter 3 on standardisation. These engagements were better than nothing, but they felt unfulfilling. However, once I re-started in-person fieldwork, and could share spaces again with the people I wanted to learn from and with, my participation in D-Lab's pilot-testing week, as well as the remote engagement felt a lot more valuable. This long-term engagement provided familiarity, and usefully conveyed a sense that I was committed to understanding their perspectives and experiences of the issues they were grappling with. In so doing, it opened up further spaces of enquiry.

Between May and July 2021, Uganda went through a severe wave of the Delta variant of COVID-19, with high numbers of infections and deaths (Bbosa et al. 2022). IDRC, the institute in Kampala that I was affiliated with, sent out an email in June asking all foreign researchers to stay away. They did not want researchers to place any demands on an already overloaded health system. When this wave of infection ebbed away, and I had been vaccinated, I applied for travel and fieldwork approval in pandemic times from LSHTM. This was approved in October 2021, and I travelled back to Uganda at the end of the month.

In order to renew my research approval in 2021 (I provide more detail on the procedure of applying for research approval in the last section of this chapter), I had to provide a COVID-19 risk mitigation plan. In this plan, I laid out how I was going to protect my study participants and myself from the risk of contracting the virus. In preparation, D-Lab's fieldwork coordinator shared D-Lab's COVID-19 risk mitigation plan with me. This helped me to figure out what I needed to include in my plan. I wrote that I would be meeting people outdoors, would wear masks indoors, and that I would stay away in case I experienced any symptoms that might relate to the virus. D-Lab's document not only provided helpful orientation of what it was that I needed to include, it also gave me insights into how D-Lab had adjusted their procedures in order to work in pandemic conditions (for more detail on how D-Lab adjusted their study, see chapter 4 on precarity).

October 2021 - April 2022

Between October 2021 and April 2022, I lived in Kampala and travelled to Hoima twice, with each stay lasting about two to three weeks. This stretch of fieldwork in Kampala and in Hoima is what I came to build most of my thesis on. D-Lab's data collection came to a close in September 2021, just before I returned to Uganda.

This stretch of fieldwork thus consisted mainly of conversations and meetings with researchers who now lived in different places. They were either employed on different projects, or they were studying for postgraduate degrees. They made time for me despite their busy schedules, always juggling multiple commitments at the same time. I met the researchers in the offices of research institutions, the campus of the university, the university hospital, the Ministry of Health, cafés, and restaurants, as well as in their homes and at the former field sites of D-Lab. In our conversations, they reflected on their experiences with D-Lab. The temporality of speaking of D-Lab in the past tense, and for D-Lab to not be as immediately relevant anymore to the former D-Lab staff enlarged the scope of our conversations. They no longer (at least not in an immediate sense) depended on being perceived as being good at their job, so they could more freely talk about the project. At the same time, these conversations no longer emerged from shared situations. They only talked

about D-Lab with me because I asked them about it, it would not have happened otherwise. This also shifted my emphasis onto ethnographic interviews and conversations and away from observation and participation. Although I did not get to participate in D-Lab's data making in the way I had imagined, this perspective of 'looking back' from the end of the project proved insightful in new, unexpected ways. It proved to be a useful lens to reflect on the premises underpinning the whole project. The Ugandan researchers' exclusion became obvious in ways that might not have been otherwise (for more detail on their exclusion and its effects on the evidence, see chapter 4 on precarity).

By the time I arrived in Hoima in December 2021, the implementing institute had closed its regional offices. All but one member of the Hoima team had left the city too. There was very little left of the 'field' that I had originally thought to be focus of my ethnographic work. Consequently, I shifted my emphasis to the context in which D-Lab had been collecting data. D-Lab had been working with a hypothesis that practices around water, sanitation and hygiene (WaSH) in their study participants' households would drive the development and spread of resistant bacteria. Field assistants spent long hours observing and reporting these practices. The centrality of WaSH, and in particular individual practices around WaSH were striking, and I thus decided to interrogate WaSH infrastructures in Hoima. For this Hoima-based part of my project, I worked together with Darlian. I had been put in touch with her by the project coordinator, while I was still away in Berlin. Darlian was also friends with the laboratory coordinator from D-Lab. They had both worked for the Uganda Unit of the Medical Research Council in recent years. Darlian was a recent university graduate and she was from Hoima, having grown up close to the city. While I was away, she supported me in the application for research approval from the Hoima District administrative offices (for more detail on the approval procedure, see below in the section on ethics).

When I arrived in Hoima in December 2021, Darlian helped me to navigate further bureaucratic hurdles - together we collected approval letters and stamps from various places. This included an approval letter from the District Health Commissioner - a government official based in the city's administration offices - which I needed to approach other institutions. With her

help and contacts provided by the District Health Commissioner, I identified and then interviewed five experts working in NGOs, as health assistants, at the National Sewage and Water Cooperation, and at the hospital in the field of water, sanitation, hygiene and the prevention of infectious diseases. All of them had been working on WaSH related infrastructures or projects in this very region for several years. I write about this part of my fieldwork in chapter 6 on WaSH. In Hoima, I also met and interviewed Robert, D-Lab's last remaining researcher. He showed me around the former field site and led me into people's households. I write about this material in chapter 5 on One Health and in chapter 6 on WaSH.

March-April 2023

A year after leaving Kampala, I returned for a two week stay in March and April 2023 to attend D-Lab Uganda's dissemination meeting. With an extra bit of funding that the Uganda-based PI had secured, a meeting was put together. It was held in a large, upmarket hotel in central Kampala. Some of the researchers, in particular the senior advisors/researchers, presented findings to representatives of regional administrations in Hoima and Kampala, as well as politicians working in ministries of health, water and the environment, fisheries and agriculture, the One Health platform, and fellow researchers. The field teams and laboratory teams had been invited, and many had come to attend the meeting. The D-Lab team had invited me to attend this meeting, even offering that they might be able to use their funds (although I had enough research funds left and came on my own grant). During breaks at the dissemination meeting, I chatted with the D-Lab teams as well as senior advisors. In the days following the meeting, I met some of the researchers again, reflecting on the meeting and its potential impact.

Although my fieldwork had come together in messy ways, my long term engagement with the group of researchers proved to be of high value. Every stretch of the project built on relations I had previously managed to maintain, even during the time when I was away in Berlin. My continuous interest in D-Lab and its employees turned out to be a stable and fruitful ground for conversations that over time would flow more easily and openly. The extended

period of time that I engaged in data making came to stand as an obvious demonstration of my genuine interest.

Writing and analysis

My analysis was iterative and emergent, and my questions shifted with my field. I stitched together pieces of evidence as they came from the different phases of research, elicited through different means. Though always multi-scalar, the pandemic had made this into more of a patchwork ethnography (Günel and Watanabe 2023) than I had anticipated. Both 'home' and 'field' went through a global pandemic, which at once pushed them further apart through restricted travel, and at the same time brought them closer together through this joint experience of living through lockdowns, and with masks, under high levels of uncertainty.

Some of the chapters emerged during fieldwork, others only as I was writing first drafts and conference papers. Before I started doing fieldwork, I had questions about the way in which global health makes evidence in a standardised way, both as an approach to evidence making (validated tools, rigid protocols, etc.) and as a goal (evidence that is meant to be valid elsewhere). This ended up in chapter 3, where I explore D-Lab's standardisation of the spaces they make evidence in. Spending time mainly with those researchers who were involved in data collection allowed me to emphasise their perspectives. I came to appreciate the precarity of their work, and how it relates to the evidence they are helping to make (see chapter 4). D-Lab's emphasis on WaSH struck me early on in fieldwork as something I wanted to look into further. I wondered what these WaSH observations were meant to do, and the settings in which they occurred. WaSH behaviours are of interest to D-Lab, as sanitation (e.g. someone washing their hands) might cut off bacterial pathways thereby reducing the likelihood of spreading resistant bacteria in between e.g. 'the environment' and 'humans'. The WaSH theme is thus closely caught up with D-Lab's focus on One Health. It was after I began writing the chapter on WaSH and contamination (chapter 6) that I decided to split off the chapter on One Health (chapter 5).

Fields and fieldwork in the COVID-19 pandemic

My fieldwork happened during the time of the COVID-19 pandemic, taking a hold of the world precisely at the moment I had intended to start fieldwork. In this section, I reflect on the shifts and turns that COVID-19 brought to my fieldwork, and how it affected my understanding of fieldwork and field. Since I write about D-Lab's adjustments to the pandemic in chapter 4 on precarity, I do not provide a detailed account of their pandemic adaptations here. However, I reflect here on differences in our ways of responding to these drastically altered circumstances, and what I learnt through them.

D-Lab implemented adjustments (e.g. field assistants wore protective equipment and provided educational materials about COVID-19 (see chapter 4)), thereby ensuring that they could roll out their research programme in the given timeframe, and stay as close as possible to their original plans. By contrast, I had no choice but to step back from fieldwork and change some aspects of my project. At the start of fieldwork, I had envisioned an ethnographic project around D-Lab's evidence making, with a stretch of fieldwork in Uganda at the time of D-Lab's data collection. The pandemic, and the different ways in which my project and D-Lab responded to it, meant that the project timelines no longer aligned. As Biruk (2014) writes, the temporality of anthropological work is always slower than that of global health, 'By nature (or culture), [...], anthropology is slow, tedious, and careful; these descriptors gain currency in their juxtaposition with the fast-paced and urgent nature of global health'. In the set-up I was working in, the difference in temporality became particularly clear through the effect of the pandemic - I slowed down, D-Lab did not.

D-Lab aimed to follow their protocol as closely as possible despite the pandemically altered circumstances. The protocol provided them with a directive of what to do, and the Ugandan researchers' task was to employ it. The obvious changes to the ways in which D-Lab's data collection came about, and the changing roles of the field assistants did not feature in project's

results.[32] Their data making apparatus did not offer the flexibility to include reflections on the role of the researchers, or the context in which they worked. Any adjustments they made were to have as little impact as possible on the data they were making. By this logic, it was possible to make data on AMR without reflecting on the changes in the project's roll out, or in the altered relations between humans and microbes that the COVID-19 pandemic had brought about. D-Lab made their data despite the pandemic circumstances we all found ourselves in, and I pushed the pandemic adjustments into the centre of my enquiry. My flexible research design stood in stark contrast to D-Lab's rigid design. In our diverging adjustments to the unexpected changes in circumstances - our understandings of fields and data became clearer.

D-Lab's protocol was not meant to be adjusted to the circumstances of 'the field', and D-Lab's field sites were ostensibly stable entities, neatly bounded by GPS coordinates (see chapter 3). Although in practice, it was a laborious process to translate the coordinates into places to navigate on the ground (and their boundaries too seemed blurrier when residents who had been recruited moved in and out of the defined area over the course of D-Lab's data collection), the GPS coded setting of their research held the promise of stability. To make data, D-Lab had to work in predefined places, and they had to employ the data collection tools in pre-specified ways. D-Lab's field assistants always anticipated uncertainties and shifts - electricity cuts, roadblocks, traffic jams, loss of cellular network, etc. were all part of daily life. Their job was to employ the tools despite these interruptions, to find ways to write them out of the picture. When COVID-19 brought more interruptions, their jobs became more demanding, rather than different.

As I set out to 'do fieldwork' in February 2020, I wanted to do participant observation to gain an embodied understanding of the processes of data making in D-Lab. George Marcus notes in the introduction to the edited book *Fieldwork is not what it used to be* on anthropology's transformations, how despite generations of anthropologists working on undoing the harmful,

[32] At D-Lab's dissemination meeting in Kampala in March 2023 where D-Lab representatives presented some of their findings, no one mentioned the pandemic conditions in which they had been working, or reflected on how they might have affected the data, (for more detail, see chapter 4 on precarity).

extractivist practices of early ethnographers, and the 'broadening horizons of research projects [...][research projects are] still holding the aesthetics and the regulative ideals of the Malinowskian paradigm of research - more crucial than ever to the signature identity of anthropology - centrally in place' (Marcus 2009, 2). Despite efforts to grapple with ethnography's history, the model of fieldwork I aspired to, still fitted squarely into these ideals. To do fieldwork, I needed 'a field'. And I imagined my field to be D-Lab's places of evidence making, most importantly their field sites - spaces in which I would make evidence on their evidence making.

I had been forewarned that fieldwork is full of ruptures, and the messiness this created would make more sense once it had been completed. I was told many times that I should not plan too tightly, that I should be attentive with all my senses, and that I should be open to shifting my questions and concerns as the research unfolded. But when the pandemic started to take a hold of the world, and national borders were closed and travel restricted, it was no longer conditions in the field that were changing, but conditions globally. I left Uganda not because I wanted to or because it made sense for my project, but because border closures were imminent and I did not want to be trapped in a new place while the world was going through something unprecedented. I imagined my grandmother dying from this new virus, and not being able to go and see her, and that is what made me book my ticket. Wenzel Geissler and Ruth Prince wrote, themselves leaving Kenya to return to Europe in March 2020, '[...] our detached and benevolent claim to ethnographic participant observation, always from a position of privilege and relative security, is put into question at precisely the moment when true participation finally becomes inevitable' (Geissler and Prince 2020). The model of ethnography that guided my work did not allow for a drastic shift in circumstances to occur in the spaces that are 'not the field' where I could no longer move in and out of the field as I saw fit.

Instead of being where I had thought I needed to be, and to observe, participate, and learn through being present, my observations of D-Lab's research and how it unfolded in this remote phase of research relied on the reflections of researchers. The field of my fieldwork took on new forms: it expanded and collapsed. When I spoke with the D-Lab researchers over the

phone, they would look for a quiet place, withdrawing themselves from the interactions they were in. Instead of bringing me into the situation they were part of, showing me, explaining to me, or translating what they were doing or what was happening as they had done when I was around, they stepped out of the situation themselves to talk to me. The D-Lab field assistants made time for me at the end of their workdays; I was no longer part of their work. Through the COVID-19 pandemic, I had lost the setting of my research. Kelly and Lezaun describe in their article on 'Room-Spaces of Scientific Inquiry' the prominence of the ethnographic field: 'The field - our discipline's most enduring and precarious methodological device - belies an aesthetic of interiority that, if no longer always site-bound, continues to cultivate a sense of setting whereby ethnographer and informant encounter each other in time and space' (Kelly and Lezaun 2017, 390). By no longer encountering informants, I was losing the ground of my research. I no longer felt like there was an interior I could refer to, or be part of.

During the remote part of my fieldwork, there were long stretches of time when I did not take any field notes. I was not involved with the work of data collection and my interactions were intermittent. Time passed as I was waiting for people to get back to me. I did not have the chance to make observations that seemed like they could become relevant later, in unexpected ways. Although waiting was always going to be a central component of fieldwork, this kind of waiting was different. Waiting was never going to be sitting at a desk far away from the people I wanted to engage with. Waiting, I had learnt and come to anticipate, was supposed to mean standing in line, sitting in offices, in archives, in traffic jams, going for walks without a destination; or waiting for something to happen while doing the same thing again and again until it loses all appeal, becomes boring and ordinary. My remote, second-hand engagement did not allow for any of that. My work was slow, and yet I did not collect the stories of 'all the long dull stretches when things are still messy and unextraordinary' that come before the events that ethnographers often focus on (Hyde and Denyer Willis 2020, 1). My waiting would have faded out without me actively seeking out engagement. This longwinded, uneventful part of my work could not spur spontaneous

encounters. My ethnographic ordinary was detached from the ordinary that I was trying to understand.

Despite the perceived detachment, my remote engagement came to shape the contours of my field in unexpected ways. During the time I was away, I stayed in touch with the researchers and learnt how they made their project work in pandemic circumstances. Only later, when I got back to Uganda, and shared a physical setting with the researchers again, did it become clear how much I had learnt and built through these regular remote encounters. My field had grown and expanded in ways I did not and could not notice from afar. The pandemic also laid open how my idea of fieldwork and 'field' depended on the very global health logics that governed D-Lab. For example, I too depended on functioning transportation infrastructures. Biruk, writing about 'the field' of ethnographers of global health, argues 'the nature of ethnography amid and within global health perhaps makes more visible the ethnographer's reliance on and complicity with the people, resources, logics, and technologies that make up the "global" she critiques' (Biruk 2018, 206). Following D-Lab throughout the unfolding pandemic - even if remotely - offered valuable insights into D-Lab's process of making evidence, and into mine. In my interrupted, dispersed fieldwork, I came to build a field that was not place-bound, that let me stay with D-Lab as it unfolded over time.

Ethics and positionality

In this section, I first focus on the formal process of applying for and being granted research approval for this study and then reflect on my positionality.

Chasing stamps

The bureaucratic process of applying for and being granted research approval for this study was lengthy and complicated. It involved applying for clearance from three review boards, each with their own forms, standards and expectations, none of which were set up to deal with ethnographic studies. The first board I received clearance from was the LSHTM research ethics committee. I submitted the documents at the end of October 2019, and my study was

approved on 14th of January, 2020 (approval number LSHTM Ethics Ref: 17876). In line with LSHTM's main focus on research within global public health, this procedure involved providing a detailed study protocol and answering questions about the logics underpinning sample size etc. As part of this procedure, I also submitted informed consent forms and information sheets, which were meant to explain to my study participants what this study was about, what participation would entail and their rights to retract consent at any moment. These forms are presented in the appendix of the thesis.

After this hurdle was cleared, I applied for approval at the *School of Health Sciences Research and Ethics committee at the College of Health Sciences, Makerere University*. At this ethics board, I had to rewrite my consent forms again, adjusting them to another format, and changing the order of headings. I was requested to add in financial compensation for study participants. Since the LSHTM guidelines discourage study compensation in order to avoid creating a financial incentive for participation, and since it was difficult to imagine what compensation might look like for any engagement that extended a one time meeting, this request was not straightforward to respond to. After consulting with my colleagues, in particular Susan Nayiga, I added a note that I would cover any costs that potential study participants might incur for participation, such as travel costs, and added a lunch allowance of 20 000 UGX (approximately 5 GBP) for each researcher. With these changes, both LSHTM and the Makerere Board at the College of Health Sciences agreed to let me proceed. Thanks to the careful guidance of the administrative staff member at the Makerere Board at the College of Health Sciences, once the documents were ready, and the Board met again, it was approved. I paid the fees of 300 US dollars (for foreign researchers, it was listed in US dollars); and I received a scanned signed and stamped approval letter from the ethics review board on the 18th May 2020 (approval number: #SHSREC REF NO: 2020-033).

The third board of ethics that I needed approval from was the *Uganda National Council on Science and Technology*, which processes every request to conduct research in the country. The COVID-19 pandemic delayed this process considerably and since I had left the country at the onset of the pandemic, I went through this procedure remotely. The research ethics team at IDRC in Kampala supported me in navigating this process, and Susan Nayiga

continued to offer her advice. I paid the fee of 300 US dollars, and then submitted all forms online in October 2020, including the approval letters from the two previous boards. In addition to all previous materials, UNCST requested a letter of clearance from the chief administrative officer of the region where the research was planned to take place, addressed to the executive secretary of UNCST. Since I expected most of my fieldwork to unfold in Hoima, D-Lab's western Ugandan field site, I needed a signed and stamped letter from their administrative office.[33]

Through the networks of D-Lab, I was put in touch with Darlian, who I paid over the next months, to assist me in the process of acquiring this letter from the Hoima administration. Darlian spent hours waiting for the officer, only to be asked to come back another day. On other days, she was sent away with the request to first provide the study approval from UNCST, the one for which we needed this letter. Together, we were trapped in a circle. Only when D-Lab's field team lead for Hoima offered to join her to the office of the chief administrator, the administrator issued the letter. The field team lead knew the people in the administration, and the processes. I received the letter on the 23rd of March 2021. Once I had this stamped, signed, and scanned letter, I submitted everything to UNCST with the help of the staff at IDRC. I gained approval from UNCST on the 22nd of July, 2021, 20 months after first submitting my study materials to the LSHTM ethics committee (approval number SS622ES).

The approval stamps came with expiry dates. I had to renew the approval from LSHTM yearly. The one from the Makerere Board at the College of Health Sciences, I renewed twice, once in in May 2021 and again in March 2023. These renewals no longer required a complicated procedure. Each time, I had to provide a summary of what I had been doing (including how many study participants I had enrolled), and for the Makerere board I also had to pay renewal fees, 100 US dollars the first renewal, and 300 USD for the second one. Each time I renewed the approval at the Makerere research ethics board, I

[33] I asked whether D-Lab researchers would be able to assist me in getting the letter, as they were doing field work around Hoima, and knew the procedures and the chief administrator. The PI responsible for the Uganda part of the study blocked this request in anticipation of a lengthy procedure.

printed out large stacks of paper and met the responsible staff at her office on the Makerere campus. She provided me with new stamped letters, and stamped the fresh copies of my consent forms. The UNCST approval was valid for four years from the date it was issued, so there was no need to renew it.

By the time I had all the approvals in hand, I had been chasing stamps for such a long time, that it felt like it had become my main job. When friends were asking what I was working on, I would sigh with a one word response, 'ethics'. One stamp allowed me to chase the next, and each stamp felt like I was one step closer to being able to do the work I had been wanting to do for so long, but it was not transparent how many more stamps I would need. I kept all signed, stamped, and scanned versions of the documents on my laptop, neatly ordered by institution and date. When I arrived back in Uganda in October 2021, I picked up the hard copies, as well as got stamps on each and every page of my approved study protocol, as well as each and every consent form. I protected all the stamped documents in plastic sleeves, and the plastic sleeves in specific folders. I was worried in case my stamped forms got wrinkled, or stained, or much worse, lost. They had been so difficult to get, that they had become very precious.

There was, of course, a rationale why this process of applying for ethical approval had been complicated and lengthy. It provided a framing for my relation to my work, that was, indeed, complicated. The lengthy process was meant to deter foreign researchers from easy access to Ugandan study participants, who would feed studies with data and receive little or nothing in return, as had been the case for far too long (Parker and Allen 2013). It also forced foreign researchers to engage with the regional administration of the relevant district(s) they were going to be working in before the rollout of their studies. The multi-step process was also set up in such a way that foreign researchers would have to pay substantial amounts of money before they could do the research work they had proposed. This process granted not only the ethics boards but also the regional administrators some agency over who would be doing research, how and on what, and it gave them the power to grant or prevent access. In this way, the process did at least in part what it was supposed to do.

Reflecting on ethical research conduct, consent, and positionality

To me, this formal process of applying for ethical approval had ended up being about chasing stamps. I had not been asked to reflect on what it meant to do this work ethically, or how to ask for consent in light of perceived and actual power differences. In this set-up, signed consent forms (almost like more stamps) would work as proof that I had explained what I was going to do in my study and with the data, and that the potential study participant had understood me, and had agreed to participate out of their free will. The signed consent structured my research engagement with other researchers, but did not work as proof of voluntary consent. As Florence Caeymaex and colleagues write in their article on the role of informed consent procedures in governing research, 'The underlying assumption is that - since every research process entails uncertainty - the participants ought to be in a position to appreciate the risks and the benefits. [...] Research ethics have thus generally sought to mitigate power and knowledge asymmetries between the researcher and the participants.' (Caeymaex et al. 2023, 1-2). However, it is questionable whether the procedure is able to do so. Klaus Hoeyer and Linda Hogle write in their review article on informed consent, 'Policies enforcing the consent requirement assume that there is a universal subject, that all subjects weigh information and make "informed" choices similarly, and that they "voluntarily" participate with similar expectations. These are normative assumptions that ignore key anthropological insights into the subtleties of human agency as well as basic conditions of existence--including poverty, hunger, lack of sufficient health care, and political insecurity.' (Hoeyer and Hogle 2014, 352). Indeed, my interlocutors' signatures alone did not tell me whether they had understood what I was going to do, or how voluntary their participation was. I was collecting the signed informed consent forms in yet another neatly organised folder - mainly as more proof that I had complied with the guidelines.

Despite occupying me for such a long time, this formal process of applying for ethical research approval had not required me to reflect on the ethical conduct of the ethnographic research I was proposing, or my role in it. It shaped my way of doing this research in transnational global health. Its focus on (usually written) informed consent, as not only a necessary condition, but

as proof or guarantee that the study was *ethical*, did not ask me to think any further. In this 'hegemonic approach to research, [there is] a tendency to objectify its participants as passive subjects, rather than as active agents with inherent power, rights and needs', as Lisa Russell and Ruth Barley(2019, 6) write in their paper on ethnography and ethics. It also frames the role of the researcher as a 'data collector', assuming that data exist ready to be collected, and relatedly, that the researcher is not part of the situation from which the data emerge. It is, in other words, thoroughly at odds with ethnographic research.

In the following sections, I reflect on my positionality vis-à-vis the researchers I have been engaging with. To the UK-based researchers, I was just a PhD student who, like many others they knew, asked questions that they did not consider particularly relevant. I had a hard time reaching them, mainly because they saw no obvious advantage of engaging with me. At the small number of meetings I attended, all of which were remote, I remained a peripheral member, mostly listening in. My further attempts to join data analysis meetings were unsuccessful. The researchers at higher levels of the collaborations were particularly challenging to reach, many of them contributed to COVID-19 related projects and their schedules were incredibly busy. In the summer of 2023, I interviewed a UK-based statistician in person during the time of their data analysis, and he openly gave me insights into his side of the project, and was happy to answer technical questions. When I asked him for written consent, the procedure felt genuine, he could have said no without any implications or missed chances. Throughout my time with D-Lab, my presence was tolerated, and the connections that had allowed me in also enabled me to stay.

In Uganda, the situation was different. People generally wanted to engage, but acquiring informed consent was more complicated. Since most of the people I was speaking with had used informed consent procedures themselves, it felt more like a ritual that one does when one engages in this thing called research. Some read the information carefully and asked questions, others quickly skimmed and signed the forms. Nobody really seemed to consider the possibility of not participating. While not doubting that most of my interlocutors were interested in participating in my project for the sake of the research, the potential connection to a researcher at LSHTM with networks

and possible future job opportunities also made it attractive. The hierarchy of D-Lab also meant that I needed approval from those in higher positions in the collaboration in order to be allowed to approach those at the lower end of the hierarchy. At the beginning of my fieldwork particularly during the remote phase, when D-Lab was still collecting data, many of the researchers made sure that my engagement had been approved by the Uganda-based principal investigator, asking me directly whether I had been granted approval. This approval from the higher levels of the collaboration not only allowed me to approach them, it also made it more challenging for them to articulate that they did not want to engage with me. Throughout my time, I tried to read (and listen) between the lines, and backed off if someone did not seem to want to engage with me. In my writing, I decided to protect the identities of the researchers, so that their generous and sometimes critical comments would not harm them or their career prospects.

Over many conversations stretched out over the time of my fieldwork, I answered questions about what my project was about. The fact that I was studying research practices seemed surprising, and at odds with their own assumptions of what I ought to be doing, which I came to understand was 'studying villagers'. Time and again, I was asked whether I would also do research in 'the communities'. In several conversations, mostly with more senior researchers, this assumption seemed to relate to ideas about what the job of an anthropologist was.[34] However, more often and in the conversation with the laboratory and field teams of D-Lab, this assumption seemed to relate more to public health logics of where 'the problem' was going to lie that needed fixing, and that social scientists could help elucidate (in this case, e.g. the use, often labelled as misuse, of antibiotic medicines).

Throughout my fieldwork, I took on a variety of roles, and so did the people I worked with. Age-wise, I fitted well into the group of Ugandan D-Lab staff, and since many of them had either recently graduated, or were pursuing

[34] In their piece on the 'global health slot', Biruk (2014) traces back where these assumptions stem from, the 'savage slot' (Trouillot 1991), that they describe refers to 'anthropology['s] monopoly over speaking about "primitive" people.', and the 'suffering slot', referring to Robbins (2013) as 'ethnography, which centers the subject living in pain, in poverty, or under conditions of oppression'.

post-graduate degrees, we were also in comparable stages of life. Over the time I got to meet them, four of the former D-Lab staff celebrated their weddings, and I too got married during this time. This brought proximity and helped bridge other differences that marked our relationships. When Francis, a former field assistant in the Kampala field site, and then a master's student in bioinformatics, introduced me to some of his classmates in a large computer laboratory on the Makerere campus, he told them I was a fellow student. This felt like the most generous thing he could have said in the moment, highlighting this commonality despite all the obvious differences. At other times, some of the researchers insisted on inviting me for drinks and meals when we met in cafés or restaurants throughout the city, breaking with the expectation that I, the white person, would always have the economic means to pay. Instead, they treated me like someone they chose to spend time with.[35]

At all times in Uganda my whiteness shaped the situations I was in. It came with expectations of power and wealth. In my daily life in the city, I was highly visible. Street sellers offered me tourist souvenirs, and I was offered very high starting prices for motorcycle rides. In the context of research, my affiliation with LSHTM, not just a wealthy institution in the Global North, but one that was known among many Ugandan health researchers and even parts of the public, only exacerbated the power people expected me to have. There are longstanding ties between LSHTM and large institutions in Uganda (MRC Uganda became part of LSHTM, and it is also affiliated with the Uganda Virus Research Institute),[36] and these institutions offer employment opportunities to many. Sometimes, I was asked directly whether I could employ someone as a research assistant full time, or knew someone who was looking for a research assistant. At other times, it was more subtle. Although I could not offer immediate employment opportunities, they were of course right that my ties with this major global health institution could potentially be helpful to the Ugandan researchers.

[35] My status of being a woman might also have shaped these dynamics, some of the men might have seen it as gentlemanly to invite me.

[36] For reference see LSHTM's webpage on the MRC Uganda unit: https://www.lshtm.ac.uk/research/units/mrc-uganda (last accessed, 18.3.24).

When I met with Paul, a former field assistant, this dynamic seemed to shape what he was telling me to an extent I had not come to expect from all my previous interactions. He had worked as a field assistant in D-Lab's Kampala field site, and by the time we were speaking, he was working on project about tuberculosis. It had been much more difficult to reach him than his former colleagues, and he was no longer in touch with them. We met in March 2022, when I had already been back in Kampala for four months. I had heard that he had left the project before it had ended, and there had been tensions before he left. When I arrived at a restaurant that he had picked, close to his new office outside the centre of Kampala, he was already waiting for me at the door. He seemed nervous, and during the hour we spent together this did not change. The conversation did not flow. I felt like I was failing to create an atmosphere where he felt comfortable, even if it was comfortable to leave. At some point, his phone rang, his wife was looking for a thing at home and he directed her to a drawer. After he put down his phone, he apologised in a way that to me seemed entirely out of proportion. Phones rang everywhere, all the time, and conversations were often disrupted. His answers to my questions felt rehearsed, especially when I asked him about factors that he thought were important for AMR but that might have been peripheral for D-Lab (a questions which I had asked many others before and had received insightful responses to). Paul did not think about the question and instead lauded the project. At the end, he asked whether I would continue working for LSHTM and on AMR, and whether I could offer him a job. This came almost as a relief, an articulation of how we had come to meet on unequal terms.

My outsider status, as a white person new to the context, and also as a non-scientist meant that I caused my interlocutors explanatory labour. They would explain laboratory procedures as well as scientific concepts and methodology to me with great patience; 'remember, Esther, we get the samples, culture them on media...', a field assistant texted me in response to a question I had had. They also made me try foods, explained how traffic worked, when it was going to rain, or what kinds of family expectations they were dealing with. At the dissemination meeting in Kampala, D-Lab's field work coordinator was presenting on the presence of resistant bacteria on clothes of people living in D-Lab's rural field site. He mentioned the *Luusu* of women in the village from

which they had taken swabs and found a particularly high rate of resistant bacteria. While he was presenting, he looked around the room, and the audience was nodding along, following him into the all familiar spaces. He stopped himself when he saw me, highlighting that I might not know this cloth that 'women in the village' would wrap around their waist, explaining to me that they would wear this cloth while cooking, or caring for their children, or working in the gardens. I felt uneasy with the whole room turning their heads towards me, the only white person, but grateful to him at the same time for ensuring that I was following the presentation. I had indeed not understood the word.

The dynamic with the field assistant who did not open up proved to be the exception. An inherited power imbalance certainly shaped but did not define my fieldwork. At no other point did I feel like it swallowed the opportunity to have a conversation. The tensions others had mentioned around this field assistant might have also affected our encounter. All other interactions felt more dynamic, there was more liveliness and openness. Power also was not so one-sided, I was obviously vulnerable as an outsider in Uganda, and as a woman, at all times visible and assumed to be wealthy, but I also depended on the researchers engaging with me. Overall, the time I spent with or around D-Lab, including the time I had been away, managed to convey my genuine interest and care in the work and the people and their lives. I felt welcomed and cared for, and I was invited to weddings and to people's homes. Some D-Lab researchers have also provided encouragement, pushing me to keep going, during the long process of writing up, even many months after I had I left Kampala. Their WhatApp messages have articulated care for me in ways I had not imagined.

Chapter 3: Standardising evidence: the recursive making of field sites, communities, households, and AMR

E: So would you expect the Malawi and the Uganda data to be similar otherwise [if it wasn't the case that the Malawi-based teams had collected their data before the start of the COVID-19 pandemic and the Uganda-based teams during the pandemic]?
S: Mhh.. if there was no COVID?
E: Yes..
S: Hm, no, no I don't think they would be similar in any way, because these are two different countries.
E: Yea.
S: The only similarity would be the fact that they are both in sub-Saharan Africa.
E: Yea..
S: And maybe the economic, they're the same economic level. That could be the only similarity. But for the drug resistance, we can only tell after the analysis.
E: Okay, so they could be very different.
S: Yea, they could, because really, we have different cultures.
E: Yea. And do you think, because D-Lab is collecting data in Uganda and Malawi, right? Do you think they will make generalisations about other places as well?
S: Yes, I think the results from Uganda would inform decisions about East Africa, because we don't have very much, like, we're not *that* different, to a big, great extent. So, the results can be generalised. Okay, I think it should all really be representative of Africa as a whole.
[Interview transcript, remote interview with Stella, D-Lab's laboratory coordinator, 21.10.20]

Institutions that steer and fund research, and develop policy and interventions in global health such as the WHO, the World Bank, or the Bill and Melinda Gates Foundation and much of academic global health research rely

on standardised, quantitative evidence (Adams 2016b).[37] Such evidence often strives to be valid across context. As João Biehl and Adriana Petryna (2013, 12) write in the introduction to their much-cited book *When People Come First: Critical Studies in Global Health*, 'much global health scholarship is invested in developing models […] of optimal interventions, and in identifying and evaluating programs that supposedly 'work,' and that might therefore be replicated or scaled up across a range of often widely divergent social contexts and geographic locations'. Trials that test the efficiency of vaccines are meant to produce evidence that a vaccine 'works', so that it can induce immunity responses globally. Interventions regarding the uptake of preventive screenings are designed to be taken up in places with vastly different health care systems. Stella, D-Lab's laboratory coordinator, is part of the global health workforce and she has adopted these ambitions of making evidence to be valid in very different places. In the interview transcript cited above, she highlights that Uganda and Malawi are indeed very different places, but also states that the evidence made within D-Lab in these two countries will be of value to Africa as a whole.

D-Lab officially devised the project with the aim to produce evidence on the drivers of AMR, and to identify the most cost-efficient interventions to reduce the risk of human colonisation with resistant bacteria that was not to be tied to their field sites, but instead would produce guiding principles generalisable to 'East Africa and beyond' (Cocker et al. 2022). The evidence on AMR that D-Lab made was meant to be able to travel and be valid in places far beyond the project's immediate reach. D-Lab's approach to study AMR in a standardised manner across field sites and countries, in order to produce evidence expected to be valid in a much larger regional area are much in line with global health scholarship and policy.

Indeed, much public health literature refers to AMR as a global issue, hereby often highlighting the traveling nature of microbes and anti-microbials. Scientists even speak of a 'global resistome' (Hinchliffe 2021; Landecker 2016; D'Costa et al. 2006), 'understood as a common pool from which all bacteria,

[37] For an account of the World Bank's role in 'global health knowledge production', see Tichenor et al. (2021).

pathogenic or benign, native to soil or to animal, aerobic or anaerobic, can potentially draw on under the selective pressure of antibiotics' (Landecker 2016, 32). In the WHO's Global Action Plan on AMR from 2015, AMR is presented as a looming threat, endangering the world we currently live in with no-longer treatable forms of infectious diseases; it follows a call for immediate action internationally (World Health Organization 2015). The understanding of AMR as an issue of great urgency and global reach, transcending borders and boundaries has led to a push on the coordination of efforts to control AMR (Podolsky et al. 2015).

Despite its global reach however, and the prominent global framing, scholars have pointed to the highly local nature of AMR. It has long been established that risks for diseases are context-dependent, and diseases take on widely different forms and have widely varying consequences in different contexts too; on average structurally disadvantaged groups suffer from higher rates of infections and mortality both across and within countries (Mendenhall et al. 2022). Since the COVID-19 pandemic, where such differences have been particularly pronounced, syndemic analyses have become more common, taking into consideration the interaction of disease agents and pre-existing circumstances including structural concerns (Mendenhall et al. 2022).[38] Building on the work about menopause and *local biologies*, Margaret Lock and Vinh-Kim Nguyen (2010) have argued that not only do circumstances differ widely, biologies are not the same everywhere either, and instead contingent upon time and place.[39]

The contingency of biology is particularly relevant in the case of AMR. In their article on 'Revisiting Local Biology in the Era of Global Health', an introduction to an issue of *Medical Anthropology*, Brotherton and Nguyen (2013, 287), highlight 'the relevance of local biology in the age of molecular manipulation, when biological substance, always already contingent, is re-crafted in accordance with political interests, local and global, and culturally

[38] The term syndemic has been employed in medical anthropology since at least the 1990s (Singer and Clair 2003). Grøn and Meinert (2017, 170), describe syndemic analysis as understanding 'diseases and conditions [as] intertwined with economic and social conditions as well as ecological and environmental factors.'

[39] Similarly, there have been more general critiques of universal models in biology, see for example (Niewöhner and Lock 2018).

informed values, local and global'. In a similar vein, Hannah Landecker (2019) reads the genetic material of microbes as specific, local archives of past human actions regarding the management of infections. Microbes and their genes that encode resistance differ across place and time, relating to our past and current attempt at managing them. These highly local particularities in the microbes, and in our means of managing them have implications for the meaning of the very term resistance. A multidisciplinary group of researchers lay out in their article on antibiotic policy making, '[T]he constantly evolving nature of AMR, the introduction of new drugs and the different availability and use of antibiotics means that terms like drug sensitive, intermediate resistant or resistant, mean different things in different regional contexts' (Kirchhelle et al. 2020, 2). AMR takes on widely different shapes and meanings across the globe.

The ways in which D-Lab was set up, not only takes AMR as a global object, it also understands the places in which the project works (i.e. where it collects data) as sufficiently similar to the region in which the evidence is meant to be applicable. The project's field sites in Uganda and Malawi are employed to speak to a much broader regional area. In this chapter, I look at what it takes to produce evidence on the drivers of AMR that is not bound to any particular space but that is meant to be meaningful across different contexts. Empirically, this chapter is based on ethnographic insights of my engagement with D-Lab researchers and documentary evidence with a focus on the making and employment of maps, shedding light on their making of field sites, communities, and households as (bounded) units of analysis. I attend to how standard places and a standard object of AMR emerged through D-Lab's work. I argue that the standard units of analysis do not only cut off the socio-economic, historical, even biological context and narratives in which the evidence was made but they also construct new contexts (i.e. standard households as sites of analysis and intervention). These new contexts recursively shape our concept of AMR, and our ideas on how to intervene on it. AMR becomes an issue that emerges from standard sites, which render the local context illegible and ultimately superfluous. AMR is made to exist within homogenous, idealised households, within which it is to be addressed.

In the following sections, I attend to rationales of standardisation. I then lay out how D-Lab constructed their field sites, communities, and households

within which they made their data. I move from large to small, starting with D-Lab's Ugandan field sites, as geographically bound places within which the researchers made their data. I then turn to D-Lab's conceptualisation of community. This is followed by a section analysing D-Lab's framing of households which, it is argued, constitute the project's central unit of analysis. I then come back to a discussion of standardisation and its politics and reflect on how these processes of standardisation bear on the AMR that comes out of the collaboration.

Why standardise evidence?

The rationale put forward as to why researchers would aim to standardise data relates mostly to generalisability.[40] Standardisation of evidence making procedures is meant to bring to the fore data that are comparable (often over time or across space, or both), and from which patterns can be derived that would not be recognisable when studying single cases up close. In order for these patterns to become recognisable, the data need to be reductive, to only represent that which is meant to be compared. In Bruno Latour's work 'Circulating reference' (1999) in which he follows soil scientists in a rainforest and aims to understand the ways in which they make sense of their data, he describes this logic in a straightforward manner. Through *reduction* we 'lose locality, particularity, materiality, multiplicity, and continuity' but we are 'able to obtain much greater compatibility, standardization, text, calculation, circulation, and relative universality'. Latour calls this gaining *amplification,* in which data points become the basis for evidence (Latour, 70-71). The underlying rationale of making reductive evidence is to enable patterns to become noticeable that otherwise could not be recognised.

[40] Evidence that is valid in general, and not only in particular circumstances is more economic. It allows global health institutions to save both costs and time regarding the production of evidence and the development of interventions where a study in one context can yield results to be valid in others. Also, within research collaborations like D-Lab, standardised evidence is also more mobile, numbers (at least ostensibly) travel more effortlessly than wordy stories - and indeed in D-Lab they had to travel large distances in between the sites of their production and the sites in which they were compiled and made sense of without accompanying narratives.

In the case of AMR, there are many examples of quantitative, reductive studies and endeavours in which the reductive data have led to the detection of patterns that could not have been known otherwise. One area where such approaches have proven helpful is the surveillance of AMR. A data base for surveillance 'tracks changes in microbial populations, permits the early detection of resistant strains of public health importance, and supports the prompt notification and investigation of outbreaks.' (The Global Health Network 2023). One major surveillance data base is the WHO's Global Antimicrobial Resistance and Use Surveillance System (GLASS), where data on AMR including laboratory data but also 'epidemiological, clinical, and population-level data' for example on the use of antimicrobials are analysed together (World Health Organization 2023). Such data bases depend on the labour of many individuals who enter single data points in a standardised manner into the data base. The patterns - such as rising numbers of resistant infections to specific antibiotics over time, or the spreading of resistant organisms across places - only become recognisable as a consequence of the combined work of the researchers and the amplification of the single data points. The single entry points cannot give us insights over historical trends or variations across space. Such data bases, however, do not reflect the varying conditions under which the data has been made, e.g. the laboratory equipment infrastructures that undoubtedly shapes the resulting evidence (for more detail on D-Lab's laboratory infrastructures, and how the local research teams navigated it, see chapter 4 on precarity).

There are factors that affect AMR globally, which prompt approaches to studying AMR that go beyond particular places. The use of antimicrobials exerts pressure on microbes and makes it more likely for them to become resistant. The reasons humans use antimicrobials most commonly is to treat or prevent illnesses in themselves, their animals or in plants, and they do so globally. Because bacteria travel and affect one another, exchanging resistance encoding genes, changes in the landscapes of bacterial life have broad and far-reaching ecological effects (Landecker 2019). Increasing usage of antimicrobials relates to global factors. In their analysis on the role of antibiotics in society, Laurie Denyer Willis and Clare Chandler (2019) show that antibiotics play myriad roles enabling life as we know it, and act as 'quick fix for care,

productivity, hygiene and inequality'. Increasing demands for food, specifically protein, increases the demand for antibiotics as well (Kayendeke et al. 2023). The global nature of AMR is a rationale for investigating it in standardised, trans-local manner, making sense of it beyond particular places and times.

Beyond the rationale to render patterns recognisable that could not have been found through examining single cases, the making of numbers and metrics through the standardisation of data and evidence bring about a sense of transparency, comparability, and thereby governability (Tichenor 2020). Colonial Empires, and in particular the British Colonial Empire have used censuses and surveys as part of their apparatus to govern, and today's data build on the colonial data infrastructures. As Engin Isin and Evelyn Ruppert in their chapter 'Data's Empire: Postcolonial data politics' (2019, 207) argue, 'technologies of colonial government of counting, categorising, and ordering were inherited, reshaped, and reused by postcolonial governments' so that contemporary data 'continues yet reconfigures colonial logics and objects of knowledge'. Metrics and numerical representations laid the groundwork for colonial governance. In her overview article on metrics, Marlee Tichenor (2020, 1) writes of today's data that '[…] our lives are increasingly governed by numbers and numerical surveillance - not only those used by nation-states, which have long used numbers as a means of governing from above, but also by non-state forces.' The current making of numerical data, whether by state or non-state actors, produces governable bodies - much in line with colonial governance - in ostensibly transparent and accountable ways.

Studying AMR in a standardised way that allows counting, measuring, comparing, and then generalising thus not only allows for the detection of patterns emerging across large geographical spaces and over long periods of time, it also renders AMR into an object that global health policy institutions can attempt to grasp and govern. One prominent example is the often cited report by Jim O'Neill (2014) entitled 'Antimicrobial resistance: tackling a crisis for the health and wealth of nations', which renders AMR into a measurable economic reality, a threat to wealth and economic growth. The report's demand to act on or tackle AMR builds on the modelled evidence of AMR's potential to

kill in large numbers ('10 million by 2050') and slow the growth of the economy (2014, 5).

The production of standardised data often comes with more leverage. As in the case of the O'Neill report, it is often large numbers that have a lasting impact on global health policy. Quantitative evidence has been attributed more value and interpretative power than evidence derived from the close analysis of single cases. Also within the social sciences this hierarchy between quantitative and reductive on the one side, and qualitative and more holistic approaches on the other side exists. As Theodore Porter writes in an article on 'The political role of social science', quantification is an attempt to turn social science into a '*science* of society, that can hold its head up in the company of physics, chemistry and engineering […]. Methodological rigor, often with an emphasis on quantification', Porter continues, has also been 'part of the distancing from politics, which, ironically, underlies the accepted policy role for social science - not as the science of the legislator, but as a resource, untainted by ideology, to which legislators can look for information and analysis' (Porter 2006, 1273-1274). In this framework put forward by policy makers at national and international levels as well as within academic institutions,[41] the price of amplification, that Latour summarises as the loss of 'locality, particularity, […]' etc of the data is hardly mentioned as a concern, ethnographic and other evidence based not on large numbers but on the close analysis of single cases (and concerned with exactly that locality and particularity) gets brushed to the side as anecdotal; see for example Parker and

[41] UK-based academic staff are incentivised to produce evidence that is of global, rather than local value. The Research Excellence Framework (REF) that is used 'for assessing the excellence of research in UK higher education providers' and for the 'allocation of around £2 billion per year of public funding for universities' research' values publications with global value over the ones with specific local analysis (UK Research and Innovation 2022). Though global value of evidence is attainable both through holistic approaches where researchers deduce larger scale implications through the thorough analysis of a small number of cases, it is more straightforward and more easily attainable through reductive approaches, where data points from across countries can be combined into large scale analysis. In the REF assessment criteria, international recognition is a necessity for the four and three stars categories, 'quality that is recognised nationally in terms of originality, significance and rigour' is a descriptor for the lowest possible category, giving the research outputs one star only (Research Excellence Framework 2021, 36). The growing precarity of academic staff in the UK - the University and College Union calls it an 'endemic problem of casualisation in higher education', with large shares of staff on fixed term contracts (University and College Union 2021), increases the pressure to perform according to the REF metrics. The social and economic commitments of researchers at UK universities push them to rather pursue concerns that would be recognised internationally over more local issues.

Harper (2005) for an analysis of the role of anthropological evidence in public health. The idea that quantitative social science is somehow less political or ideologically charged than qualitative or ethnographic social science continues to be prevalent in policy and research circles and shapes the making and employment of social scientific evidence.

Field sites, communities, and households

D-Lab aimed to make evidence on the drivers of AMR not just in the spaces in which the project unfolded but to be valid in a much larger context. D-Lab's focus was thus not on making sense of the local specificities, the historical, social or economic factors shaping the places (and by extension, the microbes in those places) but rather on what was imagined to be common across a much larger geographical space. To that end, D-Lab worked to construct field sites, and within them, communities, and households. These served as standardised units of analysis, from which the project was to infer the dynamics and drivers that shape AMR in this much larger space.

Field sites

D-Lab worked in two field sites in Uganda and in three field sites in Malawi, within which they made evidence to be valid across East-Africa and beyond. The selection and definition of the Ugandan field sites are the focus of this section. Project logistics and limited time and funding made it impossible for the project to randomly select a large number of field sites from across the country.[42] And even if it had been logistically possible to select the field sites randomly, there would still have been a gap towards generalising the findings to other spaces in East Africa, or even beyond. Uganda's districts and regions are far from homogenous; they differ in many regards including, but not limited to, the languages spoken or the average wealth and education levels of the residents (Lwanga-Ntale 2015), as well as variables such as healthcare accessibility, access and usage of antibiotics, sanitation infrastructure, and the mobility of residents, that have been shown to relate to the development and

[42] Within quantitative studies, random sample selection is meant to even out the effects of observed as well as unobserved co-variates that might differ across any set of non-randomly selected field sites.

spread of AMR. This heterogeneity, and the logistical and practical conditions made it challenging to select field sites in such a way that they could be representative of all other parts of Uganda.

In their protocol, D-Lab authors present maps of their field sites and the rationale for their selection in one rather short paragraph. They write that they purposively selected field sites in urban, rural, and peri-urban environments in both Uganda and Malawi. Across these geographical categories, the study authors expected variation in the socio-economic status of residents, as well as across numerous variables which have a direct bearing on AMR. They listed these variables as 'WASH behaviours, animal practices, ABU [anti-microbial usage], and contamination with ESBL-producing bacteria' (Cocker et al. 2022, 14), all of which D-Lab then set out to collect data on. Additionally, the authors considered 'perceived acceptability of research within the communities and existing research capacity' in the selection of field sites (Cocker et al. 2022, 14).

Aiming to better understand the process of selecting the project's field sites and defining their boundaries, I followed up with Isabelle, who worked as part of the UK-based modelling team. In a written interview with her, she explained how they created the sampling design. She wrote:

> 'My work focused on determining a suitable spatial sampling design for study sites in Uganda and Malawi, accounting for population density and socioeconomic stratification.'
> In a follow-up email, she expanded, 'The methodology is based on the spatial inhibitory design with close pairs […] but is modified to allow sampling within sites with spatially heterogeneous populations, and to allow us to stratify our population by socioeconomic status. Our study areas are separated into multiple polygons and I created the sampling design with the help of my supervisor to vary depending on what we already knew about the areas (population density, previous census availability, OSM[43]data…). […] The SES stratification was determined by the local experts prior to choosing the households.'

[43] OSM stands for Open Street Map and refers to an open access data base containing geographic data. (See https://en.wikipedia.org/wiki/OpenStreetMap, last accessed 17.1.24)

[transcript from written interviews with Isabelle, 23.11.20 and 4.2.21].

With input from local experts regarding the socio-economic status of the populations living in the study area, the modelling team had drawn boundaries of polygons on satellite maps,[44] defining the borders of the spaces in which the field teams would collect data. These polygons were meant to cover areas with populations with varying socio-economic statuses.

During my fieldwork in Uganda, I discussed the selection of field sites with the staff responsible for the roll out of the project. In an interview with Dr. Julia, the study coordinator for the Ugandan part of the study, I asked her to talk me through the process of selecting field sites. We met at her office on a Tuesday afternoon; she was still working for the same institute, but had started working on a vaccine related project following the closure of D-Lab. In the project's hierarchy, she had been working immediately below the principal investigator for the Ugandan part of the study and above all the other staff (e.g. the laboratory assistants, and field assistants). A medical doctor by training, Dr. Julia had worked in many projects and spoke with authority about research procedures. She laid out the process as follows:

> 'So what happened is […], they wanted to capture different areas [referring to the urban, peri-urban and rural areas]. For example, urban Kampala was so straight forward, but when they went to upcountry [speaking from Kampala the rest of the country is often referred to as 'upcountry'] they wanted to pick those ones in the city centre but also in the other areas [referring to rural or peri-urban areas]. So, I think they just went on a map and decided to do polygons. Those households would fall in certain polygons, in Kampala, we had two polygons, in Hoima, we had three polygons. All of them were to try to get a good sample space or sample area, to see that at least we are capturing everything; as much as it is upcountry, there is that rural and peri-urban setting.'
> [Interview transcript, 1.2.22, with Dr. Julia's in her office in Kampala]

[44] By employing the label of 'polygon', D-Lab renders field sites into mathematical units. This label also highlights that the shape of the field site is determined by the analytic rather than by characteristics of the place.

Dr. Julia and the rest of the Uganda-based team were provided with the boundaries of the polygons, drawn onto the maps, where they were collecting the data. Julia clearly articulated that she had neither contributed to their making, nor had she discussed the rationale underpinning their selection.

In the course of my fieldwork, I came to learn about the rather pragmatic reasoning behind the choice of the study areas. The selection of Kampala's field sites seemed so obvious to the Ugandan team that it was not discussed much during the time I spent with the researchers. Kampala is where the main laboratories are located, as part of Makerere University, and the location meant short distances for the researchers to the field sites and the laboratory. It therefore seemed like an obvious option for D-Lab's urban Ugandan field site. The rationale for choosing D-Lab's rural and peri-urban site was also rather pragmatic. When I asked Jamil, a veterinarian who worked in the Hoima field site, he explained:

> J: D-Lab could have… chose Hoima as one of the fields, […], because the project is interested in picking scenarios on the urban, and then the rural. So the typical urban is Kampala. And then the rural, is Hoima. But for choosing Hoima, maybe to begin with, is that Hoima, one of the core investigators has had previous work done in Hoima.
> E: is that Dr. Caroline?
> J: yea, that's Professor Caroline […]. My former lecturer. So, Caroline has done some work in Hoima for some years, and so it was a quite easy for Hoima, especially administration, the management of the district. It would not be so difficult for us to peek their willingness, to allow the project run in that site.
> E: I see.
> J: Yes, so having done some work before, and also [the implementing institute] has had a, we have had a regional office there in Hoima, for about 8 years, so it was like getting a project to operate in an area where the organisation is running a number of other projects. So it's becoming easier to choose Hoima, ahead of some other districts.
>
> [transcript phone interview with Jamil, 29.1.2021]

Dr. Caroline's prior connections, and the regional offices of the implementing institute provided certainty about both the 'acceptability of research' and about the 'existing research capacity' as mentioned in their published protocol (Cocker et al. 2022). In short, it was convenient for D-Lab to work in Kampala and in Hoima.

The practical concerns guiding the selection of field sites did not reduce the expectation that the evidence produced was meant to be valid across a large geographical space. Variation across urban, peri-urban and rural contexts and with that, variation in socio-economic status was meant to produce a sample from which D-Lab would then be able to extrapolate its evidence to a large geographical space designated as 'East Africa and beyond'. The ideal of making evidence that is not tied to a specific setting but can be generalised to a much larger space and the rather pragmatic rationale for the selection of the field sites that were to be representative of that larger spaces - that came to stand in as 'standard East-African setting'- was not a topic of long discussions.[45] There was a quiet understanding that did not require much spelling out, that research needed to be done where it could be done (and that is, where it had been done before).

As I learnt from the field assistants for whom the polygons were not abstract lines drawn on satellite maps, but territories they navigated, the boundaries of the polygons did not correspond to borders occurring on the ground. Instead, they were cutting across streets, neighbourhoods, lakes, or grassland. Rebecca, a field assistant in the Kampala field site explained to me, that at follow-up visits her field team sometimes encountered a participating household that had moved out of the polygon. Most of the residents in the urban field site were renting their homes and there was movement over the study period, where residents moved in and out of the polygon. By moving across the polygon's boundary, they were dropping in and out of the study population, becoming proof of the superimposed nature of the field site

[45] In her article on 'Objectivity and the Escape from Perspective', Lorraine Daston (1992) frames objectivity among other things as an escape from perspective. While this ideal of escaping from a perspective usually refers to researchers who try not to bring their subjective views to bear on the subject that they study, it can also be applied to the set-up of a study, where the goal is to speak for a larger whole and 'escape the perspective' of any particular place.

boundaries. The field sites which had been selected aligned with characteristics of the research apparatus (inclusion of a certain number of households in a certain distance to one another, and with residents from varying socio-economic backgrounds) and less with the places themselves.

The field sites, divided into polygons drawn out on satellite maps by UK-based modellers, became the space in which D-Lab unfolded, and within which they made their data points. The polygons featured less as specific places, and more as placeholders, or exemplary spaces in the project's evidence making apparatus. Navigating these spaces on the ground, and collecting data within them, turned out to be more laborious than anticipated and required a substantial amount of creative, adaptive labour from the field assistants (see chapter 4 on precarity for more detail on the labour of the implementing researchers).

Communities

As part of the protocol, D-Lab published a schematic map depicting a 'model community' that came to represent an imagined community in Uganda or Malawi (see Figure 2). The authors indicate that it was developed by 'Design Without Borders Uganda, [and that it] was an output from a Ugandan stakeholder Development Award. The interdisciplinary workshop included representatives from the Ministry of Health, Ministry of Agriculture, Animal Industry, and Fisheries, National Drug Authority, MakCHS, and COVAB.'[46] This graphic visualises different entities of the imagined community and their bacterial connections. Its caption reads 'Hypothetical model of related behaviours and the movement of AMR-bacteria in Uganda and Malawi. The schematic situates the household at the heart of the model, in which humans act in response to their environment within which bacteria are evolving in response to selective pressures around them.' The idea behind the schematic was not to portray any particular place, rather it served to depict the kind of community in which D-Lab imagined working and in which their evidence would be valid. The comic-like schematic includes humans, animals, as well as

[46] MakCHS stands for Makerere University College of Health Sciences and COVAB is an acronym for College of Veterinary Medicine, Animal Resources and Biosecurity, Makerere University.

microbes in an environment consisting of households, markets, health centres, pharmacies, farms, and an abattoir, with a river crossing through the image. The map establishes links and relations, illustrating plausible pathways for the transmission of microbes.

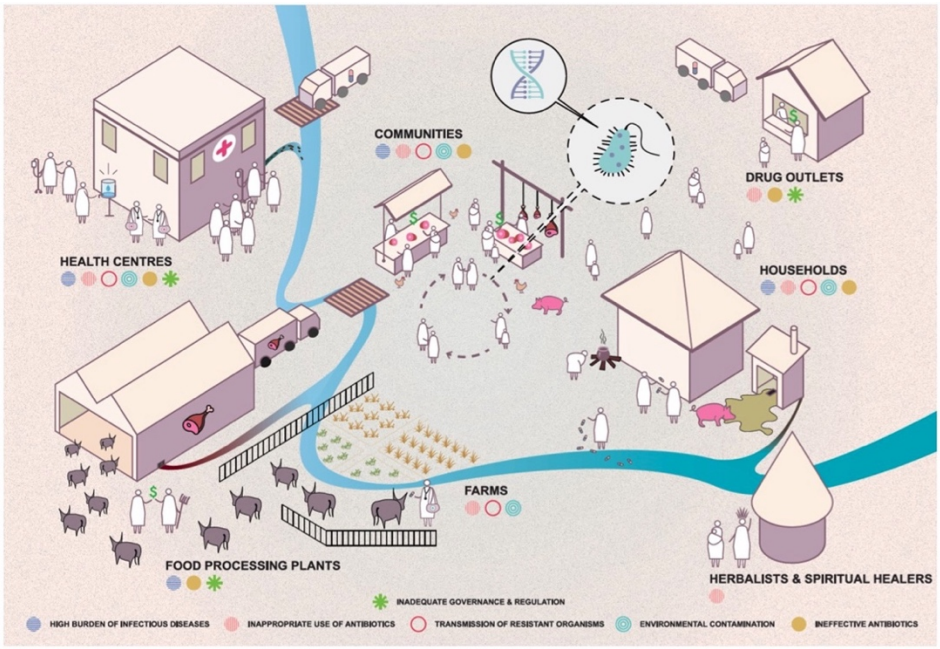

Figure 2. D-Lab's community map, as printed in their protocol (Cocker et al. 2022).

The schematic model conveys how the stakeholders who drew it and the D-Lab authors who published it, imagined the communities and their inter-relationships, as well as the factors contributing to the development and spread of AMR. The schematic depicts many events at once in a kind of temporal collapse: somebody is throwing trash into the water flow, while wastewater is flowing into the water from the hospital and from the abattoir. The 'standard community' depicted here, does not only not have a particular place, it also does not have a history. It exists in the present somewhere in East Africa. The historical, social, economic, political, legal, infrastructural as well as ecological contingencies that shape any particular place with its community, are written out so that the focus shifts to the exploration of factors that can be made tangible in such a drawing.

In their work on AMR in informal settlements around Kampala, Christine Nabirye and colleagues found that the economic entanglements of

the settlement they worked in, and its geographic location as well as the infrastructure and type of housing, all had a bearing on the diseases the residents experienced (Nabirye et al. 2021). During rainy periods, the settlements were flooded with sewage water coming from a wealthier neighbourhood uphill, where many of the residents went to work. During these periods, cases of diarrhoea soared, and pharmacists would stock up on antibiotics in anticipation. Such historically grown entanglements of geographic location and economic dependencies affecting the pathways of microbes are made invisible in D-Lab's schematic of a 'standard community'. Their standard community is neither in a valley, nor on a hill, neither close nor far from a bigger city. It does not relate to its surroundings.

Within global health, a particular understanding of 'the community' features prominently as a unit of analysis, shaping ideas of sociality, and with it disease transmission and intervention logics. So called 'community interventions' are targeted at groups of people living together and under shared circumstances. The imaginary of communities, particularly when used in reference to the Global South and non-urban environments, is far from being value-neutral. Inhabitants of 'communities' are often painted as poor, uneducated, backward and living in unsanitary conditions (Anderson 2006). In this context, the 'culture' of people living in 'communities' is often described as a hindrance to progress. As Steven Hinchliffe argues 'there is an implicit assumption that cultural and economic differences are obstacles to rational or good behaviour. Culture is a label that tends to be used as a synonym for inappropriate or incorrect (non-scientific) knowledge, and or misinformed beliefs, habits and practices (Ledingham et al., 2019)' as cited in (Hinchliffe 2021, 8). Hinchliffe further highlights that 'knowledge and beliefs have retained their relevance to global health and continue to be treated as matters for correction' (Hinchliffe 2021, 10). The implication of assuming culture to be an obstacle to scientific endeavours, namely that science is (and needs to be) without culture, has been shown to be no less flawed.[47]

[47] Sarah Franklin, in her review article 'Science as culture, cultures of science', describes the 'culture of no-culture' of scientists where the only acceptable critique is the one that aims to improve results. Franklin analyses the defensive reaction of scientists to the claim that

I encountered this all-familiar trope through the words of Ugandan researchers. At the end of a long day of pilot testing D-Lab's data collection tools in two households in rural western Uganda, Dr. Julia, the project coordinator, asked the team to be extra careful about washing hands and being clean, as 'we have been to "the community" today'. It seemed obvious to her that 'the community' and the poor sanitary conditions that people lived under posed a risk to the health of the research team.[48] Earlier the same day, Jamil, a field assistant, had explained to me while we were standing in the shadow of a small house on a compound in the rural area, that it was very challenging to get faecal samples, because of the 'culture' of the people in the rural communities. The culture, that Jamil referred to, was at odds with the science that he (and I) embodied, it needed to be worked around in order for good data to be made.[49] A good researcher, that he was aiming to be, would find ways of doing so [Fieldnotes during D-Lab's pilot testing week, Hoima, 4.3.2020].

Within D-Lab, disease transmission was mainly studied at the smaller level of households (see section below), and less at the level of communities. However, the spatial position of each household captured in the form of GPS coordinates, meant to offer insights over the relative distribution and spread of resistant bacteria across the recruited households within the demarcated polygons. In addition to data collection within the recruited households, D-Lab researchers conducted a small number of transect walks through the communities and their public spaces such as markets, waste dumping sides, and water sources, where they engaged in observations and collected biological samples too (for more detail on D-Lab's work around WaSH, see

science cannot be value-neutral and draws out 'science as a source of cultural values that are deeply felt' (Franklin 1995).

[48] I was by far the most mobile among this group of people, having recently travelled across the UK, Germany and then to Uganda. At this point I had been to Uganda for a couple of weeks, so I did not feel like an immediate risk. In my field notes of that day, I comment on how this made me feel particularly uneasy. It was early March 2020, and though we knew very little about the COVID-19 pandemic, it had become clear that it was the most mobile people of the world who were transporting this new virus to every region. We, the researchers, and particularly I, were more dangerous to 'the community' than the other way round.

[49] In an interview with Dr. Julia almost two years after this conversation with Jamil, she told me that faeces were used for specific rituals in the area under study, and that that made it challenging to collect faecal samples. Here, the 'culture' that posed a hindrance to science was less a vague sense of backwardness or lack of trust in science but rather referred to specific cultural practices. [fieldnotes/interview with Dr. Julia, 1.2.2022]

chapter 6). Communities here were not the unit of analysis, but rather provided a background, a way of linking together the otherwise isolated households of their study participants. The schematic depiction served more to illustrate the kinds of worlds the researchers imagined their participants to live in than the specific hypotheses explored in this bit of the study, with the main focus being the drivers of transmission of AMR within households.

In order to gain access to the households where D-Lab collected the bulk of their data, D-Lab, like any other research project (including mine), needed approval from the district authorities on top of the university approval boards and the national ethics approval board. In a less legally binding sense, they also needed the approval of 'the community', represented by people with influence and power, elders, church leaders, local counsellors and so on. These approvals required rather elaborate processes involving several meetings and alerting the administrators to the project's activity on a regular basis.[50] Village health workers, usually residents of the villages who are hired by the local administration and trained for basic health care and advice, accompanied the D-Lab teams to their first household visits. Their presence was explained as a way of forging trust between the residents and the researchers, while also ensuring that the researchers did not cause the residents harm. 'The community' within D-Lab also featured as a social structure which they needed to navigate to get to the data needed.

Households

Within field sites defined by neatly drawn polygons on satellite maps and inside communities as imagined spaces of social, biological, and economic life, D-Lab made their main unit of analysis - households. In their published protocol, D-Lab's authors lay out their overall goal. They wrote: 'in order to determine the critical points at which efforts to interrupt human AMR acquisition are likely to have the greatest impact in Eastern Africa and beyond, we hypothesise that the household is a key setting in which ESBL enteric bacteria are transmitted. We therefore aim to identify risk factors for and infer

[50] Since I was not working 'in the community', I did not need to go through these procedures. Approvals from the District Health Commissioner and the hospital administration were sufficient.

drivers of ESBL-E and ESBL-K transmission in Uganda and Malawi at the household level' (Cocker et al. 2022, 4).[51] Within the field sites, data collection thus happened mostly at the level of the household. Household selection was based on GPS data from within the polygons that the field teams received prior to recruiting a new household into the study; as Isabelle explained to me 'the design returns a list of GPS coordinates for the teams to go to', referring to the spatial modelling design through which the sample was constituted [transcript from written interview with Isabelle, 4.2.21].

Once the field teams had identified a household following the GPS coordinates - a process much less straightforward than had been imagined by the modelling team (for more detail see chapter 4, on precarity), and enough household members had consented to participate in the study, data collection began. As a first step within any newly recruited households, one field assistant set out to draw a map of the compound, defining the boundaries of the household they now had recruited into the study. Using paper and pencil, the designated field assistant would walk through the compound indicating on their sketch the relative closeness and distance between objects and infrastructures that they related to the mobility of bacteria. In pre-fieldwork training sessions, the field teams had been taught how to draw these maps and what to look out for. Figure 3 is an example of such a map from a household in the Kampala field site. The map details the layout of the residents' house and its immediate environment, locating it close to a major road. It shows where the residents who lived in this particular household prepared their food and where they ate, where and how they stored their water, where they slept and where the latrines were. Windows and doors are clearly indicated on the map, as pathways not just for humans but also for microbes.

[51] Since water and sanitation related interventions have come to focus on practices rather than infrastructures (for a more detailed analysis around WaSH and its focus on practices, see chapter 6), the household has become a key setting for such interventions, though more recently there has been a move to including institutional settings such as schools, or markets (Taing and Dang 2021).

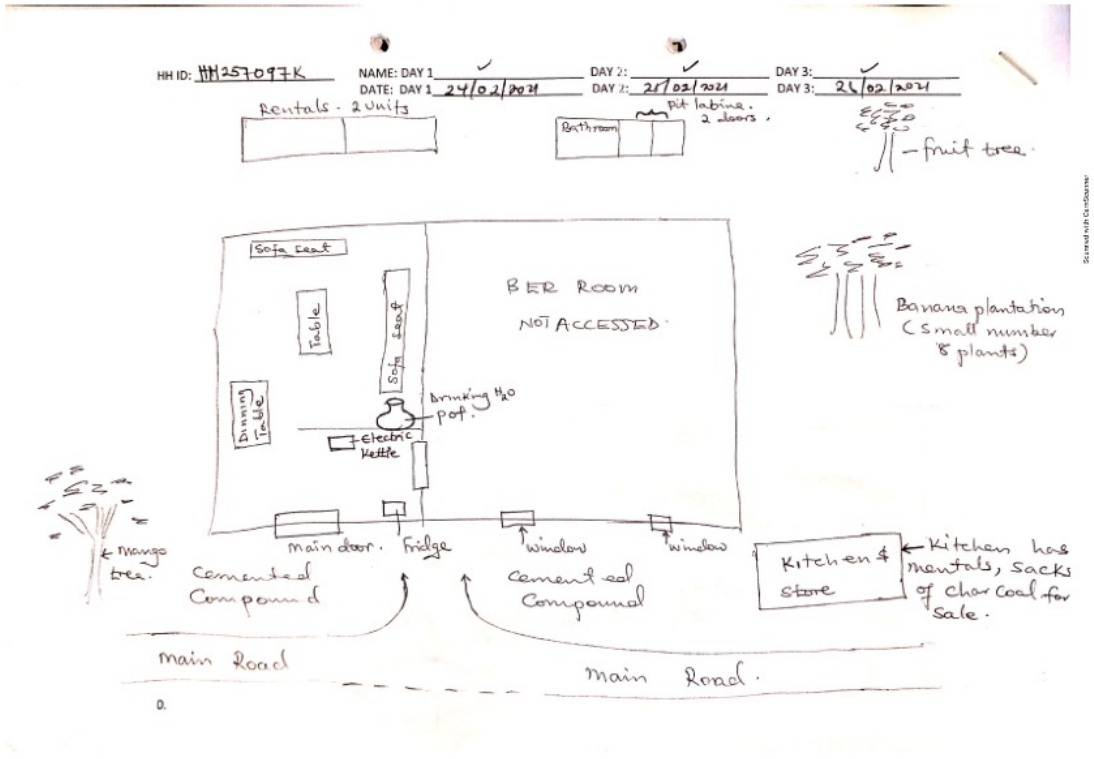

Figure 3. Hand-drawn household map of urban household, drawn in February 2021 by Rebecca. It was shared with me by a fieldwork coordinator.

Within the project's logic, household maps were intended to guide the field assistants' observations of practices relating to the transmission of microbes within the compound (see chapter 6 for a detailed account of the observations around water, sanitation, and hygiene within the residents' households). The maps were meant to shift the attention of the observers to the spaces in which bacterial transmission was deemed likely to occur. Rebecca, one of the Kampala-based field assistants, told me the maps were also meant to ensure that field assistants who worked in the compound on different days were consistent in their reporting. (She also told me that they hardly ever looked at them after they had drawn the maps, because it was 'obvious' enough where to situate oneself within the household and what to observe[52]). The hand-drawn maps were an attempt to standardise data collection across field assistants, and construct households as bounded units. These maps, more fine-grained extensions of the pre-drawn community maps, standardised the

[52] In other words, rather than the maps enforcing consistency, map-making signaled expertise in 'how to be consistent'.

households by highlighting features they had in common and that were thought to be of importance in the understanding of AMR and its drivers.

In the questionnaires and observation forms 'the household' is a set unit from which data were to be collected. The household consisted of a set amount of people living together (a minimum of four people had to consent to participating in the study), sharing food, and sanitation facilities on a compound with set boundaries. In the very early phase of my fieldwork, in March 2020, I spent time with D-Lab researchers inside the compounds of rural households, where D-Lab researchers pilot tested their data collection tools, including the drawing of household maps. It did not take much time for me to see how the boundaries to the neighbours' compounds were hardly ever clear. At times there were no visible indicators, residents would show the researchers where their vegetable garden ended and where their neighbours' gardens began. When drawing the compounds, the field assistants drew lines across open spaces in which animals would roam around, people would come over, food would be shared. Within some compounds there were several little houses, that the researchers called units. For example, an elder father would live in one of the units, and in each of the other little houses, one of his sons would live with their wife and children. Although food, vegetable gardens, animals and care for children would be shared across the whole compound, the instructions that the researchers were given, and which they repeated to each other, involved focusing on one of the units. A household was not foreseen to be this large, so the field assistants were to focus only on one of the (open) parts and they were instructed to address them as units of analysis.

The eligibly criteria for any household to participate in the study also at first included the point that the household had to keep animals. During the same interview conducted in February 2022 with Dr. Julia that I refer to above in the section on field sites, I asked her about challenges she encountered in the rollout of D-Lab. Dr. Julia mentioned that this eligibility criterion was difficult to implement on the ground. She explained to me,

'Remember, this study had a One Health component.[53] Yet in Kampala, most households do not own any animals. And at first, our protocol said that there should be at least an animal. So it was hard at first, we would miss out so many households, being ineligible.' She then added, 'Yea, but later, we amended the protocol. We said that even if there is no animal [the household would be eligible]. So we would find that in some households, the One Health component did not come out. Yes, we had the humans, we had the environment, but then we missed the animal component.'
[Interview transcript, with Dr. Julia's in her office in Kampala, 1.2.22]

When I asked about the process of amending the protocol, Dr. Julia told me that during the early phases of data collection the field teams in the urban field site had repeatedly mentioned this mismatch of eligibility criteria and lived realities. Dr. Julia, on their behalf then approached the Ugandan PI. He connected with the Malawian PI, and it turned out the Malawian field teams had encountered the same issue and also did not find animals in the urban households they were meant to recruit. From then on, the PIs applied for an amendment, and soon afterwards the proposed changes were accepted, and field teams were able to recruit households that did not keep animals.

The standard household as it was written into the protocol had not been constituted in collaboration with Ugandan researchers. Dr. Julia and the rest of the Ugandan team would have known upfront that urban residents would rarely keep animals or that the boundaries to neighbours' compounds would be less clear, but they had not been consulted. They were hired to make the protocol work, not to establish the merits or otherwise of the assumptions they were working with. Employing a standard constructed on a drawing board elsewhere required extra time and resources at the beginning of data collection, as the field teams tried to find households who kept animals in areas where that was not common practice. They were doing their best to put the protocol to work. Doubtless, there were animals in the streets between the urban

[53] Chapter 5 provides a detailed analysis of the employment of the One Health framework within D-Lab.

households,[54] but they were not included because they were outside the (imagined) boundaries of each recruited household. The amendment of the protocol changed the eligibility criteria to include households who did not keep animals, but it did not shift to include animals that might be around (but perhaps not in) the houses of residents. In other words, the classification of 'the standard household' shifted slightly, just enough so that it could be put to work. The misfit of the protocol with its embedded assumptions regarding the constellation of an urban household, or its temporal stability, or the patrilocal and patrilineal ways of living in the more rural areas did not surprise Dr. Julia very much. She seemed to have become used to these misfits through her extensive work experience in other global health research projects.

Standard sites and standard AMR

This chapter contributes to the vast critiques of standardising approaches to evidence making, that often come from anthropologists, valuing the local, the particular, as well as the spontaneous that comes out of unstructured, non-standardised research encounters. In the literature critiquing and reflecting on evidence within global health, the reductive notion of quantification has been in the foreground. Vincanne Adams and colleagues write in their article on 'slow research'[55] '[…] in global health worlds, there is a tendency to dismiss local specificities because they get in the way of large-scale comparisons and scaled-up implementation.' (Adams, Burke, and Whitmarsh 2014, 180). Mortality statistics erase the stories that lead to deaths in child birth and create an inaccurate sense of comparability (Erikson 2012), indicators of health and wellbeing are mere numbers that do not transmit the stories that shape people's lives. The standardisation of evidence, making stakes about comparability of issues across places and over time, comes at the price of valuable context knowledge. Anthropologists have engaged in providing

[54] In my own neighbourhood in Kampala, goats, chicken and sometimes dogs would roam around in the trenches and on the roads in between street vendors, shops, restaurants and market stalls.

[55] The authors present 'slow research' in opposition to the research practices considered normal within global health, where 'we are all being asked to be productive in ways that create a sense of having to do more and to do it faster, to multitask for survival in a global workplace, to always be thinking of the next big thing, to scale up and implement, often even before we have completed our tasks at hand.' (Adams, Burke, and Whitmarsh 2014, 180).

context to such numbers, regarding the making of the numbers, the places from which the numbers emerge, the things the numbers are meant to represent, or the ways in which the numbers produce realities (and how these are related), adding rich layers of meaning to otherwise sober data.[56]

The field sites, communities, and households that emerged from D-Lab's work served to produce a sense of comparability between the different settings in which they worked and those to which they aimed to extrapolate the evidence produced. These sites were framed as standard places, so that the project would pick up not on what made them particular, but rather what made them typical, standard, even interchangeable, and therefore allowed the evidence made to speak to *any* standard setting. As illustrated in the preceding sections, the process of making such standard places is about writing out the specificities of the social, economic, political factors shaping these places. Standardising the description and understanding of the places stripped them of a contextual anchoring.

In the process of making these standard places - field sites, communities, and households, their particularities not only got pushed aside, at the same time, the process of standardising also established a new context. Standard field sites, communities and households, as they emerged from the work of D-Lab (and other comparable projects) provide reference points of their own. For example, households, as bounded both in space and as units of social life are rendered into new realities, to which potential future interventions are meant to be directed. Isin and Ruppert (2019, 208) write '[A]s modes of knowledge, especially the census and the map, were not merely descriptive exercises that represented populations and territories but were performative technologies that literally produced them'. Understanding D-Lab's workings through this post-colonial lens makes the performativity of their work of mapping and categorising territories and populations legible.

Studies on the field of global health and epidemiology have also evidenced the performative character of categorisations of conditions, people, and spaces. David Reubi (2020), in his work on the epidemiology of the

[56] For an extensive analysis of *metrics,* see Adams (2016b) and Tichenor (2020) and for an exemplary ethnography of the making of numbers, see Biruk (2018).

smoking epidemic in Africa, explicitly highlights 'the performative character of epidemiology'. He argues that 'the human and social sciences are performative of the social - they bring into being new social categories and models that change the ways we imagine people and the worlds they inhabit.' (2020, 14). More concretely, he argues that epidemiology construes an imaginary of the social, what he coins an 'epidemiological imaginary'. Similarly, Susan Erikson (2012) brings our attention to the performative character of statistics.

The standard field site, community, and household that D-Lab works with, distinctively shape our imagination of the world within which AMR is made to exist. The sites are performative and render the local illegible and ultimately superfluous, so that D-Lab produces a set of portable drivers of AMR. D-Lab's sites shift our attention to pre-defined attributes, and gloss over factors that are not be captured there - such as historically grown dependencies and relations between people and the environments they inhabit. The standard sites which D-Lab employs turn the specific places in which they work into spaces that are detached from their surroundings, and instead render them into standard units that would not have otherwise existed.

The impetus to make such evidence follows from evidentiary requirements put forward by global health funders, and from the portrayal of AMR as a global threat to human health - the rationale being that when the problem is global, the solution should be too. Steven Hinchliffe offers a convincing critique to this approach. In his work on AMR in the post-colony, rather than separately occurring events, he, too, understands AMR as a global event. Despite this understanding of AMR as global, and the framing of 'one resistome', Hinchliffe posits that to find ways of living with resistance, we must develop localised approaches in line with the ecological and social conditions in which bacteria become resistant, working towards 'altering the milieu of resistance' (2021, 3). Instead of 'extending social and medical power', and employing 'unified approaches' to AMR, resistance should cause us to pause and to interrogate the ways in which global health functions, Hinchliffe further argues, casting resistance itself as a product of its milieu (Hinchliffe 2021, 1,3).

Rather than being attentive to the specificities of its occurrence, standardised approaches to AMR turn it into a generic issue. In D-Lab's field

sites and data, the household is bounded and idealised, its animal relations finessed, and the protocol pragmatically reworked in order to develop standard drivers of AMR. AMR that emerges from 'standard' sites re-enacts the sites and related imaginaries, not the specificities of the particular places in which it is made. Since policies and interventions can only address what has been evidenced, interventions building on D-Lab's evidence will necessarily approach AMR as an issue to be understood and then addressed on the level of standardised, bounded households. This renders AMR into an issue of ostensibly bounded households, and into a standardised, homogenous object, leaving out its local particularities and infrastructural factors that themselves contributed to the occurrence of AMR in the first place.

Conclusion

AMR is a particularly well-suited object to analyse the processes of standardisation, and the blind spots that come with it. Global health policies and scholarship portray AMR as an acute threat to health everywhere. Its global reach, and its predicted growing impact on health (and wealth) often comes with demands for interventions to be employed broadly and quickly - a pragmatic approach of developing solutions to a global issue (see for example O'Neill (2014)). However, scholars have shown that AMR is also a product of local circumstances – with not only the composition of microbes, but also the means of diagnosing and responding to them varying across places (Landecker 2016; Kirchhelle et al. 2020).

In this chapter, I have documented the making of evidence of a 'standard' AMR, through the making of standard sites: pragmatically selected field sites, communities imagined outside their wider social, political, and historical environments, and households consisting of ostensibly stable constellations of people living on a compound with seemingly clear-cut boundaries. By zooming in on the processes through which researchers make standard sites, such as the drawing of household boundaries, I have demonstrated the performative character of standards. The making of these sites - a non-trivial task that requires an in-depth understanding of both the spaces in which the research unfolds as well as the categories the study operates on, has established a *polygonal* imaginary of East-African settings and

the AMR within them. D-Lab produced standard sites which intentionally flattened out the local contexts, and the local variations of AMR.

D-Lab's data making apparatus, and much of global health evidence, builds on pre-conceived concepts, variables, and maps, to capture only what was a priori deemed relevant and comparable across places. The resulting evidence bundles together specific local and historically contingent factors or left them out entirely. These factors include the larger ecological environment, the sanitation and waste infrastructures, or the labour and housing conditions under which people work and live, or, importantly, the local health care infrastructures and practices, and their historically constituted relations. In so doing, global health research renders AMR into an object that emerges from, and will be intervened upon homogenous, idealised households, and not the circumstances and conditions that shape any one place, and its microbes.

Chapter 4: Distributing research labour: adaptation and exclusion in the making of AMR

> Rebecca and I met in Kampala in February 2022, it was raining heavily that day, and she had therefore invited me to her home that she shared with her three younger siblings. We sat on grey heavy couches in her living room, the rain hitting against the window, and chatted about jobs and then about COVID-19. The nation-wide curfew had just been lifted and schools had reopened after almost two years.
>
> We then spoke about her time with D-Lab. In her two years with the project, Rebecca had been working full-time, collecting data from the project's urban field site. During the most intense phases of data collection, she and her colleagues started their working day in the very early mornings, well before sunrise, and worked long hours. As she put it, 'the project became our life'. Six months had passed since we last spoke, and Rebecca told me how hurt she felt because she was no longer being kept in the loop despite the time she had spent working on the project. She expressed hope that she would be updated about the project's developments, and the evidence that would come out of the data that she had been working so hard towards, but seemed doubtful this would happen. Referring not just to her own experience with *project work* but to that of her friends and colleagues too, intentionally keeping the context of her comment vague, Rebecca told me in a soft voice, that 'in the past, there have been projects where people would work full-time for some good amount of time, and then they wouldn't even learn what came out'. She looked up, and asked me, not expecting an answer, 'don't you think, they should at least let us know?' Rebecca told me that in the acknowledgment sections of papers building on the field data, study authors often thanked the local researchers, but never by name, 'thanks to the field teams' they would write.
>
> [Fieldnotes, Kampala, February 2022]

Research collaborations in global health science typically distribute project conception, data collection, and data analysis and interpretation across spaces, people, and timepoints. Components such as their study protocols, data

collection tools, and data points, travel across continents, in between desks of researchers and funders, to other researchers, field sites and study participants, and then usually back to researchers who conceived of and designed the project. Rebecca's contribution to D-Lab happened at the stage of data collection, in the project's urban field site.

In many countries in the Global South in which global health research projects unfold, there are pools of people who work as temporarily hired project staff. Employed as field assistants (often referred to as fieldworkers), as in the case of Rebecca as well as technical and laboratory staff, they live from project to project, building their livelihoods through short-term labour opportunities that the implementation of global health projects offer. In what Ruth Prince (2014, 69) calls 'piecemeal livelihoods' writing about Kenyans working in HIV consulting, precarious lives are sustained. A large pool of potential labourers contribute to a feeling of replaceability, that Pierre Bourdieu has formulated as a point of emergence for precarity (Jonna and Foster 2016). Hayley MacGregor et al. (2022, 19) in their article on pandemic preparedness and intersecting precarities, describe precarity with reference to Judith Butler's work 'both as a state of chronic insecurity and a political process of exclusion that disproportionately erodes conditions of life for those at the margins'. Sandra Hyde and Laurie Denyer Willis (2020, 1) remind us that such conditions can emerge from 'seemingly benign structures' and that 'it is often in slow and unhurried ways that the harm is done'.

The short-term working contracts of global health researchers, like Rebecca, provide both her and her colleagues with 'piecemeal livelihoods'. They also reflect the role that local researchers like Rebecca can play within the projects. Within much of the discourse in global health research projects, the labour of field assistants continues to be narrated as simple and straight-forward; they continue to be labelled as 'unskilled middlemen' [...], 'portrayed as menial labourers, as interchangeable cogs in the machinery, and as liabilities to the collection of good data' (Biruk 2018, 28). Through their labour, field assistants provide the project with filled-in data collection tools, such as survey sheets with ticked boxes, or filled test tubes with samples of biological materials. In so doing, they contribute to the projects they work in at crucial moments, often producing substantial data that the whole project builds on. In

their ethnography with field assistants employed in large survey projects of demographers on HIV in Malawi, Cal Biruk describes the skilled translational labour[57] that field assistants provide to such projects. They position this labour much in opposition to these common narratives, where field assistants move in between project offices and field sites, translating between the logic, language, and tools of the project and the life worlds of study participants (Biruk 2018). This labour, that Biruk labels 'knowledge work', carried the potential of 'upward mobility or increased capital', however the labourers 'led a precarious existence characterized by differential levels of ambivalent stagnancy based on their role in the project and specific social connections and intimacies' (Biruk 2018, 98).

In the case of D-Lab, data collection in the Ugandan field sites coincided with the early phases of the COVID-19 pandemic, as I describe in more detail in chapter 2 on methods. The onset of the pandemic demanded that the local researchers navigate a radically altered (research) landscape. This ranged from changes in their own day-to-day life and that of their study participants, to shifting social norms that changed research encounters, to unpredicted and unprecedented changes affecting larger scale mobilities such as the shipment of laboratory equipment. The project's aims, questions, and data collection tools did not shift in response.[58]

In this chapter, I follow how locally hired research staff in Uganda, tasked with data collection for D-Lab, managed to build the project activities during the early phases of the COVID-19 pandemic. They enabled the project's roll out despite shifts in the social, political, and legal conditions of conducting research in Uganda and globally. Scholars in critical global health have provided ample evidence for the continuing inequalities of global health research[59] which relies on and yet marginalises the expertise of precariously employed local researchers. Here, I add to this literature by linking an account of the specific adaptive labour that precariously employed local Ugandan

[57] Walima Kalusa shows the long history of such translational work around biomedical practices and experiences in Africa (Kalusa 2007).

[58] As I describe in more detail below, they were amendments to the field encounters, e.g. field assistants also provided health education. The overall questions or concern of the project did not shift.

[59] See for example Geissler and Okwaro (2015), Wendland (2017), and Crane (2020).

research teams provided - working in conditions of COVID-19 - to the data and then evidence that came out of the D-Lab. I argue that global health research relies on the highly adaptive labour of precariously hired local researchers to even out inconsistencies in the data making apparatus and the ways in which it relates to the field sites. At the same time, it excludes the insights and reflections of those researchers at earlier stages in the project - its conception and design -, and later stages of the project - the data analysis and interpretation. I show how the COVID-19 pandemic exacerbated the need for adaptive labour on the site of locally hired researchers. This rendered legible adaptation and exclusion as central operational modes of global health. AMR is made to ostensibly exist independently from the conditions of data making, and from the conditions of life of the local researchers and the study participants. This systemic exclusion enables the maintenance of scientific modes of engagement, stabilising rather than questioning the assumptions on which they are built.

Distributing project work

The practice of separating and then distributing the different steps of making evidence across places, researchers, and over time presumes that all research questions and tasks are neatly defined from the outset, and that parts of research labour will be pieced together in a predictable fashion. This relies on the premise that solid, reliable evidence arises not from the perspectives and reflections of individual researchers iteratively adjusting the questions of the project in light of what they are finding, but instead from the replicable employment of pre-identified, and oftentimes, pre-validated tools. Adams, Burke, and Whitmarsh (2014, 192), make a case for 'slow research' ethnographic or otherwise, in which researchers 'recalibrate the methods and techniques' in the course of research. And in '[T]his reciprocal process produce[s] knowledge that is deeper and more responsive to context.' In projects, such as D-Lab, where no iterative adjustments are anticipated, different researchers can then perform various research tasks, such as designing the tools, employing the tools (data collection) and analysing the data, at different time points and in different places, working across data 'assembly lines' (Biruk 2018, 7). With large enough, ideally randomly selected

samples, and an advanced enough analytical apparatus, data points are expected to carry all the information necessary to render them into meaningful evidence. Within this framing, the conditions under which the different researchers work, or the terms of their collaboration ought not to affect the data and evidence they are making in any meaningful way. Indeed, the data are meant to be independent of the context and the researchers through which they have been made (see chapter 3, on standardisation).

Within global health research specifically, the distribution between parts of the research process is also enmeshed with institutional and project logistics. In many cases, researchers at institutions mostly in high-income countries apply for and receive grants from large funding bodies, and only then - after they have written the project protocol - can hire researchers through those grants in the countries in which the projects are unfolding. In this set up, researchers in the Global North have (and execute) power over research agendas, and even over defining what 'global health' and 'research' is and is not (Crane 2011).[60] There are increasing attempts to work against these dynamics. At times funders ask for applications from groups of researchers from different institutions across the Global North and South. While this can ensure the inclusion of a small number of researchers at a senior level in the conceptualisation of projects, many researchers in countries in the global South still only become part of projects for a short amount of time in which they contribute to project implementation, such as data collection or the implementation of interventions (Crane 2011). Like Rebecca in the opening vignette, these researchers are not part of the projects during the conception phase that precedes their involvement or the data analysis and interpretation that follows it. In this way, the epistemic commitments as laid out above (in which no iterative adjustments are made), and the ways in which this kind of research is typically institutionally embedded allows for a distribution of research labour across large geographical spaces, groups of people, and over time, impacting the evidence that emerges from such transnational global health collaborations.

[60] For more detail on global health partnerships, see chapter 1.

Historians of tropical medicine and global health have connected the colonial apparatus of health research and its post-colonial descendants, with the distribution of research activities and the marginalisation of local researchers. As I describe in more detail in chapter 1, in the section on 'Making evidence in the colony', the marginalisation of local researchers and their knowledge and insights were central to the notion of 'fundamental research' in colonial times (Clarke 2013). Evidence emerging from 'fundamental research' strived to be easily generalisable, framing the exclusion of local researchers as a benefit that allowed the evidence not to be too tied to a specific place and time (Clarke 2013). This set up highlighted supposedly universal research objects in the colonies while simultaneously undermining the local context and the expertise and insights of those who know it. The ongoing division between study design and analysis on the one hand (most often with input from scholars based in 'the North') and data collection on the other hand (commonly the only responsibility of scholars in 'the South') can be argued to find its roots here.

In D-Lab, research labour was distributed across teams of researchers working in the UK, Uganda, and Malawi. During D-Lab's data collection, Rebecca and her colleagues recruited residents into the study and spent considerable amounts of time in their homes employing the project's data collection tools. Neither Rebecca, nor any of her immediate colleagues were involved in the conception of the tools, or the guidelines on how to employ them, or even the schedules on when to employ them. Their job was to bring filled-in surveys and full plastic tubes with biological material back to the project offices, and to do so in a way that was compliant with the protocol. At the end of their contracts, and the end of data collection, Rebecca and most of her colleagues were no longer involved with the project.

Precarious labour conditions

When I met Rebecca at her home in February 2022, we spoke about her work with D-Lab, and the opening vignette comes out of that encounter too. Rebecca's contract and that of her colleagues within D-Lab had been extended multiple times, each time by two to six months, but it had finally ended in September of the previous year, when data collection had come to a close. At the end of her time with D-Lab, she had started working as a data manager for

a COVID-19 vaccination project. The head of this vaccination project had asked D-Lab's project manager, Dr. Julia, whether she knew someone suitable for that role, and Dr. Julia had put in a good word for her. Rebecca told me that her current contract would run only until the next month, so that in a couple weeks, she would have to find a new job again. I imagined this to be a source of stress, and it must have shown on my face. However, Rebecca had come to expect such uncertain conditions, she had gotten used to the precarity. She looked at me and, and calmly explained what it is like for her. She said, 'Projects come and go, we have to keep hoping for something else, Esther' [Rebecca, field assistant in urban field site, field notes, Kampala, February 2022]. [61]

Locally hired research staff like Rebecca within D-Lab worked under conditions substantially different conditions to researchers further up in the project's hierarchy, and their standards of living were not as high. The differences and how they felt ordinary to those involved, became particularly clear to me during an early field work experience during D-Lab's pilot-testing week.

> We had left Kampala on a Sunday afternoon, driving to Hoima in a new white van with the institute's logo on it. When we arrived in the evening, we toured around Hoima, looking for places to stay. First, we stopped at several hotels which announced their prices in US dollars, ranging from 80 to 180 USD, offering wedding packages and getaways for wealthy expats. These were hotels with large, well-kept gardens, pools, terraces, and restaurants serving 'western breakfast'. Despite us all going together, these were for the principal investigator alone to choose from. When we stopped at these upscale hotels, the Ugandan researchers got out of the bus to look at these hotels, they commented how beautiful they were, and helped negotiate the price. Once the principal investigator was dropped off in his chosen high-end option, we looked for a place for the rest of us.[62] Deciding between different places, we ended up staying in a guesthouse, that the researchers negotiated to cost 23,000 UGX

[61] In their introductory article, Nguyen and Moyer (2018, ii) describe the effects of persistent precarity as, 'crisis is an everyday reality for many who live in conditions of precarity and existential instability'.

[62] David had asked me at one of the expensive hotels whether I too was going to stay in such a place. I had only just started fieldwork, and only later fully understood the question. I responded that I wanted to stay with the group and was very warmly welcomed there.

> per night per person, less than 5 pounds. The guesthouse was in a 3-story building, with fading pink wall paint, on a busy street leading out of town. There was chatter everywhere, and people were eating fried chicken downstairs. Everyone was Ugandan, and my presence a surprise. We each had our own small room, the windows and doors facing into the courtyard, all reachable through a narrow outside staircase. The women on the team made sure my room was in between theirs so I would feel safe. After a couple of nights, we moved to a different guesthouse close by, as some of the female researchers had complained their sheets had not been cleaned. In the new guesthouse, there was also warm water in the shower. There were holes in my mosquito net, and Stella, the laboratory team lead, showed me how to tie little knots to keep the mosquitoes away. That the principal investigator, working on the same project was lodging in very different conditions, with a budget 10 to 20 times as high was not discussed (at least with me). It was clearly expected by everyone, including the hotel staff.
>
> [Fieldnotes, Hoima, early March 2020]

Rebecca and all of her colleagues had graduated from universities across the country, and they were part of an educated elite. Their jobs with D-Lab served as stepping stones for their careers. Many subsequently got better paid jobs in the following years or obtained master's degrees. Compared to most people in the country, they were making a lot of money, and lived in conditions of relative security. Not one of them had to worry about whether or not they would be able to put food on the table. Still, they worked on short term contracts. Their working conditions were less privileged than those of other members of the research collaboration. Although their work was precarious within the project, they still had easier lives than most Ugandans.

COVID-19 in D-Lab's Ugandan field sites

In March 2020, after many months of preparations, D-Lab was ready to start its data collection in Uganda. All of the necessary research approvals were in place, and all local staff, including a field team and a laboratory team for each field site, had been hired and undergone training sessions. COVID-19 reached Uganda with a first detected case on March 23, 2020 (Parker, MacGregor, and Akello 2020), and the start of the project's roll-out had to be

postponed, as all research activities in the country were paused following official regulations. D-Lab started data collection four months later, in July 2020, and until the end of its data collection in September 2021, the Ugandan part of D-Lab worked through an ongoing viral pandemic. Measures to manage and reduce the speed of the spread of the COVID-19 virus included abrupt changes in the mobility of people and objects. For D-Lab, mobility restrictions from the international to the regional level affected the roll out of the project in Uganda. Without warning, Entebbe Airport, the only international airport in the country, was closed from late March to the beginning of October 2020 as an immediate reaction to the first detected case in Uganda. This affected the procurement of laboratory tools which were meant to be shipped from the UK and arrived in the country with a nine month delay in December 2020. During a remote interview with Stella, the laboratory coordinator, she explained to me how the delayed shipment of samples had affected data collection:

> E: so, uh, what are the samples that you are not collecting but that you had planned to collect?
> S: water, food, uh.. water, food, and the swabs.
> E. hmm..why are you not collecting those?
> S: we are not collecting those because we don't have the supplies for them. They are not yet here, we ordered them from Liverpool. So they have to be shipped from Liverpool. When they are here, we are going to start collecting them.
> E. I see. And the delay is related to COVID?
> S: Yes, yes, the delay is related to COVID.
> E: okay. How about WaSH observations? Do they happen?
> S: yes, they do, they do. They happen.
> E: So people go into households to observe WaSH [practices] during this time.
> S: yes, they still do and they collect stool.
> [transcript remote interview with Stella, 21.10.2020].[63]

Within the country, a lockdown limited the possibilities of researchers to travel even short distances, and thereby their possibilities to reach the places

[63] In an interview a few weeks later, Ivan told me that the supplies had still not arrived, which had implicated their recruitment schedule. As they were waiting for the supplies, they had been asked to stop recruiting new households into the study.

and households in which they were meant to collect data. Infection control measures also altered social life and served as a constant reminder of the ongoing pandemic. The Ugandan government passed regulations requiring the closure of public spaces including schools and markets, and a suspension of public gatherings (Baluku et al. 2020). In addition, D-Lab staff told me about near ubiquitous reminders on the radio and other public outlets during these early months of the pandemic, prompting people to wash their hands and to keep physical distance from others in order to avoid the virus from spreading. When I walked through an area close to D-Lab's peri-urban field site in January 2022, COVID-19 education leaflets were peeling off the walls of buildings, and spray-painted lists of typical symptoms and protection measures were fading away. These infection prevention measures not only made COVID-19 a present day-to-day reality, but also pushed sanitation and hygiene and their relation to contagion (a constellation that D-Lab was investigating) on people's minds.

Photograph 6. Gate in Hoima with a slowly fading list of COVID-19 symptoms and instructions on how to protect oneself (29.11.2021)

In addition to changes in social interaction, the pandemic came with additional administrative hurdles that D-Lab needed to clear. Shortly after the first detected case, the research department of the implementing institute and

the ministry of health had developed a procedure through which research projects could apply for additional clearance to be allowed to unfold in pandemic conditions. Stella explained this to me during the same interview I cite above, in October 2020,

> 'So in collaboration with the research department and the ministry of health, we came up with a…, we had to like amend a little, and include COVID screening and education as part of our protocol. So when we go to the field, we don't just go to take samples, we still educate the community about COVID, give out some material about COVID and then we have temperature guns and we screen everyone that we come in contact with. If we go to a household, we first screen everyone in the household, for COVID, like the basic screening of temperature, ask them "do you have flu, do you have cough, do you have a headache?", so that's the change in the protocol.'
> [transcript remote interview with Stella, 21.10.2020].

D-lab, like every other research project, had to provide a so-called 'risk mitigation plan' in which they were to lay out the potential risk of infection of study participants and research staff and measures they would take to ensure everyone's safety. In the plan,[64] the project leads described measures such as the use of protective equipment, including masks and gloves, and the keeping of distance whenever possible. On top of that, as Stella had already explained to me, they promised to educate study participants on COVID-19 symptoms and transmission pathways, and to screen potential participants for COVID-19 symptoms.[65] They also promised to cooperate with the local authorities and to report any suspected cases of COVID-19 among the study participants. In practice, this meant that in every field encounter, D-Lab's field teams carried temperature guns, measured the temperature of any potential study participant, provided handouts about sanitation and infection control and openly collaborated with state authorities.

[64] When I was preparing my own risk mitigation plan in advance of my fieldwork in June 2021, a team member of D-Lab shared their COVID-19 risk mitigation plan with me. This was to help me figure out what to include in my plan. D-Lab's mitigation plan complemented narratives of field staff about how they had worked in pandemic conditions.

[65] As I lay out below, in the section on encountering study participants, the field assistants alerted state authorities in case they found someone with COVID-19 like symptoms.

In the introduction to an issue of *Medicine, Anthropology, Theory* on 'Clinics and Crisis', Nguyen and Moyer (2018) wrote '[C]rises are moments of rupture where the surface of everyday life splinters to reveal what lies underneath'. In many respects, they were asserting what has become a truism of medical anthropology and social epidemiology. In common with previous major health crises, COVID-19 has revealed structural inequalities shaping our unevenly distributed risks of infection, illness, and death (Mendenhall et al. 2022). The COVID-19 pandemic did not only expose fault lines in health and healthcare systems globally, but as this chapter illustrates, it also exposed fault lines in the ways in which global health research operates and produces evidence. Pandemic adaptations of D-Lab revealed assumptions e.g. with regard to the mobilities of certain people and objects, the relations between field assistants and study participants, and the kind of the labour expected of locally hired research staff. Pandemic conditions rendered legible how conditions in the field shape the making of data, and the labour involved in concealing those conditions.

Curating data in D-Lab

Since D-lab's data collection in Uganda coincided with early stages of the COVID-19 pandemic, the field teams worked in unexpected conditions. Within the study protocol, the researchers had laid out their methodological approach, justifying the decisions they had taken in the design of the study, e.g. they described the rationale of employing a particular sampling frame, data collection tool, or analytical strategy. Such disclosures are meant to render transparent how evidence is going to be made and to provide context for its interpretation. All ensuing steps within the life of the project - from data collection, to analysis, and interpretation - were described in the protocol. Since the protocol was meant to contain all necessary context for the interpretation of the data, and the context in which data collection happens ought not matter, there were no infrastructures in place in which the implementing researchers would have had the chance to lay out the decisions they had taken during fieldwork. Instead, the research staff worked to keep up appearances that they had only implemented guidelines, even in the particular conditions marked by the ongoing COVID-19 pandemic. In the following, I will go on to illustrate

how local Ugandan researchers enabled the project to roll out during the COVID-19 pandemic. They adjusted procedures in ways that were not foreseen by the study designers, while making data that would not carry the traces of the adjustments, effectively narrating data collection as compliant with the protocol.

In order to ensure the successful rollout of D-lab, the local research teams had to be familiar with the logics of the projects, 'to know the protocol well'. They also needed to be familiar with the spaces in which they were to employ the data collection tools, spaces that those who ran the project could rarely (if ever) access. This familiarity concerned their ability to speak the language of the study participants - Runyoro for the western Ugandan field site, and Luganda for the Kampala field site. They also were to be 'culturally' attuned to the spaces they were moving in, that is, e.g. they needed to be able to navigate the intimacy of the homes of their study participants. As became clear over the course of my fieldwork, the jobs of the local research teams required an array of insights and skills regarding the research infrastructures and their inherently unpredictable nature (e.g. road blockages hindering transportation, or electricity cuts affecting the cooling of samples). Even without the onset of the COVID-19 pandemic, navigating the different demands of the lifeworld of the project and that of the field site and Ugandan research infrastructure, required highly skilled, creative, translational labour. Despite recurrent reminders by the project managers and among the research teams 'to follow the protocol closely', to do the job well, that is, to do it the way it had been laid out by the project designers,[66] it was no surprise to any member

[66] There were systems in place to ensure the strict following of project guidelines. In February 2022, when I met with Dr. Julia, the project coordinator, to talk about her time with D-Lab, and her insights into the work of the collaboration, I found out about an institutional policy. Just as I had stopped the recording on my phone, Dr. Julia's colleague Hope entered the room. She sat down at her desk opposite Dr. Julia's and entered our conversation. It turned out, that Hope's job had been to audit the projects of the implementing institute, including D-Lab, to make sure everything was being done according to protocol. Hope had administered random audits, and had checked a few of D-Lab's templates for data entry for their accuracy. She told me that it was very important to check, to ensure that everything was going according to the plan, according to the protocol. Hope and I had not met before. Hope highlighted that during her audits almost everything was in order, a few signatures were missing, but they managed to add them accordingly. Hope's job of ensuring the accuracy of procedures as an outsider to the project had not been mentioned to me before, it was part of ordinary project set-up at the implementing institute.

of the team that their job required extensive amounts of creative, adaptive labour.

As I will illustrate in the following sections, the Ugandan research team - the field assistants, laboratory technicians, project managers and the data managers, under the guidance of the locally based leading investigator - had to take decisions that had not been foreseen in the project guidelines. Implementing the research protocol required adapting the procedures at every step in the process. Measures of infection control in light of COVID-19 exacerbated the extent of the adaptive labour they needed to provide.

Identifying households to recruit

Within D-Lab, a team of researchers based in the UK had defined the project's field sites by drawing their boundaries on geo-spatial maps. An algorithm then produced GPS coordinates from within those field sites, which were meant to designate specific households (for more detail on the making of field sites and households, see chapter 3 on standardisation). During data collection, the field teams' coordinator provided the field teams with GPS coordinates that the algorithm had produced. The field teams had to follow the GPS coordinates, and to recruit the household closest to the provided GPS coordinates into the study and to employ the data collection tools with them in their homes. They also had to upload the precise location of each recruited household with the tablets they were using for data capture.

Although this process had been planned in much detail, it required more translational labour than anticipated by those who designed the study. The resulting sample and data are not only a result of the algorithmic computation of GPS data and the subsequent employment of data collection tools, but of the researchers, including the field assistants, engineering solutions of how to employ the research apparatus on the ground and the ways in which those adjustments were communicated within the project. When the GPS coordinates came up in my conversation with the field assistants and the project coordinators, they often expressed frustration. They narrated a mismatch between an imagined unfolding of the study where they could easily locate a household with the given coordinates and then recruit its residents into the

study, and the reality they found themselves in. This mismatch became an onerous task to manage.

One problem was that the GPS coordinates did not always lead the field assistants to residents' houses because the prior geo-spatial mapping was less accurate than anticipated. Dr. Julia, the project coordinator, who had overlooked the work of both the field teams and the laboratory teams over the course of the project, told me during an interview in February 2022 at her office:

> 'When the teams went on the ground, it was sometimes a different story [different to what was assumed in the geolocation data that the UK-based researchers handed the Ugandan teams]. You will find that a house that was geolocated, it is now falling into Lake Albert[67] [laughs]. Or it is in the middle of a forest. So they [the field teams] will just try to look for the closest one. And you know, Uganda has no pure landmarks.[68] You find that you are seeing a very small road, which has no name. It was hard for the teams to be locating these households.'
> [Interview with Dr. Julia, Kampala, 1.2.22]

In other conversations, field assistants complemented Dr. Julia's narrative around the ways in which the GPS coordinates did not match the landscape of the field site very well. When the coordinates were very far off any household, the field teams had to request new coordinates from the field teams' coordinator who would be based at a project office and could access a file that could provide the GPS coordinates; and then the field teams would start the process of identifying a household anew. At other times, the GPS coordinates led the field assistants to a space in between several households. Unclear as to which one they should start approaching, and conscious about not wanting to base it on their own intuition and thereby skew the data base, they reported deciding to spin a bottle and to approach the household closest to the direction in which the bottle was pointing. The spinning of the bottle and

[67] Lake Albert is a large lake in between Uganda and the Democratic Republic of Congo. This comment relates to their rural and peri-urban field site in Hoima.

[68] By 'pure' landmarks, Dr. Julia refers to the stable linking of a place on a map with a clearly defined place on the ground. Often times, a landmark that people use to orient themselves would not be indicated on maps, and it might be not very stable, like her example of a small road that might vanish when it rains heavily.

its randomness became an extension of the algorithm, both technologies meant to avoid the systematic biases of other potential selection mechanisms.

A second problem was that some parts of the study areas had poor network coverage. This made it challenging to work with the GPS devices. The GPS devices were not only meant to guide the field teams to a pre-selected location, but also to capture the coordinates of the precise location where the field teams ended up working. The poor network coverage meant that the devices did not always automatically capture the location. In such cases the field teams would have had to update them manually, adding an additional task to an already extensive list. In an interview with James, a data manager in Uganda, who had set up and managed the data servers, and who collated the data after the end of data collection, he told me that the field teams did not always end up filling in the coordinates by hand. When the coordinates were not updated, the pre-selected coordinates were used 'as a proxy'. James explained that his UK-based colleagues had no way of finding out the accuracy of the GPS coordinates of the households that they were using; and yet they unquestioningly employed the data in their quest to make sense of the spatial distribution of resistant bacteria.

Recruiting participants following the GPS coordinates also meant navigating unnamed routes that changed over the dry and rainy seasons, as the quote from an interview with Dr. Julia's illustrates. The protocol specified the times at which the field assistants were meant to start their data collection days, and an early start into the day meant driving through landscapes well before sunrise, when the streets were still pitch dark, without any street lighting. Rebecca told me about their driver who would pick them up in the early mornings to drive them to the households. 'He had such a good sense of orientation', she told me, 'he knew his way around'. The driver, and his intimate knowledge of the streets and their conditions made it possible for the field assistants to reach the places they had to work in, on time. The driver-researcher collaboration helped to bridge the divide between the protocol and the imagined field site and the conditions the field teams found themselves in.

Recruiting residents

In conversation with field assistants that we had over the phone during their data collection, they mentioned how challenging it had been to recruit residents into the study. The lengthy process that had led them to the residents' homes did not guarantee their willingness (or eligibility) to participate. The COVID-19 pandemic brought about a new set of conditions to navigate, altering the relations between field assistants and study participants in ways that could not have been foreseen by the study designers.

Jamil, a field assistant in Hoima, described a general climate of fear in the field sites in view of Uganda's infamous authoritarian approach to infection control during the COVID-19 pandemic (Parker et al. 2022). As had been promised in the study's COVID-19 risk mitigation plan, the field teams entered the households of potential study participants in full protective gear, wearing masks, gloves, and equipped with temperature guns, evoking imaginaries of epidemic policing. Reacting to strangers in protective gear, Jamil told me how children were running away in fear, hiding from him and his colleagues, and adults remained hesitant too, scared to be screened and sent to isolation centres. Jamil also explained to me that residents in the rural field site where he was working at times perceived the researchers as potential carriers of disease. The researchers were ostensibly from outside the communities. By way of dress alone, the participants could tell that the researchers came from urban areas, and they heard every day on the radio that numbers of infections were a lot higher there. Navigating the study participants' fear emerged as an additional task for the field assistants, unexpected and time consuming. Jamil's laboratory-based colleagues spoke in appreciation about the field teams, well aware that residents would be more hesitant than usual to let strangers into their home.

Field assistants in all Ugandan field sites also reported how those households whose members had not gone to school at all or not for longer than a couple of years, were more challenging to recruit than others. They found it difficult to explain the study's rationale to the residents in a way that convinced them, and the hesitation and fear towards the researchers appeared to be larger than for those who the field assistants described as 'learnt' (that is, who had

received formal education). At all field sites, there were times where the field teams struggled to find a household willing to participate, they had to go from one household to the next until someone let them in. At other times, the neighbours of those they had successfully recruited wanted to join the study too. This happened mostly, once these neighbours had seen the 'compensation' they had received, in the form of wash basins, jerrycans, and soap (for more information, see chapter 6 on WaSH). In such cases, the field teams had to turn those interested down, as they were only allowed to recruit those households which had been pre-selected through the algorithmic calculations (or after those had declined, had followed from the GPS coordinates they had been sent to).

The informed consent procedure was an act of careful deliberation for the field assistants too. Rebecca told me that it was crucial to make sure that the study participants' consent was actually informed, that the participants had an understanding of what the study was about. This was not only because it was ethically imperative, but also, Rebecca said, because the risk for dropouts or worse, withdrawal of consent, would increase for ill-informed participants, which, she reckoned, was detrimental for the study. With this in mind, she and her colleagues developed strategies of how to ensure the potential study participants understood the rationale of the study, and why it should matter to them. First, she told potential study participants what anti-microbial resistance was. Translating her words from Luganda to English for my benefit, she summarised her explanations the following way:

> 'So we would explain to them and tell them that resistance is, "say you go into the hospital and then you receive an antibiotic. You have an infection here and then the doctor prescribes an antibiotic and then tomorrow, you're feeling okay. Let's say you're home, you get back home, you swallow the antibiotics and then you feel better, but after let's say a month or two, the same infection returns. If you went back to the hospital and then the doctor tells you it is the same infection, and you are given the same antibiotics again, you swallow them. But like if it continues, now that clearly indicates that your body is now resistant.'
> [Transcript from interview with Rebecca, Kampala, February 2022]

Rebecca's narrative of re-occurring infections, and the example of urinary tract infections that she gave, resonated with the potential study participants. Particularly women, Rebecca told me, would recognise this pattern, and would tell her about recurring urinary tract infections, or candida yeast infections, they had experienced and would then consent to participation in the study. Rebecca had come up with this explanation by herself. Since the study focussed on bacteria that live in the digestive tract and they collected faecal samples, the link to urinary tract infection was not obvious. Listening carefully to the residents' questions and concerns, she translated the language and logic of the project, of the abstract concept of colonisation with resistant bacteria, into the reality of the lives of people she was speaking with. Thereby, she curated the narrative of the project' s aim and likely impacted who would be willing to participate, and also how study participants would respond to the survey questions.

Rebecca also told me that during the consenting process, participants would ask what the field assistants would give back to them, what was in it for them apart from the immediate compensation they would receive. In particular, many wondered whether they would be updated about the presence or absence of resistant bacteria in their bodies and in their homes, and what the consequences would be. She told them that they would not be updated, and explained that the information and samples they provided would inform policies at the national level that would aim for healthier lives in the community. Rebecca spoke about this in a tone that made me think it was challenging for her to reply to the study participants' questions that she deemed understandable, with answers she did not think were satisfying. After I had switched off the recorder, and our conversation became less linear, Rebecca went back to this, adding that sometimes it did not feel like enough, wondering out loud what else she could have done.

Recruiting residents into the study was a task that required the field assistants to be attuned to the life worlds of the study participants, and that of the project. Pandemic conditions altered these worlds, and the role they had vis-a-vis the study participants, with their protective gear and temperature guns expanding the distance between them and their study participants. In translating the project's logic and rationale to potential participants, they

shaped the study's roll out, including the pool of people who ended up participating and what the study participants had understood the study to be about.

Encountering study participants

Once the study participants had gone through the consenting procedure, the field assistants' roles remained ambiguous. Employed as researchers, they also acted as health educators on the ongoing pandemic. By agreeing to alert local authorities of suspected cases, they entangled their research work with the policing, surveillance, and management of the spread of COVID-19. In other words, they became part of the epidemic police and were perceived as agents of the state. Only once during their data collection did a field team alert the local authorities of a suspected case of COVID-19 among their study participants. The participant in question was sent to a health centre, and all of the family members in her household were tested and found to be negative. She fully recovered, and D-Lab was able to continue their data collection. In the narrative of the field assistants from the rural site where this occurred, the study participants had been grateful since the project had covered the related expenditures for health care and testing. The worry about the health of their relative, and the high costs that they might not have been able to cover, had outdone their fear. As the regulations around isolation centres and financing of care shifted, the field teams' roles changed too. This entanglement with state authorities undoubtedly made the job they had been hired for harder, namely deploying the project's tools to collect data. They had to build relationships of trust with the study participants despite their multiple roles.

Rebecca highlighted to me the need to build rapport - a formulation that I encountered also at other points within the project - as a necessary condition to be able to do this work. Robert, a field assistant in the rural field site, later framed this even more strongly as 'befriending' study participants. Robert and I had been touring the rural field site, and had stopped at homes of former study participants who let us into their homes without reservation (for an example of such a visit, see chapter 5 on One Health). Surprised about the warm welcome six months after the end of D-Lab's data collection, I asked about his relationship to study participants. Robert told me that there was no

way he could have collected any data if he had not made friends with the study participants, checking in with them every now and then in between data collection points.

In my conversations with the field assistants, they described gender as a factor that had considerably shaped their research encounters with their study participants. When doing observations inside the households, the field assistants spent stretches of six hours inside the intimate spaces of their study participants. They were counting the number of times the household members had washed their hands, observed who went to use the latrines and when, and accompanied them inside their kitchens, observing the practices around what they called 'food hygiene' (for more detail on these observations, see chapter 6). Rebecca told me about one household where her two male colleagues had come back for follow-up data collection which included these observations. Upon their arrival, the household members asked the researchers to leave immediately. The researchers managed to engage them in a discussion, it turned out that the husband of this household did not feel comfortable letting a man they did not know inside his home, and in particular inside the kitchen with his wife while he might be gone for work. The field assistants found a way to work around this, so that the household did not drop out of the project. They adjusted their schedules in such a way that Rebecca as a female member of the team would do the observations in this particular household, to which the husband and his wife agreed. Neither the potential issue nor ways to work around it had been anticipated in the project design, and the solution the field assistants had come up with does not feature in the project's data either.

Although building rapport was highlighted as an important part of their work by the in-country project managers during data collection, it did not feature in the study's protocol. The relationship between field assistants and study participants evolved along their repeated visits in the participants' homes, and sometimes check-ins in between. All of the field assistants told me about how they had made an effort to be friendly and approachable, and to be of help to the study participants. Steven, a field assistant from the rural field site, told me about how study participants sometimes stopped him mid questionnaire to ask more questions about COVID-19, which he then took the time to answer. The field assistants came to be seen as experts in a situation

that felt threatening. Building rapport meant navigating the participants' fear and embracing the COVID-19 health educator roles they had been given.

The field teams in each field site spoke the respective language of the region they were working in and had ethnic ties to those places. During their fieldwork, they remained obvious outsiders - they were not from those exact places, and they were more educated than most of their study participants. The pandemic increased the distance between them and their study participants. As outsiders and strangers, reinforced through the protective gear they had to wear, and their collaboration with the epidemic police, they often were met with suspicion and fear. In order to collect the data that D-Lab needed, the field teams had to work within these complicated dynamics, making space for questions and concerns and offering help where they could.[69]

Managing data and samples

Once data collection had come to a close in the Ugandan field sites of D-Lab, the contracts of the field teams and laboratory teams ended. The last two months of data collection were particularly work-intensive for all research staff. After two years in the project, their work was done. The research staff started new jobs in other projects or studied for advanced degrees. In common with Rebecca, they found new jobs often through connections established through their work in D-Lab. As I met with them over the months after the end of their time with the project, D-Lab had already moved into their past. Soon after my return to Uganda in October 2021, I met with Francis, who had worked as a field assistant in the urban field site. He was surprised to hear that I was still interested in the project, and with a little hesitation in his voice said, 'But Esther, the project is over'. For their work with D-Lab, the field teams and laboratory teams had all been hired through an in-country implementing partner institution, through which they had been given institutional email addresses. With the end of their work for D-Lab, their access to these email addresses

[69] In a conversation we had in March 2023 long after the end of data collection, Steven, the former field team lead of the Hoima field site told me that he and his colleagues had regularly offered advice to their participants on how to manage sanitation in the household, such as how to set up hand washing facilities. He clarified that this had nothing to do with managing COVID-19. Both the researchers and their study participants understood the researchers' expertise regarding infection control to come with the responsibility to help the study participants manage their health.

ended. Rather abruptly, they were no longer included in email chains, and no longer invited to attend any meetings. For them, the project was over. The data they had worked towards lived on without them.

After the end of the contract of most of the researchers, the data they had collected needed to be assembled before data analysis and interpretation. Two Ugandan researchers continued their work for the project, providing this labour in the following months. David, who had coordinated fieldwork activities and at times had supported the fieldwork in the project's urban field site, had a working contract that ran two months longer than the rest of the team so that he could organise the data. And James, the in-country data manager, continued working as he was not hired as project staff, he was hired on a stable contract with the institute and was working as a data manager on many projects simultaneously. David was meant to transcribe the data, which entailed creating digital data sheets out of the parts of the data that had been collected on paper (mostly the observations of practices around water, sanitation, and hygiene).[70] He was then meant to archive the paper versions of the data collection sheets for potential future audits. Both David and James continued working even after the end of David's contract. This did not come as a surprise. Indeed, David told me that he had been certain the labour he had to do was never going to fit into the extra two months he was paid to work on the project.[71]

Throughout the project, James had been responsible for the setting up and caring for the data servers, where data were captured, stored, and cleaned. Before the data were moved to researchers outside the country, James and David worked to decrease inconsistencies. They made sure all data entries were linked to the household they had been collected from and, where relevant, to the individual study participant who had provided the sample. They also checked for missing data points. By running basic descriptive statistical

[70] This process entailed translating verbal descriptions into numbered evidence. An example of an observation would be 'Child of about 8 years washed their hands using a jerrycan without soap after using the latrine', and David would translate that into 1s and 0s (has washed hands or not, has used soap or not, etc).

[71] David added that he had been paid throughout including during the early months of COVID-19 where they could not do much work, and he therefore felt it was in order to provide labour to the project even after his contract had ended. He also continued working with a subset of the data for his Master's thesis.

analysis, for example frequencies of responses, they looked for inconsistencies in the data. Where those occurred, for example numbers of replies to questions not adding up, they went back to the data entry forms, both digital and analogue, tracing where a mistake could have happened. When I met James, he told me how helpful it would have been if he could have reached out to the field teams when finding inconsistencies in the data. At that point, they had all moved on. David and James sorted it out to the best of their knowledge. This part of data cleaning also entailed adjusting the data entries to reflect what they deduced to be most probable; for example where a field assistant had ticked a box that reflected that there were no hand washing facilities in a recruited household, only to describe the kind of hand washing facility in the following questions, David and James edited the first answer, establishing coherence in the data. James and David spent many long hours like that, ironing out inconsistencies. They worked on the data in the hope that those in the UK would have an easier time making sense of them, and presumably also to produce a positive image of the work of their team.

Not only the data points on survey forms and excel sheets but the biological samples too required a substantial amount of labour after they had been collected and before they could be analysed. The storing, processing, and shipping of the samples both within the country and internationally was a complex endeavour that the Ugandan team was responsible for. The project's laboratory assistants worked in two laboratories, one in Hoima and one in Kampala. The Hoima laboratory was part of the Regional Referral Hospital, where the hospital's patients' samples were also processed (for more detail on the hospital, see chapter 6 on WaSH). Here, they worked with intermittent electricity and water infrastructures, unpredictable space in the laboratory fridges that were shared with other research projects or clinical usage and inadequate staffing for the regular clinical laboratory work as well as COVID-19 related changes. The Kampala laboratory was located within the major teaching hospital and came with more reliable infrastructures.

Photograph 7. Inside a Microbiology Laboratory at Mulago (27.3.2023)

I learnt about the unpredictable nature of the project's laboratory work, and the researchers' means of dealing with these conditions during my visits to the laboratories, and through the explanations of the laboratory assistants. Their adaptive labour in managing the unpredictable conditions was central for the research project to function, but it was neither anticipated, nor celebrated or highlighted, like many of the local researchers' tasks. Working between two laboratories required the researchers to ship samples from one laboratory to the other. As I learnt during an end-of day meeting during D-Lab's pilot testing week in March 2020, it was the laboratory team who organised this transportation. During that meeting, the laboratory team reported that they were testing out a provider to ship the samples from the Hoima laboratory to the Kampala laboratory, before a selection was sent to the

UK for whole-genome sequencing. It became clear that the PI had not asked them to look at shipping providers, they had taken things into their hands, mentioning that they needed to find a reliable provider to ensure that samples were shipped in a secure and timely manner.

During that same week, the laboratory team showed me the Hoima laboratory where they were setting up the infrastructure they needed to run the project. It was mostly the laboratory team members who organised this themselves. Stella, as the laboratory team lead, oversaw the actions. The Hoima laboratory consists of two rooms in a flat, one-story building. There is a small sign attached above the door to the building saying 'Microbiology Lab', nothing else separates this particular building from others in the hospital compound, and the doors were not locked. In the entry way, there was a sink, and signs encouraging people to wash their hands, but that afternoon when Stella showed me around, there was no running water (for more detail on the hospital water infrastructure, see chapter 6 on WaSH). Stella and I walked right in, passing signs saying 'toxic chemicals' attached to wooden lockers, and an 'Only enter with a lab coat' sign at the door to the room of the laboratory. The laboratory's windows were open, warm air was flowing into the room. One of the windowsills served as a counter for patients from the hospital wards to drop of their samples for analysis, they would place them on the windowsill and a laboratory technician would pick them up from inside the laboratory. There were a few desks with computers, and some machines on the counters to run blood and urine samples.

Photograph 8. Door of microbiology laboratory at the Hoima Regional Referral Hospital (5.3.2020)

Photograph 9 & 10. Entrance to microbiology laboratory at the Hoima Regional Referral Hospital (19.1.2022); View from inside the laboratory (19.1.2022)

Stella welcomed my curiosity and showed the space to me. In between explanations of a machine to run blood cultures, and a fridge to store samples and reagents, she mentioned that the electricity was not 'clean', the supply of electricity was not stable, and the results that the machines produced could therefore not be trusted. The fridge was too full too, there was no space for the project's samples. Stella further explained to me that the implementing institute was collaborating with the Hoima laboratory and that a few months ago it still looked very different in this laboratory, implying that there was less equipment available. The way it was set up when she showed me around seemed like a good start to her and to Ivan, a laboratory assistant who was going to be based in the Kampala laboratory, and who was standing next to us while Stella showed me around.

A couple of months later, I learnt through remote interviews with Stella and Ivan that soon after data collection had started, D-Lab's laboratory team had decided to send all samples to the Kampala laboratory before any analysis had been conducted. The Hoima laboratory's electricity supply had proven too unstable, and they had not found ways to work around that onsite. Ivan explained to me:

> 'The Hoima lab has not been able to do that work because they have several challenges. The lab is not able to carry out cultures upon the samples. So samples that are collected from Hoima are shipped to Kampala for me to work on. Yea, they have power problems, the incubators cannot run, run normally.'
> [transcript phone interview with Ivan, 2.12.2020]

The implementing institute had bought an extra fridge which they used to store their samples in Hoima until they had collected a set of 100 samples and the fridge was full. John, also a laboratory technician, then packaged the samples and prepared them for shipment to the Kampala laboratory. In Kampala, the laboratory equipment was more reliable, and the team could store the samples at lower temperatures. Ivan explained to me:

> 'We store the samples brought from the field at minus 80 degrees. So when all the supplies have come, for example the agar, and other materials, that's when we retrieve the samples, the stool samples,

> and then inoculate them, on chromogenic ESBL agar, and find out whether a sample has ESBL positive *e.coli* or *k.pneumoniae*.
> When they are stored at minus 80, they can still, the isolates, sorry the bacteria, can stay inactive and we can retrieve them, for at least.., for at least some good time.
> [transcript phone interview with Ivan, 2.12.2020]

John was meant to work in the Hoima laboratory only and to 'build capacity' there. However, he travelled to Kampala and processed the samples together with Ivan. The laboratory conditions adjusted not only the trajectories of the samples but also those of the researchers themselves.

The management of the samples and the observational data happened after the data had been collected, and in preparation of them being further analysed. In this in-between phase, the Ugandan researchers took decisions with far reaching consequences, that the rest of the research collaboration, in particular those who were going to analyse the data, did not know about. The transcribing, cleaning, adjusting of the data will have shaped them in a considerable way. However, the data that landed on the desks of UK-based data analysts did not include reflections on these decisions. The management of the biological samples amidst unreliable infrastructures was a highly complex task, and without the laboratory assistants thinking with the project, and far beyond their assigned tasks, the samples would not have been processed.

Making sense of data

After the Ugandan researchers had collected the data and collated them into tables, the data travelled further; away from the compounds of residents, the unreliable electricity network and overcrowded fridges, the desks and computers and, crucially, the researchers who had worked to produce the data and who knew what decisions they had taken along the way. In the data, there were no explicit traces of the extensive, adaptive labour of the field assistants and laboratory technicians. A large part of the analysis and interpretation happened outside Uganda; it was mostly UK-based data analysts, including statisticians and mathematical modelers, who ran the analyses. To make sense of the data, they only had the data and the tools through which they had been

elicited, no narratives around their making, or insights into the adaptive work that the local research teams had provided. The data were meant to contain all necessary context.

The distance between the field (with its narratives surrounding the making of data), and the researchers who analysed the data became particularly clear when I interviewed Oliver, a statistician based at a UK University. He had been working on the data collected through D-Lab in Uganda for the past couple of months. Oliver was permanently employed at the university and was working on several research projects. He had only been asked to work on D-Lab's data from the Ugandan field sites long after the end of data collection and had not been involved in earlier stages of the project. He did not know about D-Lab's other field sites, outside Uganda. The data he worked with were the survey data elicited through the *Case Report Forms* (e.g. questions around household composition, around sanitation facilities, water sources, or the presence of animals etc)[72] and results of the testing of biological samples, in particular whether or not a sample had contained the target bacteria (*ESBL e.coli* and *ESBL k.pneumoniae*).[73] Oliver did not know the place and circumstances in which D-Lab's field assistants and laboratory technicians had worked, and the only points of contact he had in Uganda were David, who had worked as a field work coordinator, and James, who was a data manager, the last Ugandan researchers who had been involved with the data, and with the PI of the Ugandan part of the project.

Describing his team's main task, Oliver explained 'most of what we do is making sense of the data'. More concretely, Oliver told me that his team's task was to run 'risk analyses' to establish the likelihood with which a biological sample contains resistant bacteria given certain household characteristics. They would calculate for example the likelihood of biological samples containing the resistant bacteria that D-Lab focussed on, given the presence of certain kinds of toilet or handwashing facilities in a particular household. As our conversation progressed, I asked whether or how he was

[72] For more detail on the data collection tools, and the specific survey mentioned here, see chapter 6 on WaSH.

[73] For more detail on the target bacteria, see chapter 2 on methods.

thinking about the COVID-19 pandemic and its potential impact on the project, and the data he was analysing. Oliver was surprised by this question. The survey sheets had been filled out, and the samples had been taken and processed. The fact that the study had not been suspended meant for him that there was nothing to worry about. He made clear that he did not know what impact the pandemic had had on people's lives, or on the research, because he had not been in Uganda. This was not to say that he would have liked to know more about the circumstances in which the data had been collected, but more to explain that he could not answer my question. Oliver did not know, for example, about D-Lab's COVID-19 risk mitigation plan, and the additional roles the researchers had taken on. He did not know about how their schedules had changed in response to COVID-19 related delays. To him, these things did not matter. He was only interested in clean data sheets. [notes and transcript, interview with Oliver, statistician, 9.6.22].

When I asked the Ugandan team about COVID-19's potential impact on D-Lab's data, the answers were quite different. For example, in a phone interview with Stella in October 2020, she told me how the handwashing behaviours that D-Lab focussed on had changed during the pandemic:

> 'Okay, I would say it has changed, […] Because, initially, people were not practicing hand hygiene, cause that's not what they used to do, but now, everyone is practicing hand hygiene because of COVID, so I would think it has changed. People will wash hands more than before. I don't know about results, but that is it.'
> [Transcript phone interview with Stella, 21.10.20]

Similarly, Ivan reflected:

> 'The WaSH observations deal more with, for example hand hygiene, and you know COVID-19 is also, COVID-19 IPC measures [infection prevention and control] are also more like looking at hand hygiene, like washing hands with soap. I believe if COVID-19 had not come, different observations would have been captured. Because the message has been preached through this season, "wash hands, wash hands, wash hands' […]. So people are now accustomed with this situation. If COVID-19 wasn't there, I believe fewer people would have been captured washing hands, compared to when COVID-19 is around.

[transcript phone interview with Ivan, 2.12.2020]

Jamil saw a potential effect of the pandemic on health seeking behaviour that would affect D-Lab's. He explained:

> J: Then, for data, data, uhm, I think there could also have been some changes in the quality of data. In the sense that, some people who could have had some illnesses that they would maybe routinely or occasionally visit the health centre […]. [The pandemic] could also influence the frequencies in which these people are taking in medications, or adhering maybe to certain treatments. Because of the fear, that if they go to the hospital, maybe they will contract this disease. So, I think there could be some adjustments in the quality, rather uhm, not in terms of quality but the depth of data probably that we could have acquired if there was not this pandemic.
> E: so, people are scared to contract the disease in the hospital, or when they see a doctor, so that makes it less likely to seek treatment, right? That's what you were saying?
> J: yes, previously, at the beginning of the pandemic, people would fear to go to the health facilities, because they would think that probably going there in the first place, there would be taken for people who are suspects of COVID. Or if not, they would now predispose them to the people who have COVID in the same set-up. So, if they are not so badly ill, then they would hesitate from seeking for medical care.
> E: I see, and how does that influence your, the data you're collecting?
> J: of course, in the data that we do collect, we're interested in let's say, in a number of illnesses and frequencies where one has visited the health facility and the kind of medications one has taken over time. Yes. So if one has, if there has been a change in behaviour, of seeking for medical care, as well as, access to drugs, anti-microbials, or any other chronic related treatment, then that will also make us not get the data that used to be routine before the pandemic as compared to this situation.
> [transcript phone interview with Jamil, 29.1.2021]

When I asked further about the potential impact of D-Lab's field assistants teaching people about COVID-19 prevention strategies on the observational data, in particular the WaSH observations,[74] Stella explained:

> 'Logically, I think, someone will react differently. Because, remember, you already told them about hand hygiene, […] at the top of their mind, they know, someone is watching. They know what you told them.'
> [Transcript phone interview with Stella, 21.10.20]

Neither of these reflections made it into the data, so that James did not have access to them. He did not wonder about pandemic adaptations, or about what happened in the field. He would not have known how to integrate that into the risk analyses he was running. To make sense of the data, the only thing he needed were clean data sheets.[75]

In March 2023, a couple of months before I interviewed Oliver, I attended D-Lab's dissemination meeting in Kampala. At the meeting, Ugandan representatives of D-Lab including the local PI, senior advisors to the project, as well as David presented the study, its rationale, aims, and methods, as well as some of the findings to regional representatives, policy makers and fellow researchers. D-Lab's field teams and laboratory teams had been invited and some of them had managed to attend the meeting. Rebecca (from the opening vignette), who had wanted to be updated, could not make it to the meeting, because she had to work for yet another research project. The findings presented at this dissemination meeting did not include the modelling teams' results, or the results of the risk analysis that Oliver and his team were running. At the meeting, they mostly presented descriptive statistics around the presence of resistant bacteria in the biological samples, and the observational data around WaSH practices in the Hoima and Kampala field sites. At the time of the dissemination meeting, COVID-19 was no longer very present in the daily lives of those present - the large meeting was held indoors, and no one was wearing masks. Throughout the meeting, no one mentioned the pandemic

[74] For more detail on D-Lab's observational data, including the WaSH observations, see chapter 6.

[75] Oliver thought the quality of D-Lab's data was not very high, which he thought related to implementing institute which might have been less experiences than other implementing institutions he had worked with before.

conditions in which D-Lab had been working, or offered or demanded reflections on how these particular conditions might have affected the data. It was not only in the risk analyses of Oliver and his colleagues that the conditions of data making did not feature. In Kampala, and through the narratives of those who knew the circumstances, the place and time in which the data had been made were also not considered important. No one mentioned the very particular conditions in which the researchers and the study participants had encountered one another.

When 'making sense of the data' in the UK, or in Kampala, the researchers did not consider the adaptations that had been made to enable the project to unfold. During data collection, there had been no space for the Ugandan researchers to communicate how exactly they had employed the protocol, and during the analysis phase that happened in large part outside the country after the contracts of the field teams had ended, their input was not sought out (even when David travelled to the UK to work with Oliver, it was for him to learn about statistical analysis, not to provide input into the analysis). The explicit expectation and regular reminders to not deviate from the protocol during data collection, and the strict hierarchical nature of expertise and skill across the researchers created a situation in which the local Ugandan researchers did not expect their input into data analysis and interpretation to be conceived as potentially useful. Their labour conditions, in particular the short-term nature of the contracts and the dependence on referrals for the follow-on jobs reflected their marginalised position within the research project, thereby making it very difficult, if not impossible, for the field and laboratory teams to speak up.

Adaptation and exclusion

The field assistants and laboratory technicians navigating the D-Lab's field sites and laboratories in COVID-19 conditions were hired on the condition that they knew the place and spoke the language of the study participants. But, as Cal Biruk writes 'becoming a good fieldworker does not entail mastering a body of stable local knowledge or being native to a geographic or cultural place, but rather learning and embodying new ways of seeing that rely on and reproduce difference and distance between knowers and known, science and

culture, and office and field' (Biruk 2018, 99). Moving in between these poles demanded that D-Lab's Ugandan research teams employed creative means, adapting the project to the conditions they found themselves in. These local researchers were thus best placed to not only establish and build the project in the field sites, but also to reflect on the myriad effects the COVID-19 pandemic had had on the project's field sites, their study participants, their own lives, the research encounters, and ultimately the data.

Yet, the Ugandan research team was not asked to reflect on their fieldwork experience, and they were excluded from the project's more conceptual phases; both at earlier stages during the project's design, and later stages, during data analysis and interpretation. Instead, they worked to keep up a resemblance of normalcy, leaving out how the protective equipment they were wearing in the field shaped their research encounters, or the effect of heightened attention to hygiene measures on the frequency of observed hand washing, or indeed smoothing the data points already in the tables. The Ugandan field teams provided this labour under conditions of precarity, where the end of their working contract was never far, and for their future job prospects referrals were indispensable. Their marginalised position - referring both to the limited time they were part of the project, as well as to the appreciation of the expertise they brought to the table, - rendered it difficult if not impossible for them to challenge the rigidity of the apparatus in which they worked, and the assumptions built into the tools they had to employ.

D-Lab's research apparatus did not elicit reflective insights from the Ugandan researchers, and the researchers also were no longer considered as part of the research project following the end of data collection. This became clear to me after the dissemination meeting, where Ivan had asked whether he could get access to the slides of a presentation he had particularly enjoyed. In that presentation, a former post doc had shared some of the findings of the genotyping analysis of the resistant bacteria including of those that Ivan had processed, before they had been shipped to an institute in the UK for whole genome sequencing. Despite his interest, he had never been updated about the findings. When he messaged David, who had organised the meeting, David told Ivan it was not possible for him to get access until the data was published and he would therefore have to wait. Ivan was not considered a colleague, but

an outsider to the very data he had been making. He texted me about this outcome, correctly guessing that I would want to know.

Conclusion

The COVID-19 pandemic and the way in which the different researchers within D-Lab responded to the ever-changing circumstances revealed the centrality of adaptation and exclusion as operating modes of global health research. Adaptation was both necessary and expected by those who worked in the project's Ugandan field sites and had already acquired experience of working 'in research'. Their role had always been to render research projects doable, to establish and develop them in the spaces that only they knew. They did so by adjusting and stretching the rigid instructions. Yet, they had come to expect their own exclusion. The local research teams knew they would not be included in the project's reports and papers. To them, the project was over, once data collection was over. The particular circumstances brought about by the COVID-19 pandemic revealed the ways in which adaptation and exclusion work together to uphold the logics on which D-Lab and global health research are based.

Despite substantial disruption, the evidence that emerged from D-Lab did not reference the pandemic conditions of its making. In D-Lab's data, there are no reflections of the many ways in which the ongoing COVID-19 pandemic shaped the way in which the project unfolded, including the shifting schedules, and the likely impact of masked, temperature-gun-equipped field assistants on study participants (many of whom were scared of the novel virus, and concerned that researchers might sent them to isolation centres). By taking a close look at the adaptive labour that enabled D-Lab to collect data in pandemic conditions, this chapter has revealed how the project depended on creative, adaptive labour of locally hired researchers. It has also revealed the rigidity of the research apparatus, which only values data that fits into pre-defined data entry forms, and the ignorance of researchers outside the field on what the labour of 'collecting data' entails. The exclusion of local researchers from the conceptual and reflective processes of research, and their precarious labour conditions, emerge from and consolidate deep-seated inequality in global

health research.[76] This inequality mirrors the health inequalities that global health takes as a starting point.

[76] This increases the distance between the places, relations, and labour of the field, and the resulting evidence, which, as I describe in more detail in chapter 3, is meant to be standardised to extend its scope of validity.

Chapter 5: Drawing pathogenic risk: the One Health framework in AMR research

As part of a field site visit in D-Lab's Hoima field site, Robert showed me several of the compounds, in which he and his colleagues had collected data. The residents seemed happy to see him, it had been a while since he had last visited them. In one of the households of D-Lab's study sample, a mother and her teenage daughter greeted us and allowed us into their home. The two shared their home with ten other relatives, all of whom were out of the house at the time of our visit. Darlian had joined us for the day, and she translated for me. The residents led us all into their backyard, past their house.

The mother remembered how Robert and his colleagues were interested in their animals' health too, and so she updated him about recent developments. All of their chickens had recently died, she said, adding that they had probably fallen victim to an infection. Their neighbours had also experienced recent illness among their animals, she told us, and we heard similar stories in other households we visited that day. Now, they were worried about their pigs. While talking, we were all standing next to their open pig pen, a simple construction made of wooden boards nailed together that provided space to their pigs in two separated pens. The pigs had recently had piglets, lying closely together in one of the pens.[77] They had built the pigs' pens immediately next to their house. With bare hands, the woman, and her daughter, and then also Robert, were stroking the pigs while talking about them in a caring manner. They were not quite sure what the pigs had, and though they seemed to be improving, they still had a rash on their skin and the woman was thinking out loud what to give them. Calling the veterinary doctor would not be worth it, she said, and he responded in way that made clear he agreed. It was too expensive to call a veterinarian, and she would have to try out different drugs that she could buy at a drug shop instead. Robert suggested that they should give the pigs an anti-parasite medication, that it would likely resolve the issue, repeating the name of the medication as 'Ivermectin'. It would need to be injected into their skin, he added. It seemed to be a common

[77] See Photograph 14.

> occurrence that their animals would fall sick. The pigs provided the residents with economic opportunities - they would sell them for the meat, but their ties extended beyond the economic realm. They were caring for their pigs, and about them, keeping them close, stroking them carefully.[78]
>
> [Fieldnotes, Hoima, 19.1.2022]

The One Health paradigm purports to acknowledge that human, animal and environmental health are not only interrelated but dependent on one another and it has been growing in influence in global public health since the early 2000s (Podolsky 2018; Craddock and Hinchliffe 2015). In 2010, three until then rather siloed institutions, the WHO, the Food and Agriculture Organization of the United Nations (FAO), and the World Organisation for Animal Health (WOAH) (formerly OIE) agreed to collaborate to advance a One Health agenda, and signed a tripartite agreement for 'sharing responsibilities, and coordinating global activities to address health risks at the animal-human-ecosystems interfaces' (FAO, OIE, and WHO 2010). More recently, these three organisations joined by the United Nations Environment Programme (UNEP), published the comprehensive plan 'One Health Joint Plan for Action' (FAO et al. 2022). Within it, they offer the following definition of One Health: 'an integrated, unifying approach that aims to sustainably balance and optimize the health of humans, animals, plants and ecosystems. It [the One Health approach] recognizes the health of humans, domestic and wild animals, plants and the wider environment (including ecosystems) are closely linked and interdependent' (FAO et al. 2022).

The close linkages or interconnectivity that One Health ostensibly foregrounds, materialise - on a biological level - in the form of microbial exchanges. As Brown and Nading (2019) argue, once we pay attention to the constant flow of microbes that live in and on us, that leave and enter our bodies and our environments, the three spheres' boundaries appear as porous. Marsland (2021, 413), writing about pandemics of infectious diseases, and

[78] While talking about pigs soon after this encounter, Darlian mentioned that she also kept pigs at her home. She spoke in an affectionate language about them and told me how she and her grandmother that she lived with made sure they were well fed and healthy. Once they were big enough, they sold them for meat. When I asked whether she would eat the pigs they had raised and cared for, she was very clear that that was impossible. She loved eating pork - roasted pork is a delicacy in many parts of the country, - but would not eat her own.

taking the examples of COVID-19 and malaria, argues that the management of infectious diseases within global health and its historical predecessors builds on a 'logic of separation', where 'the cycle of transmission is broken by separating humans from each other or from nonhumans'. The logic of separation takes a 'western division between the human and nonhuman world' as a starting point, where '[N]ew pathogens are considered to "spillover" when the pristine zone of nature is entered by humans, or creatures from it encroach on human "territory"' (2021, 413-414). This applies to One Health too, despite its 'holistic aspirations' (2021, 422).

Efforts to avoid zoonotic outbreaks (which have become more frequent over the past decades (Brown and Nading 2019)), and to uphold these western boundaries between humans and non-humans have taken various physical or chemical forms. Boundaries include measures such as increasing the distance between human and animals including wildlife as well as livestock, technical solutions to vector control such as mosquito nets, as well as soap, disinfectants and other chemicals and pharmaceuticals, including antimicrobials, that destroy microbes and thereby hinder them from traveling further.[79] However, microbes keep finding ways of surmounting or circumventing the boundaries. The development of AMR is one means with which microbes evade attempts at these microbial disentanglements, the ubiquity of resistant bacteria a material proof of the porosity of boundaries.

In response to evidence around the ubiquity and mobility of (resistant) bacteria (and the separately travelling genes that encode resistance), AMR has come to be framed as a 'One Health' problem (Cañada, Sariola, and Butcher 2022). Over the past decades, AMR has helped the One Health's paradigm to prominence (Cañada, Sariola, and Butcher 2022; Robinson et al. 2016). At the same time, One Health's framing of infectious diseases has come to shape research and policy on AMR (Podolsky 2018; Kamenshchikova et al. 2019). In

[79] Denyer Willis and Chandler have argued that antimicrobials, most prominently antibiotics, have come to fill in the gap left by malfunctioning sanitation systems, serving as a 'quick fix for hygiene' (Denyer Willis and Chandler 2019). Where sanitation systems are porous, and clean water and effective waste management are not available, pathogens can travel easily to new hosts, and the drugs act as a sanitation barrier. Since anti-microbial drugs are no longer working in the way they used to - with the development and spread of resistance encoding genes, - the (sanitation) barrier they are meant to uphold is becoming porous too.

line with this development, D-Lab applied a One Health framing in their study to identify drivers of AMR across the three realms of humans, animals and the environment. Taking households as their unit of analysis (for more information on 'households', see chapter 3 on standardisation), they collected samples from humans, animals and from the environment of the compounds in which their study participants lived. Additionally, the D-Lab researchers collected observational data, mostly in the form of WaSH data (see chapter 6 for a more detailed account of the WaSH data and the related data collection tools) to evidence the microbial interlacing between human, animals, and the environment. These could take the form of e.g. the drinking of untreated water, or the touching of contaminated surfaces, allowing microbes to pass from the environment to the human.

In this chapter, I trace D-Lab's framings of human-animal-environmental relations around AMR, attending to One Health's 'holistic aspirations', as well as to inherited logics of sanitation (and separation) which undergird much of global health. Following long-established modes of making visible the pathogens that humans may become exposed to through diagrammatic sketches, the D-Lab project aimed to inscribe risks through drawings. I analyse graphic representations of these relations within D-Lab (its community map, and its household maps), and build on my ethnographic engagement with D-Lab's researchers. I argue that D-Lab, and global health more broadly, rely on a logic of separation, representing (and understanding) One Health as three-healths: human, animal, and environmental. The representations that allocate humans, animals, and the environment to different zones forecloses the ability to reimagine health in the way that the conceptual appeal of One Health has the potential to do. D-Lab's emphasis on the interlinkages between humans, animals and the environment created possibilities for identifying future interventions to reduce bacterial transmission between the three spheres. In so doing, D-Lab took microbial interlinkages not as proof of the inherent porosity of boundaries, but as a hurdle to be overcome.

I first shed light on D-Lab's operationalisation of the One Health concept, including the diagrammatic representations around human-animal-environmental relations. I show how the diagrams build on an inherited

figurative apparatus centring a logic of separation. I then present ethnographic insights around porous human-animal-environment relations in D-Lab's field sites and the labour of inscribing them when making evidence around microbial interlacing. In the last section, I discuss the significance of these findings in relation to the wider literature on One Health, including the (re-) inscription of boundaries in global health.

One Health, and its operationalisation in D-Lab

In publications and presentations of D-Lab, the study's authors highlight the One Health framing they had employed as an important feature of their study (Cocker et al. 2022; Cocker et al. 2023). As stated above, the overall aim of D-Lab was to identify patterns of bacterial movements in between humans, animals, and the environment, in order to suggest where and how to interrupt their flow most efficiently. D-Lab was set to unfold within households and D-Lab's operationalisation of the One Health framing included establishing evidence on the presence of certain resistant bacteria in all three realms as well as identifying the pathways through which they might travel in between them within the chosen setting of residents' households. As I laid out in more detail in chapter 2 on the project's methodological approach, the D-Lab researchers took samples of human and animal faeces and samples of soil and water, as well as swabs from around the household, including from food, often touched surfaces as well as participants' clothes from each recruited households, from which they established the presence or absence of certain resistant bacteria. The researchers additionally administered surveys regarding demographic information (e.g. household composition), and data on infrastructures around sanitation (e.g. the kind of water source that the household uses, or the kind of toilet or hand washing facilities they have access to). In a subsection of households, the researchers also observed study participants' practices around the transmission of bacteria within the compounds, such as around hand or food hygiene (see chapter 6 for more detail on the WaSH observations). The purpose of the survey and observational data was to establish the potential pathways through which bacteria might travel in between humans, animals, and the environment, and to connect the biological samples they had taken through these pathways.

D-Lab's operationalisation of the One Health framing focusses on bacterial connections between the three realms. Genetic analysis of the extracted bacteria was meant to give insights into their relatedness. D-Lab thereby evidences the blurriness of human – animal – environmental boundaries, and the interconnectedness that One Health seems to purport. At the same time, the categorisation of a human vs. an animal vs. an environment emphasises three distinguishable realms and thereby reflects ideas of separability rather than of interdependence. D-Lab's observational data on specific routes of bacteria, and, by extension, the ways in which these routes might be disrupted, in a similar vein, creates possibilities for cutting off bacterial pathways. D-Lab's work thereby does not speak to the holistic idea invoked in policies on One Health.

Photograph 11. D-Lab researchers taking sample of animal faeces at pig stall in rural household (5.3.2020)

Visualising human-animal-environmental relations

As part of their study materials, D-Lab produced diagrams in which they visualised relations between humans, animals, and environments in the field sites they set out to study. Following Lynteris' work on diagrams of

human-animal relations, I take D-Lab's diagrams 'not merely as simplified schemata of animal-human infection, but as a practice of "visual reasoning" that embodies and reproduces fundamental principles as regards interspecies relations' (Lynteris 2017). In these graphics, D-Lab laid out their expectations of microbial encounters in between humans, animals, and environments and the risks they inscribed into them (focussing on risks to human health).

One such diagram is a drawn map of an imagined, exemplary community and its bacterial connections that the D-Lab researchers regularly referred to, see Figure 2 below. It was published as part of their protocol, and I provide a detailed description in chapter 3 on standardisation. The diagram depicts the spatial relations of built infrastructures, such as a marketplace, houses, an abattoir, and a health care centre, as well as fields and gardens where residents grow food, and places these in relation to a water stream passing through the imagined community. Little schematic figures representing humans are scattered throughout the community map, some at the healthcare centre, others at the farm and food processing plants or the market, some at their homes, or at drug outlets. In their interactions, the figures get into contact with animals - also drawn on the map - that stroll around the marketplace, farms, and households. The residents also interact with their environments, in particular the water stream that carries waste from pig stalls, the abattoir, and the health care centre, as well as waste that humans drop directly into the water. At the centre of the diagram, there is a drawing of large schematic bacterium and its extracted DNA. An arrow leads the viewer to a circle of customers at the marketplace, next to meat vending stalls, indicating this space as particularly risky with high chances of transmission of resistant bacteria, presumably from animals or their meat to humans. At the market, there are pigs and chicken strolling around, potentially enabling the bacteria to travel through them too.

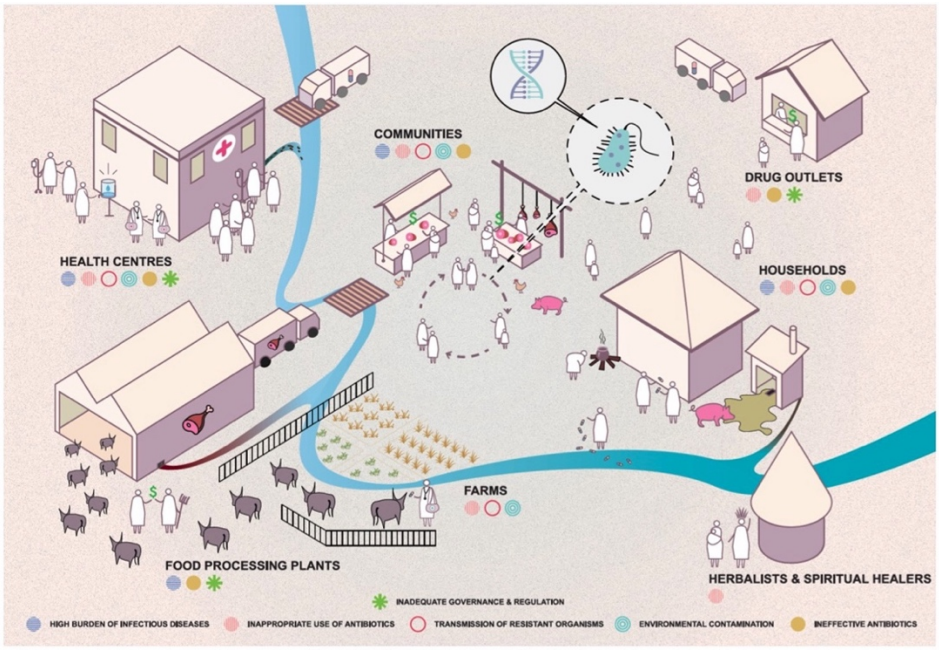

Figure 2. D-Lab's community map, as printed in their protocol (Cocker et al. 2022).

The map renders the spaces D-Lab set out to study into a landscape of risk, marking areas as well as behaviours and interactions of residents with their surroundings as coming with high risks of bacterial transmission. It breaks down D-Lab's framing of One Health into areas, behaviours, and interactions, that their evidence was meant to shed light on. In so doing, the map and its conception of the community and its bacterial interconnections not only depicted D-Lab's idea of the places they worked in and the ones they aimed to make evidence for, it also guided D-Lab 's data collection and data analysis efforts.

In addition to the community map, D-Lab's field assistants set out to draw a map of each compound within newly recruited households during the study's data collection. In contrast to the community map described above, the maps of compounds were not hypothetical depictions of imagined places, but graphic representations of recruited households drawn by a designated field assistant. On these maps, the field assistant would indicate where people kept their animals and grew their vegetables, focusing their attention on spaces in which the study's designers deemed microbial encounters between human, animals, and the environments likely to occur. Figure 3 is an example of such a map from a household in the Kampala field site. The map details the layout of

the residents' house and its immediate environment.[80] Like the community map, the household maps render the depicted households into spaces of higher and lower transmission risk. Here, there are no depictions of residents and their actions, rather the drawing of the spatial set-up of the household is meant to identify the areas in which the field assistants were meant to carefully observe the residents' behaviours.[81] The spatial division into areas of 'human' vs. 'animal' vs. 'environment' reflects D-Lab's idea of separability of these areas into distinct categories, so distinct that they can be mapped onto a sheet of paper. The drawn household maps not only oriented the taking of biological samples I describe above, but also underpin the underlying rationale.

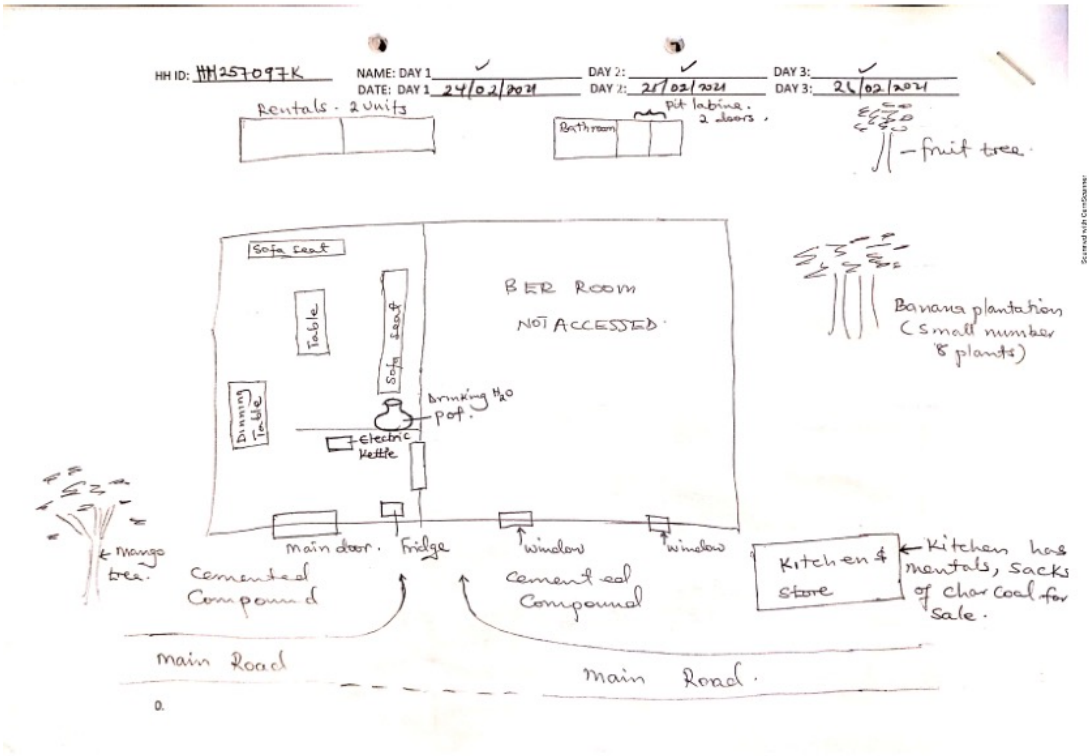

Figure 3. Hand-drawn household map of urban household, drawn in February 2021 by Rebecca. It was shared with me by a fieldwork coordinator.

[80] This exemplary map does not contain any animals. This is not atypical for an urban household, where many of the residents do not keep any animals (see chapter 3 on standardisation). In the rural and peri urban households, the large majority of recruited households lived with animals.

[81] These behaviours were described in the so-called WaSH observations, that field assistants did in a subsection of the recruited households. Their focus was on behaviour relating to sanitation (and particularly hand and food hygiene); for a more detailed analysis of WaSH observations, see chapter 6).

D-Lab's diagrams, and their underlying idea of separability, can be understood in line with a history of diagrammatic sketches visualising pathways of infectious agents and their traveling routes. A very early example is Wagner and Lanoix's much cited work on *Excreta Disposal for Rural Areas and Small Communities* published in 1958 by the WHO. In this monograph, the authors, both engineers in the field of sanitation, make the case for considering the importance of proper excreta disposal for public health in general; and they offer a framework regarding the role of sanitation for the prevention of infections. Their work concerns the (potential) pathways of bacteria from excreta to a new host, and the spaces and ways in which these pathways can and should be disrupted.

Early on in their monograph, Wagner and Lanoix (1958) present two diagrams. Their first diagram (see Figure 4), printed on top of the page, depicts potential transmission routes of pathogens. Here, pathogens travel from left to right in between circles and connecting arrows. A circle on the left containing excreta represents the beginning of an infection route and through potential intermediary circles such as water or hands, and another circle containing food, arrows lead the pathogens to a new host. This newly infected host can then, as predicted by the graphic, either develop a 'debility' or die, each one event contained in a circle towards the right of the page. In the second diagram (see Figure 5), printed below the first one, Wagner and Lanoix present an alternative scenario. Here, the authors have added a thick black line that cuts off the arrows coming out of the focus on infection. This black line - annotated to represent a 'sanitation barrier' - cuts off the potential of pathogenic transmission. The intermediary circles - water, hands, and food - are neither connected to the focus of infection nor the new host and towards the right of the graphic, Wagner and Lanoix position a 'protected host'. The second graphic then depicts an ideal scenario, in which sanitation protects new potential hosts from infection.

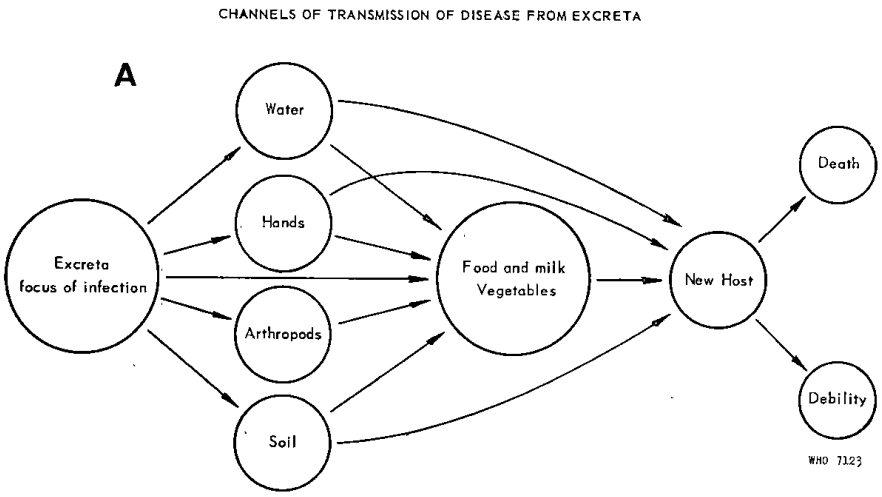

Figure 4. 'Channels of transmission of disease from excreta'; drawing from Wagner and Lanoix (1958)

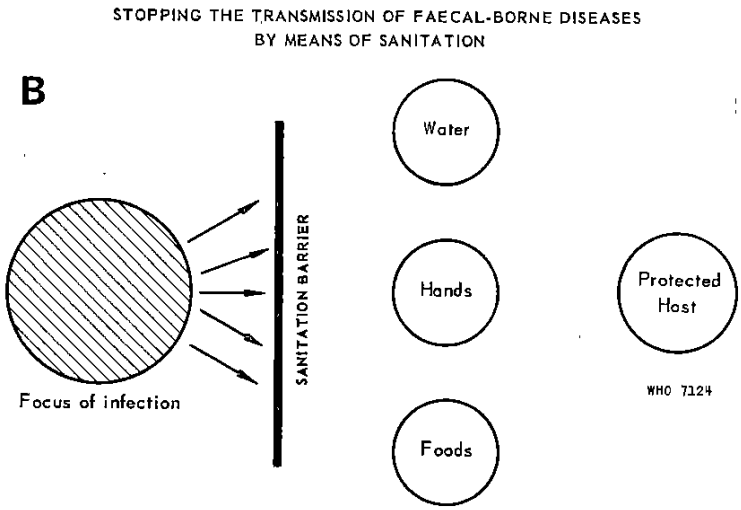

Figure 5. 'Stopping the transmission of faecal-borne diseases by means of sanitation'; drawing from Wagner and Lanoix (1958)

Both diagrams, and the ways in which they inscribe risks of pathogenic transmission and sanitation as means to handle the risks, have since been taken up widely by public health scientists and policy makers. Policies around water, sanitation and health refer to the F-diagram to this day, a diagram that has been slightly modified from Wagner and Lanoix's original one (World Health Organization 2018). In the F-Diagram all intermediary circles of the Wagner and Lanoix diagrams have been re-named to start with an 'F': Fluids, Fingers,

Flies, Fields/Floors, Food.[82] This is so that the framework can be remembered (and presumably applied) more easily. D-Lab authors do not refer explicitly to either the Wagner and Lanoix (1958) or the more recent iteration of the F-diagram, however, they reference so-called 'Shit Flow Diagrams', 'which visually describe excreta flow in urban and rural settings, and data will be mapped to provide a spatial outline of potential pathways for faecal exposure' (Cocker et al. 2022, 10).

To this day, the Wagner and Lanoix diagrams exert influence on imaginaries of human-animal-environment relations in public health, and the role that sanitation ought to play in sorting out these (microbial) relations. Recent iterations of the diagram include one published in a WHO guideline on sanitation and health in 2018 (World Health Organization 2018). In this diagram, the authors have added sanitation hazards (such as 'unsafe toilets' or 'unsafe end use/disposal') as well as additional animals as vectors for disease transmission. Despite these adjustments, the underlying logic of Wagner and Lanoix's original diagram is still apparent with a flow of bacteria from left to right, with many of the indicated vectors being the same.

In contrast to the graphics by Wagner and Lanoix described above, the flow of microbes is not unidirectional in D-Lab's illustrations. There are no arrows to indicate a direction in the pathway of microbes. Rather, the spatial closeness and distance of objects and infrastructures, and the flows of waste connecting areas, illustrate where the transmission risk is deemed to be high. Rather than anticipating the transmission of resistant bacteria along pre-conceived multi-step pathways with beginning and endpoints, D-Lab's depictions (both the community model and the hand-drawn sketches of the recruited households) shift the attention of the observer to areas of high risk. In these high-risk spaces, pathogens are expected to travel in high numbers, transgressing spheres of humans, animals, and environment. In D-Lab's community graphic, in addition to representation of spatial closeness and

[82] A recent reference to the F-diagram can be found for example in Taing and Dang (2021)'s chapter on Water, Sanitation, and Health in the Handbook for Global Health, where they refer to a version of the F-diagram first published in materials on urban sanitation by The Open University (The Open University 2016).

distances of drawn infrastructures, there are red circles to indicate explicitly the 'transmission of resistant organisms'.

The framing of particular spaces as 'risky' is common in the field of disease ecology, where scholars speak of 'hotspots'. Brown and Kelly have employed this term in their analysis of viral hemorrhagic fevers to 'speak[s] to the mundane interactions that create the conditions of pathogenic possibility' (Brown and Kelly 2014, 282). Following their analysis, the hotspot is a space in which certain (inter)actions happen that allow for pathogens to travel. The caption of D-Lab's community map reads 'hypothetical model of related behaviours and the movement of AMR bacteria in Uganda and Malawi' and indeed its focus is not only on the spatial set-up of the community, but it also shows comic-like figures engaging in certain behaviours as they unfold in particular environments. The prototypical residents, as mentioned above, buy drugs at drug outlets, consult herbalists and spiritual healers, buy and sell meat at market stalls, take care of their cattle, cook food at their homes, or drop garbage into the water stream. The interactions that the figures find themselves in become spaces in which bacteria travel to and from humans (and thereby share resistance encoding genes); the social encounters that take place in the ecological spaces contribute to the risk of pathogen transmission.

These areas of high risk (or of high likelihood of bacterial transmission to humans) as indicated on D-Lab's maps correspond to a large extent with recent versions of the F-diagram's vectors and hazards as well as with the original Wagner and Lanoix diagrams. For example, on D-Lab's community map, excreta from the pigs' stall flow into the water stream. Water is one of Wagner and Lanoix's vectors in their original diagram, and this also corresponds with the 'unsafe end use/disposal' of the WHO's recent version of the diagram on the 'Transmission of excreta-related pathogen' (World Health Organization 2018). The microbes' pathways in Wagner and Lanoix's diagram found their way onto D-Lab's hypothetical community map with areas of high risk for pathogen transmission. D-Lab produced this map to help orient research, framing microbial encounters ones along the axis of transmission in Wagner and Lanoix's graphic as risky.

More than 60 years after Wagner and Lennox's publication, D-Labs research continues to be shaped by the same underlying logics which aim to predict the pathways of microbes, in order to irrupt their flow. Wagner and Lanoix drew a black line in their second graphic to illustrate how sanitation can protect a new (human) host from infection. The black line, a thick and impermeable sanitation barrier, cuts off all transmission pathways. D-Lab similarly aims to identify ways in which transmission pathways can be cut off, with a view to reducing the risk of spreading resistant microbes. Indeed, finding out where and how to build this sanitation barrier is a central goal of the study.

The endpoint in Wagner and Lanoix's diagrams is human health, and the sanitation barrier is meant to prevent infections among humans. In these diagrams, the centrality of the human in its wider environment goes unquestioned. D-Lab's maps decentre the human to some degree, and highlight the multiplicity of bacterial connections across humans, animals, and environments in line with its employment of the One Health framework. The closeness and the multitude of interactions as represented on the map, (such as the visible flow of waste from the abattoir, the healthcare centre, and the pig stalls into the water stream that humans and animals get into contact with), draw attention to otherwise less tangible interactions between humans, animals, and the environment. The pathways of bacteria in the drawn community and households do not necessarily link them to humans. However, D-Lab's maps and their reflection of the underlying public health logic imply that microbial encounters between humans, animals, and environments, bear a risk to human health and *therefore* ought to be reduced. The idea of separability of the three spheres of One Health persists, despite an acknowledgement of more complex and less linear bacterial connections.

When drawing relations that make up One Health, in sequential diagrams or maps, (or the often referred to triangles with humans, animals, and the environment each in one corner, see for example Munkholm et al. (2021)), we rely on the 'western division between the human and nonhuman world' (Marsland 2021, 413) that we employ to organise our imagination: we draw humans as separate from animals, and the environment as a realm of its own. In these drawings, we build on the public health logics and the figurative

devices we have inherited, exemplified in the Wagner and Lanoix diagrams. Such depictions re-inscribe boundaries, despite One Health's attempts to upend them. Indeed, they run counter to One Health's ostensible goal of developing more holistic ideas of health, which, in theory, takes interdependencies as a starting point and not as hurdles to be overcome. They also foreclose possibilities for rethinking health as 'one', despite the framework's original premise.

Porous boundaries, and the labour of inscribing them

While spending time with D-Lab's staff and in D-Lab's field sites, I paid attention to the narratives around One Health, and human-animal-environmental relations more generally. While 'in the field', I followed ideas about microbial pathways and the ways in which they might be to cut off, while relating these ideas to the drawn maps I had seen early on.

In conversations with D-Lab's staff, One Health came up a lot as a perk of the study, an approach that set it apart from others. Most often, this related to cross-sectoral collaboration, and the wide range of samples that the study built its evidence on. In a conversation I had with Dr. Julia, the project manager, at her office in February 2022, I asked what she had liked about the study and she responded without hesitation, that she had enjoyed working with colleagues from various backgrounds, and that this had made the project more fun and more interesting. She referenced her various colleagues' specialisations, e.g. veterinarians, environmental health officers, and public health specialists. The laboratory assistants also mentioned how much they had liked working with a wide array of samples, coming from humans, animals, and the environment. Ivan, a laboratory assistant, always took time when we met to carefully explain to me the various kinds of samples they had taken and the procedures he and his colleagues had used to work on them or prepare them for further analysis. He was enthusiastic about the set-up of D-Lab, and its focus on One Health - so much so that he decided to work on a related project for his master's degree, where he was about to analyse resistant microbes in water samples in different parts of the country.

At a visit in D-Lab's western Ugandan field site in January 2022, I gained insights into how D-Lab's One Health approach mapped onto the households of residents in which the study was working. In Hoima, I met with Robert, one of D-Lab's Hoima-based field assistants, and he offered to show me around. The chapter's opening vignette emerged from this field site tour. We drove through the district, along the roads he had passed through many times during fieldwork for D-Lab up until September of the previous year (a more detailed description of this exploration of D-Lab's field site can be found in chapter 6 on WaSH). As part of our tour around D-Lab's field site, Robert took me into the compounds of residents, whom he had befriended. The former study participants willingly let us into their homes. Their relationship with Robert seemed friendly, and residents seemed to have seen him a lot. They were happy to chat.

All the families that we visited lived with animals, and the way their homes were built meant that they were constantly in close contact with the soil and water around them. In the residents' compounds, I saw chicken and goats roaming around, some families kept pigs in pens close to their houses into which the chickens would also go. One family had rabbits, others kept a few cows, which were grazing outside their homes during the day, and which would be brought back onto the compounds at night. There were dogs in many of the households too. In one of them, large pieces of the skin of a cow they had bought and eaten for Christmas a month earlier was lying on the ground. The residents had left it there for the dogs to eat. I saw hardly any fences anywhere, the boundaries to the neighbouring compounds were not immediately visible. Vegetable gardens and matooke trees were openly accessible too, and the animals would roam through them.[83] In many of the spaces we entered, there was dried up cow dung, and other animals' feaces on the ground. The kitchens were open, and residents were cooking on fire pits close on the ground. Children were playing, in between all of this, in the same spaces as the animals, and where vegetables were growing.

[83] Matooke is a kind of banana that grows on palm like trees. It is a staple food in much of the country, where the fruit most often get steamed and mashed.

Photograph 12. Goat tied to tree inside a rural household in Hoima (19.1.2022)

Photograph 13 & 14. I am looking into wooden pig stalls in a compound in Hoima, observed by a girl; View inside the pig stall (19.1.23, Photos by Darlian)

In the rural area in which D-Lab unfolded, human - animal - environment relations were close and (microbial) interactions frequent. In this setting, microbial encounters were obviously common place, and there was a

form of 'interspecies intimacy' (Shukin (2009), cited in (Hinchliffe 2015, 30)). D-Lab's field assistants had mostly grown up in cities, and without such close contact with animals. But those whom I asked were not surprised about these relations. Their relatives who resided 'in the village' lived closely with, and cared for, animals, and tended to vegetable gardens within their compounds.[84] When field assistants were speaking of these spaces they knew intimately, they did not portray the interspecies interactions as dangerous or risky.

Both the community map and hand-drawn maps of the compounds inscribe areas of risk, in which microbial encounters across the three spheres are deemed particularly likely. The drawing of the compound and its division into areas in which humans or their animals live, and into spaces of microbial transmission, seemed to me at odds with the interconnections I was seeing. To the field assistants, the labour of inscribing the areas, of drawing boundaries into spaces in which there were no tangible boundaries, did not seem counter-intuitive, rather they narrated it like an ordinary task. The drawing of maps, and observations around imposed boundaries consisted of labour of translating a heuristic they had learnt to be scientifically 'right' (and thereby lifesaving) into a space in which interdependencies crossed boundaries of the zones they had to draw. They were providing what Kelly and Lezaun (2014, 369) label as 'labor of interspecies separation' in their work on mosquito control.

The ways in which the families we visited cared for their animals, and worried about their health aligns with literature on human-animal relations in other parts of Uganda. Denyer Willis, Kayendeke, and Chandler (2023) have described the careful labour of tending to chicken of chicken farmers in suburban Kampala. In their article on antibiotic use and economic opportunities in rural eastern Uganda, Nayiga et al. (2022) have also described

[84] The reference to 'the village' as a familiar space also came up in D-Lab's dissemination meeting in March 2023 in Kampala. David, the field coordinator who had organised the meeting and who at that point was still working with D-Lab's data for his master's thesis, referred to 'life in the village' when presenting data around the presence of resistant bacteria and WaSH practices of residents in the Ugandan field sites. He invoked the attendants' care and attention speaking of 'our brothers in the village', 'our mothers' aprons', (on which D-Lab had identified a high numbers of resistant bacteria) taking the audience into the space in which the study unfolded and for which it was meant to speak.

how residents cared for their animals.[85] During their ethnographic fieldwork with rural residents, they found that humans shared their medicines with their animals, and used similar language to refer to illnesses, not only their human kin but also their chickens, goats and pigs had a cough, flu, or a fever. Residents stored leftover medicines from previous illnesses of household members in their homes and used them to treat and prevent infections across all household members, human and non-human. Although keeping and caring for animals came with economic opportunities for the residents, 'their encounters with their animals [were] intimate, engaged, and about more than profit' (Nayiga et al. 2022, 7).

From conversations with D-Lab staff, particularly the field teams, I learnt that some of D-Lab's study participants kept animals such as goats or chicken inside their house at night. Steven, a Hoima-based field assistant, told me about this in a voice that sounded like it was clear that this would be something I would consider a risky practice - something that I, an outsider to the space, would certainly feel surprised about and that I would judge. When I asked Steven why the residents might have kept their animals so close with them at night, the answer was clear, it was to make sure that thieves would not come to steal them. Several field assistants subsequently confirmed the practice. Nayiga et al.'s (2022, 2) interlocutors also mentioned that they had had their animals stolen from them, and they had started keeping them in their homes overnight. Keeping chickens or goats in rooms where residents slept allowed D-Lab's study participants to care for their animals, and it blurred boundaries as imagined in D-Lab's framework, where any space is either 'human' or 'animal'.

D-Lab applied a One Health framing in order to study what drives the development and spread of resistant bacteria. They did so in a setting in which the lives of humans and animals, and the environment are intricately interlaced

[85] The area in which the authors conducted their study is in rural Eastern Uganda, a region with much higher levels of poverty than the region in which D-Lab unfolded. According to the Uganda Bureau of Statistics, the eastern part of Uganda has the highest numbers of residents living in poverty, and the western regions are above the national average (Uganda National Bureau of Statistics 2019). Despite the difference in wealth, and differences in languages spoken, one can assume that there are parallels regarding the relations between humans and their animals.

in microbial, emotional, and economic terms. Caring for and living with animals in the context in which D-Lab unfolded, and in particular in their rural and peri-urban field sites, meant keeping animals close, watching them carefully, providing them shelter, food and medicines shared with other humans. Despite One Health's emphasis on interdependence, employing the framework entailed pulling the spheres apart. It meant imagining and drawing boundaries around human, animal, or environmental spheres, with a view to then tracing the trespassing of microbes in between them. This inscription of boundaries into blurry spaces of interdependence then worked to establish boundaries - to break health into three rather than to draw it together into one.

Fragmenting health to protect whom?

As I have laid out in the above sections, researchers and policy makers often frame AMR as a One Health issue - foregrounding that it both affects and emerges from all three areas of One Health and their interconnections. Yet, they work with the assumption that the three areas are separable. This is undoubtedly the case for D-Lab too. The devices and framework researchers lean on when describing, studying, and intervening on health, render One Health into 'three healths' - and they foreclose imaginations of alternative approaches. The assumed separability continues to govern the research and the resulting evidence. This is the case even in the described context in which humans live with and care for their animals in shared environments, where interconnections and interdependencies between the spheres are observable. In this understanding of One Health consisting of three distinct spheres to be separated, the role of human health remains the central concern, to be protected from microbial intrusions from the other spheres (Cañada, Sariola, and Butcher 2022).

In line with the literature on the prominence of anthropocentric approaches in One Health, I came to learn that among the D-Lab researchers, there was an understanding that human health stayed the central concern too. More often invoked than made explicit, the research apparatus with its emphasis on human, animal and environmental samples was tasked to provide insights into how to best protect the health of humans. This became apparent for instance in discussions around sanitation, as a means to cut off microbial

pathways to humans; or in conversations about the potential applications of D-Lab's evidence into interventions to cut off microbial pathways more generally, protecting humans from their microbial surroundings. At the project's dissemination meeting in Kampala in March 2023, Dr. Caroline, a veterinarian by training and one of the senior advisors to D-Lab, gave a presentation about One Health. It was the second presentation of the day, and it was meant to provide a framing for the study's results. Here, Dr. Caroline, referred to definitions of One Health in the policy arena, and then, with much fervour, argued that AMR needs to be addressed using a One Health framework.[86] To back this up, she showed the audience slides with bar charts indicating the increasing levels of antibiotic use in livestock over the past decades. In her presentation, mostly addressed to the policy makers in the room, she argued that in order to more efficiently protect humans from resistant infections, we should not ignore that these infections occur in animals too.

The anthropocentric approach put forward by D-Lab presupposes the importance of humans, that can be disentangled from their surroundings. Although wrapped in framings of One Health, it is at odds with One Health's radical proposition to upend the re-drawing of boundaries and to embrace the interdependencies between humans, animals, and environments - microbial and otherwise. This apparent contradiction did not come up as such during my fieldwork encounters. The central importance of the human, as a separable entity, seemed self-evident to my interlocutors, and the One Health framing served as a means to better protect humans from infections. Kamenshchikova et al. (2019, 7) have argued in their policy analysis around One Health and AMR, that the policies similarly present 'human health at the centre stage, and the animal and environmental sectors […] primarily as risks to human health'. This framing lies at the heart of classical public health approaches, as laid out above with the example of Wagner and Lanoix's conceptualisations. Public health's focus has been to sustain human health and to prevent infections. Over

[86] Dr. Caroline not only advised the study around animal health, she also provided ties to the region in which the study unfolded. Passionate about wildlife conservation, she led an NGO in the region that works to improve the lives of great apes and knew people in administrative roles there. Dr. Caroline also led workshops around One Health as part of a course for international groups of medical doctors looking to expand their expertise, one of which I was fortunate to attend at an early field site visit in 2018.

decades, we have built new boundaries around humans to protect us from infections. AMR is a powerful reminder of the porosity of any boundary we have built - the barrier that antimicrobial drugs are made to uphold is increasingly becoming more dysfunctional. Residues of antimicrobials as well as resistant microbes can be found across bodies and environments globally. As Landecker (2016, 20) argues '[T]he bodily condition [of antibiotic resistance] bleeds into the environmental condition'.[87] The drugs contribute to the development and spread of resistant microbes that transgress the spheres of One Health instead of keeping them separate. The use of antimicrobials as a microbial boundary has itself become a risk to human health.

Inscribing borders and boundaries, is common in global health more broadly despite an acknowledgment of their inherent permeability. The global spread of pathogens and diseases, that do not stick with borders, has been a defining point of reference in global health particularly since the SARS outbreak at beginning of the 21st century (Yates-Doerr et al. 2023). Global health, particularly in its departure from international health, defines itself as a field concerned with health as a global, interconnected phenomenon. Yet many global health policies and interventions have focussed around attempts to surveil potential microbial transgressions in order to build, keep up, or restore boundaries or borders, tightly weaving together global health and concerns around national security (Yates-Doerr et al. 2023). Craddock and Hinchliffe (2015) in the introduction to their special issue on 'One World, One Health', link global health and its attempts to identify and react to emerging infectious diseases to the post 9/11 efforts of rendering 'the Global North as impregnable as possible' (2015, 2). Although the interconnection of the world through microbes and pathogens often stays, at least ostensibly, in the foreground of global health, it serves as a tool to protect the security and health of the Global North.[88]

[87] For an analysis on drugs leaking out of bodies, see Hardon and Sanabria (2017).

[88] There are continuities from tropical medicine and colonial health serving mainly to protect the health of settlers and to secure the health of the colonial labour force to enable uninterrupted economic extraction in the colonies (Marks 1997; Vaughan 1991) to global health instrumentalised to protect the health and security of the Global North (for more details, see chapter 1).

In the discourse around AMR too, there are attempts at divisions between Global North and Global South, both in attributing blame, and in trying to keep up microbial boundaries.[89] This is particularly obvious in discussions around the use of anti-microbial medicines, which often get framed as misuse, overuse, or irrational use of medicines particularly in places where the usage is less regulated and the medicines can be bought over the counter (Denyer Willis, Kayendeke, and Chandler 2023). This 'irrational' use of medicine is understood as a global driver of AMR, which therefore ought to be reduced (most often through behaviour change interventions, see chapter 6). This accusation fits into a narrative of blame on people living under conditions of poverty who frequently use anti-microbial medicines as a means to survive in unsanitary conditions (Denyer Willis and Chandler 2019).

Despite globalised networks through which microbes travel, and the 'the imperial and post-imperial role of Europe and North America in spreading disease to the global south', the imagined direction in which diseases spread continues to be from the Global South to the Global North (Marsland 2021, 411). Africa features prominently in this narrative, and an 'image of Africa still conjures up an antediluvian zone where humans are part of a fecund "nature" that brings forth disease' (Marsland 2021, 411). In this imagination, the human – nature (that is animals and environments) boundary is portrayed as blurry, and in the blurriness ostensibly lays a risk for the health of all humans, globally. These intimate interspecies encounters in places imagined as remote 'occupy pride of place in these end-of-the-world fantasies' (Kelly, Keck, and Lynteris 2019, 1). However, as Kelly, Keck, and Lynteris (2019, 1) have argued when referring to the possibility of pandemics originating 'in antimicrobial-rich hospital environments', it is not the lack of technological, modern interventions

[89] Not only get borders re-inscribed into global health in order to protect the health of the wealthy and powerful, but the fragmentation can also tragically be seen when mapping deaths from resistant infections. Though often framed as a problem that lies in the future, infections with resistant microbes are already causing deaths and disability - a recent estimation of deaths attributable to AMR came to 4.95 million death in the year 2019 (Antimicrobial Resistance Collaborators 2022). Much like the unequal blame put onto people using antibiotics, these deaths are not equally distributed across the globe. Where the share of death attributable to infections is higher relative to other causes of death, and access to drugs is more limited, more of these deaths occur (Antimicrobial Resistance Collaborators 2022). In the regions where D-Lab collected their data, the numbers indicate that deaths from resistant infections are relatively high.

which pose a danger. Instead, '[E]pidemics are the dark side of modernisation, medical and political progress; they represent the impossibility of securing the body politic in an ever-more interconnected, technologically advanced and globalised world.'

Conclusion

In global health policy as cited above, 'One Health' invokes imaginaries of unification and holistic notions of health that knit together the human, animal, and environmental spheres and that support integrative thinking. Employing the framework is meant to overcome the siloing of funding, scholarly and clinical expertise, and institutional responsibilities, so that policy and research can better reflect and more efficiently intervene in health.[90] AMR has become a central object of the One Health agenda, highlighting the presence of resistant bacteria across human, animals, and the environment. AMR can also be understood as a biological proof of failures of past attempts at separating humans (or animals, or plants) from certain microbes.

Despite One Health's holistic notion, its employment follows the logic of separability of the three realms (Marsland 2021). In drawings that guide scientific inquiries and reflect and produce researchers' understanding of the relations under study, the three realms of One Health are drawn as separate, and therefore separable. In D-Lab, both a map of an imagined community, as well as drawn maps of the households of their study participants portray interspecies encounters as risky, and to be avoided.

Negative side effects of efforts to keep microbial encounters between humans and the world around us to a minimum are well known. Lorimer (2019), writing about the field of immunology, describes how a growing body of literature starting in the 1980s has exposed the downsides of efforts to disentangle humans from the microbial worlds that surround us, describing a 'reappraisal of the prevalent negative associations of microbes in immunology'

[90] In their article, Lee and Brumme (2013, 778) argue that '[A]t the global level […] this vision [of a holistic One Health approach] is hindered by dysfunctions characterising current forms of global health governance (GHG), namely institutional proliferation, fragmentation, competition for scarce resources, lack of an overarching authority, and donor-driven vertical programmes.'

(Lorimer 2019, 61). The absence of microbes formerly understood as a desirable state of cleanliness has come to take on new meanings, and at times describes a state of concern. As a consequence, 'in some parts of the world, the focus of health care is beginning to shift from wholesale microbial eradication toward differentiating microbial agencies and curating encounters with beneficial microbes'(Lorimer 2019, 62).

Conceptually, One Health has the potential to overcome the undergirding logic of separation. In its basic formulation, it asks us to rethink our relation with the world around us, and 'living with' allows for new futures to emerge (see for example, Tsing (2012)). Mutsaers (2015) describes One Health as a potential solution against fierce measures of security that can lead to what she calls 'auto-immune responses'. She writes that taking seriously One Health and 'acknowledg[ing] the fact that the fundamental dependency on anonymous others is not a condition we can get away from, neither on the political nor on the biological level […] would further our commitment to living with a certain kind of "vulnerability to others"'(Mutsaers 2015, 129). The employment of One Health that no longer separates health into three would allow for an approach where microbial exchanges would no longer seem like a risk or danger to be avoided but rather as a feature of the system that we need to learn to live with. MacGregor and Waldman argue that rethinking interspecies boundaries might enable new ways of addressing zoonotic disease, in 'closer integration with people's own cultural norms', further arguing that 'If we can bring this kind of knowledge into One Health debates, we find ourselves with a multiplicity of worldviews, where bounded categories such as human:animal and nature:culture cannot be assumed. This might, in turn, influence our scientific ways of seeing our own disciplinary cultures, and generate novel ways of understanding zoonoses and constructing solutions' (MacGregor and Waldman 2017, 1)

D-Lab's study participants who share their lives with animals do not organise their compounds around boundaries and separation. Their interspecies relations could be a starting point for re-drawing and re-imagining One Health as One. In a set-up in which D-Lab's researchers were more than implementers of a study protocol (see chapter 4 on precarity), but theory makers in their own right, D-Lab's evidence on bacterial connection might

come to more fruitful conclusions than the re-drawing of boundaries that are impossible to uphold.

Chapter 6: Water, sanitation, and hygiene: behavioural approaches in contaminated landscapes

We had been touring around D-Lab's field site for over an hour when Robert, the project's only staff member who had stayed in Hoima after the end of data collection five months prior, stopped his car to show me another sampling site. While most of D-Lab's data collection had happened within recruited households, the fieldworkers had also collected biological samples and had conducted observations in the surrounding environments. At this sampling site, Robert and his colleagues had collected water and soil samples which were tested for the presence of the resistant bacteria of interest.

When I opened the door of the car, there was a strong rotten stench. We were standing in front of large brown piles of waste with bits of grass growing on them, and colourful plastic bags and bottles sticking out. Robert pointed to fresh banana peel on top of one of the piles, an indication that the waste dumping site had been used recently and mentioned that it had grown substantially since he had last been there a few months before. A slowly moving knee-deep water stream passed through the waste piles. On our tour around D-Lab's field site, we had stopped further upstream, and would stop again further downstream, where people washed their cars and motorcycles in the water and led their cattle to drink. Others came to fetch water for household usage, perhaps to wash their clothes. The water that passed through these piles of waste would likely enter the nearby households.

As we were standing there, Robert laid out to me how these waste piles ended up there, rotting, with no one coming to pick them up. The residents could not afford to pay to have their household waste picked up and instead started this pile of waste right where we were standing. He told me that it was inadvisable, and also illegal, to build houses immediately next to the water stream. Residents therefore started their waste dumping site here, in an otherwise empty space that was not part of anyone's compound.

Robert did not seem surprised about either the ways in which the

people discarded their waste in the water stream, or about D-Lab's methodological apparatus. For the study, he had collected samples and had not been asked about these historically grown entanglements of economic and legal factors that shaped these landscapes and their microbial composition. As we turned away from the piles and towards the car, he expressed hope that 'D-Lab would do something about this all'.

[Fieldnotes, 19.1.22, Hoima]

Photograph 15. Waste dumping side along water stream in Hoima (19.1.2022)

At least since John Snow's famous epidemiological study on cholera in London in 1849, there has been public health evidence that water can spread severe diseases (Watts 1997). Water, sanitation, and hygiene feature prominently in global health and its historical predecessors (Anderson 2006). The acronym WaSH, originally standing for water, sanitation, and health, and for the past decades for water, sanitation and hygiene denotes a major sector within global health (de Wit et al. forthcoming; World Health Organization 2024). While the MDGs did not explicitly mention water and sanitation as one

of their eight major goals, the WHO states on their website that '[D]iarrhoeal deaths as a result of inadequate WASH were reduced by half during the Millennium Development Goal (MDG) period (1990–2015)', with significant progress in the provision of water and sanitation playing a key role (World Health Organization 2024).[91] The SDGs' more comprehensive list of 17 goals contains a goal dedicated to Water and Sanitation. It reads: 'Ensure availability and sustainable management of water and sanitation for all'. Such a goal illustrates the importance of the sector for contemporary global health (Sustainable Development Goals Fund 2014).

Up until about the 1980s, the international health community worked on the premise that improving water and sanitation would improve health. That changed with the growing power of philanthropic institutions in the field, their neoliberal agendas and structural adjustment programmes, and the related introduction of new evidentiary requirements. Increasingly, funding eligibility for global health interventions depended on quantified evidence providing proof of a discernible effect of an intervention, as well as its cost and time-effectiveness, within the time frame of the funding cycle - usually a few years. This requirement also meant that ever larger proportions of the funding allocated to the WaSH sector ended up being used to produce evidence on the effectiveness of interventions, in some cases up to 20% (McMillen 2021, 3; Gimbel et al. 2018).

Put forward ostensibly as a means to increase transparency, accountability, and to ensure funding is spent in the most efficient manner possible, the new evidentiary requirements narrowed down the scope of both the problems that could be addressed and the solutions that were devised. In the field of water and sanitation, the introduction of these requirements meant that it had become necessary to prove that improving water quality was a worthwhile goal (McMillen 2021). Since water affects life and health so broadly, assessing the impact of improved water quality is challenging, and nearly impossible within the short time frames dictated by funding cycles. Instead of

[91] In a recently published Global Health Handbook, Taing and Dang (2021) in their chapter on WaSH however write that 'Alarmingly, diarrheal diseases remain the second and sixth leading cause of death in low- and middle-income countries (LMICs) despite the widespread availability of oral rehydration solutions (ORS)'.

broad infrastructural investments, new projects - and the growing sector of WaSH - were narrow in scope and 'more in line with pharmaceutical modes of consumption' (Livingston 2019, 23). The narrowing down of the scope of interventions also came with a shift of responsibility away from the state and towards individuals. WaSH interventions often focus on individuals' beliefs and practices around water, such as changing water filters (Redfield 2016), or using oral rehydration therapy to treat diarrhoea or even cholera caused by contaminated water.[92] Hand-washing, and to a lesser extent household water treatment, became known as the most-effective interventions in LMICs to improve health in general, as they could be assessed with randomised controlled trials and the evidence produced seemed compelling (Schmidt 2014).[93]

AMR has come to be framed as an issue of WaSH behaviours too. Despite evidence on AMR's complexity and its relations to the ecological environment of bacteria such as heavy metals or disinfectants (Landecker 2016, 40), global health institutions continue to falsely 'suggest narratives of mastery and eventual control' (Hinchliffe 2021, 3). In these narratives of control, individual behaviours feature centrally, in particular behaviours around the 'misuse' and 'overuse' of antibiotics (Denyer Willis, Kayendeke, and Chandler 2023). The often-cited O'Neill report on AMR's future impact on health and wealth lists several actions necessary to 'tackle' AMR, including to 'improve hygiene to prevent the spread of infection'[94] further specifying, and thereby directing the attention to individuals again, '[T]he simplest way that all of us can help counter the spread of infections is by proper hand washing' (O'Neill 2016, 4).[95]

[92] Marsland (2021) argues that the attention to technological fixes as opposed to broader infrastructural interventions has fatal consequences. Writing about infectious disease control, she argues '[T]he emphasis is on technological innovation, at the expense of primary healthcare and improvements to standards of living. In this way, social inequality is allowed to continue – life is promoted under conditions that might otherwise cause death' (2021, 413).

[93] For a recent example of such a trial, see Null et al. (2018).

[94] Kirchhelle et al. (2020) in their paper on antibiotic policy highlight the area of WaSH as a crucial sector through which to intervene on AMR, 'IPC and WASH is likely to be most effective for reducing AMR in many settings as a base on which stewardship might then be built'.

[95] In the paragraph on improving hygiene, the reports frames infection prevention as a means to reduce the demand of anti-microbial medicines, 'the less people get infected, the less

In their quest to identify drivers of AMR, D-Lab investigated WaSH practices of their study participants. According to the study's protocol, they collected WaSH data to understand the drivers of transmission of resistant bacteria in between the human, animal and environmental spheres (Cocker et al. 2022). Through data on hygiene practices, such as handwashing that might cut off bacterial pathways, D-Lab traced the pathways of (resistant) bacteria through households. To do so, D-Lab used a variety of tools including surveys relating to WaSH and structured observations of so-called WaSH practices such as hand and food hygiene. The evidence on WaSH was meant to complement the biological evidence: where resistant bacteria were found in the biological samples of e.g. humans and animals living within the same compound, the WaSH data were to shed light on potential links in between different samples. With their WaSH data collection tools, D-Lab attended to narrow, discernible units of observation, focusing on individual practices that might affect the development and spread of AMR. D-Lab's WaSH data fit neatly into the above-described paradigm of evidence and performance metrics.

In this chapter, I follow 'WaSH' through the D-Lab study and into their Hoima field site, attending to the environments that often get disregarded in global health research (Neely and Nading 2017). I argue that by focussing attention on the sanitation practices of individuals, D-Lab flattens the biological, social, environmental landscape in which it unfolded. This leaves unquestioned infrastructures around water and waste, and the social, economic, political, and legal ramifications that shape people's lives, their sanitation practices, and the microbes surrounding them. This argument builds on ethnographic evidence consisting of conversations and interviews with D-Lab researchers, attendance at D-Lab meetings, field site visits in D-Lab's Hoima field site, as well as D-Lab's reports, presentations, published materials, and protocols. In addition, a series of interviews with experts working in the

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they need to use medicines such as antibiotics, and the less drug resistance arises.' To do so, it first lists structural requirements 'some [countries] in the developing world will need to focus on improving the basics first, by expanding access to clean water and sanitation', only then to go shift the focus and responsibility on individuals, writing 'The simplest way that all of us can help counter the spread of infections is by proper hand washing' (O'Neill 2016, 4).

field of water, sanitation and hygiene in Hoima informs the second part of the chapter, where I contextualise the study in its Hoima field site.

WaSH in the D-Lab project

As part of their published protocol, the D-Lab authors presented a layout of a prototypical community, illustrating entities within an imagined community and their bacterial connections, (for a more extensive discussion of this graphic, see chapter 3 on standardisation and the 'standard community'). On the graphic, a thick blue line depicting a water stream runs through the comic-like community. A health centre's waste flows into the water stream, as does a pig stalls' waste, and that of an abattoir. There is also a person dropping something into the stream. Adjacent to the stream, there are fields, presumably watered with the stream's water, and cattle passing by, potentially drinking from the water. Following the logic of the graphic, those sources of contamination of the water stream contribute to the making and spreading of resistant bacteria in the imagined prototypical communities. The water stream at the heart of the drawn community connects the entities with each other, the stream of water is a pathway for bacteria to travel.

Despite the centrality of the water stream and the depiction of the wider ecological environment in the graphic, D-Lab studied water and sanitation mostly within compounds of residents. Within those compounds, the study focussed on the practices of individuals, and employed a set of data collection tools. This set consisted of: an extensive survey within the enrolled households (*case report forms*), structured observation of practices relating to water and sanitation (*WaSH observations*), including a *hand hygiene audit*, where field assistants counted the number of times study participants washed their hands during the observation times; transect walks to take environmental samples and conduct observations around the households (*transect walks*); as well as a survey informed by the findings of the observations using the 'Risks, Attitudes, Norms, Abilities and Self-Regulation (RANAS)' model (*RANAS survey*).[96]

[96] As part of their protocol, D-Lab published the tools they employed. All data collection tools, including the questionnaires can be found here: https://zenodo.org/record/5855820#.Y0cxt1KZNAc (last accessed 23.4.2024).

Below I provide a short overview of each of the tools and embed them in narratives of the field assistants who administered them.

Case Report Forms

In every recruited household, the fieldworkers administered an extensive survey around the demographics of each household, as well as the household's water sources and other WaSH related questions, such as type of toilet and handwashing facility used, and the presence of animals in each compound. The administration of the survey took about one to two hours. The tablets used for data capture registered the GPS coordinates of the household, linking the data to its geo-spatial context (for more detail on the use of GPS coordinates, see chapter 3 on standardisation).

WaSH observations

The most time-consuming part of D-Lab's data collection were the WaSH observations that they conducted in a randomly chosen subset of the households. In those households, the field teams spent six hours (either 6am to noon or noon to 6pm) on three consecutive days at each data collection point to record the study participants' practices around WaSH in their households. As a first step, one of the three field assistants walked around the confines of the households and drew a map visualising expectations of microbes' pathways, (for a more detailed analysis of the map drawing within the household, see chapter 3 on standardisation). The maps were meant to guide the structured observations, identifying spaces and situations to observe more closely (e.g. the latrines, the kitchen, animals in the compounds).

During the observations, one designated fieldworker would sit down in the compound and write down short descriptions of what they came to call *WaSH events* during six hours intervals. A WaSH event could entail observing someone preparing food, using the latrine, feeding a child, caring for an animal, or any other activity that they related to bacterial pathways between humans, animals, and the environment. The description would include a timestamp and a short description of the event in relation to an underlying ideal - e.g. '11:52.

child of 7 years used latrine, then washed their hands with a tippy tappy[97] without soap.' This underlying ideal - the child should have used soap when washing their hands after using the latrine - against which the fieldworkers benchmarked their observations was not spelled out as much as it was assumed. The ideal related to the possibility of an interruption of a pathway of bacteria. Washing hands with soap could have cut off a pathway of bacteria from the hands of the child protecting that child (and other members of the household) from a possible colonisation or infection with (resistant) bacteria. The field assistants conducted the hand hygiene audit during the observation times, writing down the number of times household residents had washed their hands and whether they had used water and soap to do so.

Photograph 16. Handwashing facility in rural household, the 'tippy tappy' consists of a jerrycan hanging from a wooden construction (4.3.2020)

[97] A tippy tappy or tip tap is a construction used for hand washing that some of D-Lab's participants were using, see Photograph 16. It is designed to be operated by foot. A jerrycan hangs on a string and that string can be pulled by pushing a pedal with a foot. This then tilts the jerrycan enough for it to pour water. The idea is that the person washing their hands would not have to touch the jerrycan, avoiding the contamination of the jerrycan's handle, and that they would be able to wash both hands at the same time by rubbing them together.

Transect walks

In addition to the collection of data within households, field assistants collected a small amount of data outside of the compounds to assess the study participants' environmental exposure. During the transect walks, the field assistants collected observational data around WaSH as well as biological samples of water and soil, as well as swabs from often touched surfaces at sites in the community that they related to WaSH and linked them with GPS data of their origin. Sites for observations included markets, water sources such as wells, boreholes, and river water, as well as waste dumping sites, (there was an initial plan to include schools too, but the regulatory requirements turned out too burdensome). The environmental samples allowed the researchers to establish for instance whether the water at the collection sites contained resistant bacteria, and in case they found any, to relate the bacteria to the bacteria they found inside the households. Field assistants also conducted focus group discussions and interviews with key informants to 'explore perceptions of barriers and challenges to WASH posed by circumstances of daily life' (Cocker et al. 2022, 10). The field assistants hardly ever mentioned these interviews and focus group discussions, and when I asked, it sounded like these encounters did not offer new perspectives, but rather served to legitimise the researchers' presence in the communities. Since D-Lab had deliberately placed its focus on the households, data from outside the households were not as central.

RANAS survey

Towards the end of data collection, the fieldworkers administered a survey with respondents in up to 100 households per field site. This survey's goal was to identify psycho-social drivers of WaSH practices in the household. The survey's results were meant to inform behaviour change interventions targeting high risk areas identified through the analysis of the rest of the data. During my time with D-Lab, this survey was hardly ever mentioned. In their dissemination meeting held in Kampala in March 2023, almost 18 months after the end of data collection, the RANAS survey did not come up at all. At that point, the researchers had only analysed a part of the data, and the survey data were likely not included, since the was meant to inform the later steps of the

project, i.e. identifying how to intervene most efficiently to decrease the development and spread of AMR.

D-Lab's observational data around the bacteria's pathways within the households were meant to complement the study's evidence on the presence of resistant bacteria in the biological samples inside the households. Former D-Lab researchers illustrated the underlying logic to me. Ivan, a laboratory technician in the Kampala field site, described the following hypothetical scenario, in a conversation we had in November 2021 in Kampala: D-Lab could find resistant bacteria in a water sample as well as in a human faecal sample taken both in the same compound. In the same household, a field assistant could, for instance, have observed that someone had been drinking the water from which the sample had been taken. This would provide a direct link between the water sample and the human faecal sample. Or else, the field assistant might have observed that a resident had washed plates using the water from which the sample had been taken, and the plates had not dried before being used to serve food, thereby offering a pathway for the bacteria in the untreated water into the digestive system of study participants. Ivan went on to explain that the pathways could also be more complex involving for example, animals living in the household: a goat being kept inside the compound could drink the untreated water, and children could play closely with that animal, allowing for the bacteria to travel from the animal into a child's digestive system. Observational data around WaSH practices served as a potential means to understanding how the bacteria in the samples might be related (and by extension, how the pathway between the two samples could be interrupted).

Ivan took the ubiquity of bacteria in environments, and in and on bodies of human and animals as a starting point and explained to me in detail the multiplicity of ways in which bacteria became resistant. He complicated the narratives of transmission pathways by adding the possibilities of horizontal

gene transfer. [98] He explained that the resistant bacteria did not simply travel in between humans, animals, and the environment, but that it was also possible for them to exchange the resistance encoding genes through horizontal transfer with other bacteria that are not resistant yet. This possibility increased the chances of spreading the bacteria's ability to resist antimicrobial medicines, first within households and then within communities. In an interview in December 2020 that we did over the phone, he explained:

> 'So I believe if someone has picked a resistant bacteria, from…, from wherever he has picked it from, I believe it will be spread throughout the entire household through such a mechanism, such as through conjugation[99] […].
> So if only they [the bacteria] are collaborative in a way, that if a bacterium has gotten this resistance gene, it has to pass it on to other bacteria that don't have it, so that they also survive, so through the ways that I talked about, the horizontal and the vertical, the horizontal, through conjugation, transformation and transduction […]. So the more we get into physical contact, and we spread bacteria to each other, that's when these bacteria multiply. The bacteria you have, if I get in contact with you, my bacterium will spread those resistance genes to the bacteria that you have and then that continues. And then the entire community, in the long run, will have resistance against that drug.'
> [transcript from phone interview with Ivan, 3.12.2020]

Tracing the transmission of bacteria was, according to Ivan, not only about understanding how bacteria travel to and between bodies of humans and animals in the environment. Through horizontal gene transfer, bacteria could also share resistance encoding genes and thereby render more bacteria resistant (Podolsky 2018). The possibility of horizontal gene transfer makes the (potential) transmission routes of AMR substantially more complex, as those

[98] Ivan explained to me what mechanisms there are for bacteria to share and spread resistance encoding genes: 'there are several ways, and usually we define them through horizontal and then vertical. So horizontal ways, remember, bacteria have plasmids that can carry these resistance genes. And these plasmids can be carried from one bacteria to another through mechanisms such as conjugation, transduction and transformation [..]. Yea, that's the horizontal. Then the vertical, is when that bacteria, you know, multiplies, and all the daughters have gotten that resistance' [transcript from phone interview with Ivan, 3.12.2020].

[99] In a recent publication, Virolle et al. (2020) describe conjugation as follows: 'Bacterial conjugation, […], is a major horizontal gene transfer mechanism through which DNA is transferred from a donor to a recipient bacterium by direct contact.'

routes are no longer just about bacteria. They also include the routes of separately travelling resistance encoding genes that are shared in between bacteria, even across different species.

For D-Lab, the observational data around the pathways of bacteria within the households of their study participants not only served to understand the spread of AMR, but also offered possibilities of intervention. When I asked the former D-Lab researchers what they expected the study's policy impact to be, often in the first instance, they spoke about measures relating to water, sanitation and hygiene as a means to interrupt bacterial pathways and thereby the development and spread of AMR (for a more detailed analysis of the prominence of sanitation as a means to interrupt transmission of bacteria in public health, see chapter 5 on One Health). Hand washing with soap for example, Ivan told me, kills bacteria, and thereby prevents them from travelling further and from exchanging genes with other bacteria they might get into contact with. If observations within households like the exemplary transmission routes above occurred multiple times so that patterns of transmission became clear, an intervention strategy would target those bacterial pathways.[100] In the scenario above, this could be for instance policies about treating drinking water, using drying racks for plates, or increasing the physical distance between humans and their animals (all examples come out of conversations with field assistants). WaSH served to imagine potential interventions to disrupt the bacterial pathways. The researchers' imaginaries of D-Lab's impact circled around WaSH as a means to unstitch the pathways (of resistant bacteria or the genes that encode resistance) that the WaSH tools had made tangible.

It was not only imaginaries of future interventions to reduce the threat of AMR which circled around WaSH practices; but during the study's rollout, D-Lab also immediately intervened into the WaSH practices of their study

[100] Multiple times during my fieldwork I heard from the D-Lab researchers that they expected identification of such patterns to come out of the agent-based models which would build on all of the collected data to make predictions about where to best interrupt the pathways of bacteria. However, the models' output never made an appearance during my time with D-Lab in Uganda. Although invited, no one from the modelling team presented at the study's dissemination meeting in March 2023 in Kampala. The presenters still mentioned the models during the meeting and stated that the evidence would be brought together from the various different work strands and data sources at an unspecified point in time in the future.

participants. Field assistants handed out WaSH items (wash basins, jerrycans, bars of soap, and powdered soap)[101] as the compensation for their participation in the study. Although they had planned to compensate the study participants in cash, they switched to handing out these items during the pilot testing week to ensure the money went towards something they considered useful.[102] There was not much discussion about what an appropriate compensation could be, the researchers quickly landed on WaSH items, which fitted the theme of the study and served as tools to improve the WaSH practices of the households. Handing out soap as compensation for study participation in global health studies is a common practice, with which both the researchers and the study participants will likely have been familiar (see e.g. Biruk (2018), in particular chapter 3 on 'clean data, messy gifts'). After the end of the data collection, field assistants mentioned to me that the study participants had 'generally appreciated' the compensation in WaSH items.

Through the change in compensation, it became clear that the field assistants understood their role in relation to the study participants not only as researchers who came to the households to fill out forms, observe, count, or understand. Entering the households with the education they had, they felt a

[101] In my field notes, I did not specify the exact compensation. I asked Francis over WhatsApp and he recalled that the compensation for participation for households in which the field assistants had not done the WaSH observations included a washing basin, one bar of soap, and 500gr of powdered soap and for the households in which they had done the additional WaSH observations, the compensation included an additional jerrycan, and an additional bar of soap.

[102] The change of strategy came about early on during pilot testing work. The team had given out the 25 0000 Ugandan Shilling (about 5 GBP) in cash on the first day of pilot testing. (For reference, 300-500 Shilling was the price of a jerrycan of water. One kilogram of cassava flour cost about 1500 Shilling. A meal in a restaurant at the side of the road, usually beans, peas or groundnut sauce and a few starches, usually cost 4000 Shilling). When they returned the next day to pick up faecal samples in little plastic tubes, it turned out that the household head had given 500 shillings to a few of the other adult household members, his sons and daughters in law, but had kept the rest of the 25000 for himself. As they explained to me what had happened, the D-Lab staff laughed wholeheartedly at the absurdity of giving out as little as 500 shillings coins, but they were particularly concerned that the money would not end up where they considered it most useful. The old man was drunk when we were at the household and showed us the clear, locally distilled schnapps he was drinking from a reused plastic water bottle. The D-Lab staff expected all the money they had handed out to go into his alcohol consumption and they foresaw this being a pattern in the households yet to be recruited. There was a consensus that they wanted the money to be shared among the household members and the value of compensation to go where they considered it to be more useful. The issue of compensation came up briefly during that day's meeting, and after a short discussion there was agreement that giving out items relating to WaSH instead of the cash would be a solution to their problem.

moral obligation to provide their participants with something in return that would make their lives a little bit easier. The field assistants did not expect changes on a structural level with regards to, for example, the water infrastructure. Giving out WaSH items seemed like a good starting point. When I spoke with Steven in March 2023, who had been a field assistant in the Hoima field site and the lead of the Hoima team, about the study three years after this pilot testing week, he told me that the study participants often asked about things they could do to limit the risk of resistant infections in response to him and his colleagues explaining what D-Lab was about. The handing out of WaSH items was not the only intervention. Steven and the team would do what he called 'sensitisation', they told the participants about WaSH practices, about setting up a hand washing facility inside the household and about the reduction of infections. Steven talked about these interventions and did not see them at odds with the study being observational. Sharing this knowledge and handing out the WaSH items was the price of doing the observations, he clearly felt like they owed it to the participants.

D-Lab's approach to studying water and sanitation stabilised a specific terrain of interventions. This terrain sets out specific measures to improve sanitation in the residents' homes in order reduce the chances of infections with resistant bacteria. The kind of interventions that will follow from the study are written into the data collection tools – recording sanitation practices and counting the number of times residents washed their hands is only relevant if those practices are of interest to understanding the drivers of AMR and therefore ought to be intervened upon. The field assistants not only expected the study's impact to circle around such interventions, but they already started intervening into residents' sanitation practices by providing advice and guidance and through handing out the WaSH related items as compensation for participation in the study.

Water and sanitation in D-Lab's western Ugandan field site

D-Lab's data collection happened in the specific contexts of their field sites. D-Lab conceptualised the households in which it collected data on AMR and WaSH related practices as bounded units, however, as I argue in chapter 3

on standardisation, they imposed the boundaries for the sake of the study. Not only were humans, animals, (and microbes) circulating freely crossing the ostensible boundaries, the households were also situated in a broader environment emerging from a set of historical, social, economic, and ecological factors. In its attempt to understand what drives AMR not in the particular settings in which they were collecting data, but in standardised interchangeable settings, these factors were bracketed out of D-Lab's study. Neely and Nading, in their article on place-based research, argue that an 'emphasis on the body has meant that too little attention has been paid to the environments […] and the people who lie outside the spaces of biomedical intervention and that shape the places sick and healthy people inhabit' (Neely and Nading 2017, 56). Following this invitation to attend to the places of global health research, this section links the study to one of its field sites.

I trace how D-Lab's conceptualisations of WaSH and AMR and their graphic depiction of the community's bacterial pathways mapped on to their field site in Hoima in western Uganda. I attend to two spaces in particular, the water stream that crosses D-Lab's field site, and the Hoima Regional Referral Hospital. I portray these two settings and factors that shape their microbial landscape which lay outside the scope of D-Lab. These insights emerged from my engagement with D-Lab in Hoima, in particular with Robert, who had worked as a field assistant in Hoima and still lived there when I came back, and our visits to the field site and the water stream. An extensive tour of the hospital's water and sanitation infrastructure with the head nurse responsible for infection prevention and control programmes at the hospital, and a series of interviews with other experts working on WaSH in NGOs, and the National Water and Sewage Cooperation (NWSC) further inform this section.

Water in Hoima

Through interviews with experts working in NGOs and in the NWSC, a complex mosaic of water infrastructures emerged. There were boreholes and shallow wells that residents drilled to access groundwater, there was a water stream running through the region, and there was piped water supplied by the NWSC. When I interviewed Alice, a quality assurance officer working at Hoima's water filtration plant, she explained to me that NWSC pumped up

water through six boreholes and then aerated, filtered, and disinfected the underground water. There was no microbiological testing available, but the disinfection process made the water relatively safe, she told me. Other groundwater, she said, though it might look safe and clean to the residents might be contaminated since pit latrines in the region are often not lined (for example of ground water sources, see Photographs 17 and 18). Home-based treatment of water, such as boiling, made it relatively safe but she told me that many did not know groundwater could be contaminated, and through other interviews, I kept hearing that residents could not afford to spend their limited resources on water treatment.

NWSC's supply of treated water was limited. The population had doubled since the water filtration plant first was first put to use in 2006[103], and it could not keep up with the demand. Not all areas were connected and even if there were water pipes, for many it was prohibitively expensive. Alice added that it was also unreliable. NWSC had to ration the water supply throughout Hoima, she explained 'everyone needs water, so everyone gets some'. They pumped water to different areas of Hoima at different days of the week. Alice explained that the schedule helped to keep residents at peace, the predictability helped them manage the situation better. Though the hospital had a particularly high priority, they had to cut off the water supply after a few hours in the morning. Even the rationed schedule was not always feasible since the water filtration plant depended on a constant supply of electricity to fill its tanks that was not always available.[104] The unreliability made residents look for alternatives, and Alice commented on that in an understanding manner: one cannot tell people not to use their source of water if one does not offer a feasible alternative. To increase the amount of water available through NWSC,

[103] This is in line with official numbers as reported on the Ugandan Bureau of Statistics, with the population of Hoima town increasing from 60,561 in 2002 to 122,700 in 2020 (Uganda National Bureau of Statistics 2022).

[104] Alice told us it would take about 12 hours to fill up the tanks, but that that was only possible with a stable supply of electricity. To get 12 hours of uninterrupted power was the exception rather than the rule, so it usually took more time. That night, the city centre's supply to water got cut off and would not turn on again before the next morning. Heavy rains lasting the whole day had caused particularly long power outages, the pumps were probably not turned on for long enough to fill up the tanks, I realised, failing to turn on my tap in my guest room that night.

construction was underway for two more aerators and two more filters for the region.

Photograph 17. Well maintained spring well in Hoima (19.1.2022)

Photograph 18. Spring well with goats grazing around, car wash station partially visible on the left, in Hoima (19.1.2022)

Photograph 19. Water fetching at a spring well with make-do water pipe construction in Hoima (19.1.2022)

An open water stream

For household usage, many of the residents particularly in the more rural areas, relied on untreated water from nearby sources such as water streams, which D-Lab had included in its community graphic as well as in the transect walks. I learnt about the water streams from Robert, a former field assistant of D-Lab. The chapter's opening vignette is an excerpt from my tour of the Hoima field site in January 2022 with him. Robert was in his late thirties and had started a job with the government right after his contract had ended with D-Lab, which made him stay in Hoima. We drove through the study's former field site with his car. He had an intuitive understanding of what I wanted to understand and see, and why it was insightful for me to not just speak with him and others about their work with D-Lab but also to go to the very places they had been working in. During our tour of the field site, it became clear that Robert knew the area intimately. He had a sense of the streets and their conditions, and people greeted him wherever we went. Robert led me into a few of the enrolled households and introduced me to the residents

that he had become familiar with. We walked along the transect routes, passing by wells and boreholes, car washing stations and waste dumping sites. We spoke about D-Lab and his experience of working as part of the project, and about water and sanitation and bacterial pathways in this setting in Hoima.

Robert showed me the path of the transect walk and sites where he had taken samples for D-Lab. As we were standing next to a water stream, the same one that passed the waste piles further downstream and described above, he pointed me to the cyclical nature of bacteria's pathways. He directed my attention to dried up cow dung at the stream's edge, which was likely contaminating the water with *e.coli* from a cow's guts. He went on to tell me that the water from the stream would end up in nearby households, that people would come to fetch water from around here, paving the way for the bacteria to enter the residents' homes. He knew this, because he had asked about the study participants' water sources as part of one of the questionnaires, and the water stream had been mentioned by nearby households. While we were looking at the water and following its movements, a teenage boy passed by with a small herd of cattle, about ten of them, and he led them to drink from the stream. They urinated into the water too. As we were leaving, somebody arrived by bicycle, packed with eight jerrycans. He filled them up with water to bring them to the nearby households. It felt like they were illustrating Robert's narrative, making sure I understood how the water, and the bacteria it contains, connects the various parts of the community.

Photograph 20. Water stream with a herd of cows coming to drink and a man washing his motorcycle in Hoima (19.1.2022)

Robert's way of answering my questions made me think that I was asking for what was obvious to him. He spoke about waste piles and why they would accumulate at the stream. He also spoke about how the rainy season affected the water, with rain sweeping down dirt from the streets into the drains. Despite his understanding of the intricate relations of the community and the landscape in which the study was unfolding, Robert had been hired only to work with the pre-designed data collection tools. His input into D-Lab was limited by the set-up of the study and the tools through which it had made its data. The study's data did not explicitly include his intimate knowledge of the space, and the ways in which economic circumstances, animal husbandry, waste dumping, seasonal fluctuation, or landscape regulations were entangled to shape the microbial landscapes (for more detail on the ways in which the Ugandan researchers' insights were not included, see chapter 4 on precarity). Robert was neither surprised about how residents related to, and engaged with, the water stream, nor about D-Lab's approach that did not include questions around these relations. He embraced the study's approach of

focussing on the behaviour of individuals despite everything he knew, broader, more structural changes felt out of scope to him.

Water and sanitation in Hoima's Regional Referral Hospital

In my quest to understand the local context of water infrastructures and relations to infection prevention in Hoima, I also visited the Hoima Regional Referral Hospital to understand its water and sanitation infrastructure. Although the hospital does not feature prominently in D-Lab, one of the study's target organisms, *k.pneumoniae*, mostly causes nosocomial infections (i.e. infections acquired during the process of receiving care at a health care institution) and the other one, *e.coli*, is both known to be community-transmitted and nosocomial. The bacteria that D-Lab looked for (and found) in the samples taken from its study participants in their households in the Hoima field site were possibly related to nearby health care institutions, such as this large hospital centrally located in Hoima town. The microbial landscapes of the hospital likely related to the microbes in the community, as even D-Lab's own graphic depicts.

With a capacity of 300 beds, the regional referral hospital is the largest hospital in the region. Its catchment area extends into the neighbouring districts and even across the national border into the Democratic Republic of Congo, catering for a population of about 3 million people (Uganda Ministry of Health 2019). The hospital was built around a large compound with separate buildings, each marked as a separate ward, with signs indicating the paediatric unit, a building for ophthalmology, maternal and child health, etc. The buildings were added at different times over the past decades, after it was first opened in the 1930s. Early in the morning, the lines of people waiting to be seen by a medical professional were particularly long. Once admitted to the hospital, patients stayed in crowded wards, many of which had no glass in the windows. The doors were open, air circulated freely. Patients' attendants - usually family members who provided care, brought food and medical supplies, washed the patients' cloths and bed sheets - stayed in or around the patient wards or were resting in the shade that the small number of trees provided. There was a little pharmacy on the compound too, a private business, selling medications and supplies that the public hospital could not provide for its patients.

Sister Lydia was the head nurse at the hospital and responsible for the infection, prevention and control (IPC) programmes at the hospital. Lydia welcomed both Darlian[105] and I into a newly built part of the hospital, and later told us it had been built with money from an American funder. The flat, bungalow-like building had not been there in March 2020 when I was last there, and the contrast to the run-down buildings that formed other parts of the hospital was striking. She led us into an air-conditioned meeting room with desk chairs, large TV screens and an elaborate audio set up for remote group meetings. She knew about D-Lab's laboratory part of the study, as D-Lab's samples from the Hoima field site had been stored in the hospital laboratory before being shipped to Kampala. Sister Lydia told us that AMR had been a topic at many meetings in the hospital recently, and she talked about guidelines concerning the use of antibiotics, and particularly the advice to restrict prescriptions.

The guidance for clinical work in Uganda, published under *National Guidelines for Management of Common Conditions*, includes a section on AMR, which might be what Sister Lydia was referring to. The guidelines specify that as AMR is spreading quickly, certain measures need to be taken, including 'Using antimicrobials only when it is really necessary and according to recommendations (e.g. not for simple viral infections!)' and 'Avoiding using last generation and broad spectrum antibiotics as first-line treatment' (Uganda Ministry of Health 2016, 42). In a section titled 'prescribing guidelines', the guideline further asks health care providers to 'not practice multiple medicine prescribing (polypharmacy), especially when the diagnosis is uncertain. It is a tremendous waste of resources and puts the patient at increased risk without clear benefit' (Uganda Ministry of Health 2016, 43).[106] Sister Lydia pointed out how the hospital's laboratory is continuously understaffed and lacks the reagents so that she cannot send in patients' samples for more specific diagnosis or sensitivity testing. The guidelines frustrated her, and she

[105] As I describe in chapter 2 on methods, Darlian supported me in this phase of my fieldwork in Hoima.

[106] The guidelines were updated in 2023, the sections cited here did not change (Uganda Ministry of Health 2023, LVII,LIX).

rhetorically asked: 'so you wait until the patient dies before you administer an antibiotic? Of course not.'[107, 108]

Sister Lydia offered to show us around the hospital compound, and in particular the water and waste management system, for me to understand the structures that they had put in place to prevent the spread of infection on the hospital compound. We left the air-conditioned new building and began the tour at the hospital's water storage tanks. Behind the largest hospital building, she showed us a metal construction holding large black tanks: those tanks stored water that the hospital received through the city's water pipes. Next to those tanks was a grey cemented cylinder-shaped structure containing a pump and another tank for water the hospital had pumped up with its own pump. The two sources made water available when needed, either source could fail but rarely did they both fail at the same time, Lydia explained.[109]As we walked through the compound, Lydia pointed me to pipes, showing me where they would usually get blocked and which ones had been replaced recently. Water shortages and irregularities in the supply were expected at all times as explained by the NWSC water quality assurance officer,[110] so they had put this infrastructure in place.

[107] In the section on AMR, the guidelines also describe sanitation measures, including 'practicing strict measures of infection control in health facilities' and 'improving hygiene and sanitation in the community, thereby reducing the circulation of germs.' Sister Lydia did not mention these parts of the guideline, they might have appeared obvious to her, as she was invested in improving hygiene and sanitation at the hospital.

[108]A recent study on the adherence to clinical guidelines on antibiotics prescriptions in Eastern Uganda found that health care providers did not adhere with the guidelines when prescribing antibiotics in over 80% of patient encounters (Obakiro et al. 2022).

[109] While such patchwork infrastructures have long been criticised, a recently published article embraces this approach. In their article on sanitation infrastructures in Kampala, Lawhon, Nsangi Nakyagaba, and Karpouzoglou (2022) present evidence on the patchwork nature of sanitation infrastructure in Kampala. They make the case for a 'modest imaginary' – an imaginary that does not take modernity (e.g. in the shape of a sanitation system which provides everyone, everywhere, at all times with flushing toilets) as its teleological object, but one that allows for alternatives to emerge, embracing the patched-up nature of the urban sanitation system.

[110] A video published by COU Family TV in June 2023 reported on a 'Crisis In Hoima Regional Referral Hospital As National Water Cuts Supply Over Debts'. In it, a reporter says that NWSC cut the hospital off its supply entirely since it had accumulated a debt of over 150 Million Ugandan Shilling (about 31,500 GBP), and that the hospital now relied on collected rain water (COU Family TV 2023). This recent crisis illustrates the unreliability of water supply.


Photograph 21 & 22. Water infrastructure in the Hoima Regional Referral Hospital, large water tank (7.12.2021); Additional water storage to supply the Hoima Regional Referral Hospital (7.12.2021)


Photograph 23 & 24. Head nurse pointing to water pipes in the Hoima Regional Referral Hospital (7.12.2021); Water pipes supplying the Hoima Regional Referral Hospital (7.12.2021)

From there, Lydia led us to pit latrines next to the paediatric ward. On the way she greeted all the other nurses, thanking them for their hard work. The smell of the latrines was intense, I found it hard to enter and was grateful my mask was covering my face, making it easier to hide my disgust. Somebody was cleaning the toilets while we walked in, using a floor squeegee pushing faecal matter into the drains.[111] Though the smell was impossible to not notice, it was not brought up, like a loud background noise that everyone was familiar with. Sister Lydia seemed content about the state of the latrines and mentioned how it had improved recently. She told us that she and her colleagues had started doing regular education sessions for patients and their attendants, in which they taught them about the importance of sanitation, including handwashing and littering. As part of these sessions, they had started asking patients to bring toilet paper instead of natural materials like leaves, which blocked the drainage pipes. She told us that some patients could hardly afford to buy their drugs, so that buying toilet paper seemed like a waste of money to them, but Sister Lydia insisted on it.

There was a hand washing station in front of every ward: a lidded blue bucket of water with a fixed tap at the bottom, and liquid soap. In passing, Lydia pointed her finger at one, a part of the infrastructure of IPC that she had implemented. The liquid soap was delivered every other month, but they always ran out before the next shipment. Lydia and her colleagues diluted it before the next shipment would arrive. They had tried using chlorine instead but stopped because of skin irritations. During earlier phases of the COVID-19 pandemic, the hospital also received donations of hand sanitiser, but that was no longer the case at the time I met her in December 2021, and they could not use the sanitiser where they needed it most. Strict donor guidelines meant it had to be put to use a certain way (she only specified that the sanitiser was distributed by Baylor who operated under the CDC which meant that 'there are strings attached'), and she could not use it in the handwashing facilities in

[111] We walked into the latrines' stalls with our shoes on, which we also then walked with through the hospital compound, like everyone else. I could not shake off the idea that I had faecal leftovers stuck on my soles that I would now disperse into the hospital and then later into town. The tour around the hospitals, and the sustained efforts to control the spread of infection made the presence of microbes feel urgent.

front of the wards. She did not sound annoyed about this, it was an ordinary situation that she still deemed interesting for me.

In the paediatric ward, the beds were so close to one another we could hardly cross the room. Guardians were curled up in beds next to their ill children, some of whom were on ventilators. The door to the surgery, a small room next to the ward, stood open and Lydia showed us the tap, opening it to demonstrate that the water was running, and pointed to the liquid soap next to it (see Photograph 25). The surface of the patient bench had cracks in it, there was no way it could be kept sterile. But Lydia directed my attention instead to another recent improvement: in the surgery, there were three open bins to separate waste according to their levels of infectiousness - non-infectious, infectious, and highly infectious (see Photograph 26). Later, outside, she showed me that the different bins corresponded to doors at the final waste disposal site of the hospital (see Photograph 27). In an incinerator they burned the infectious and highly infectious waste. Syringes and other such things were kept in cardboard boxes next to the incinerator, to be picked up every other week and brought to a special waste disposal site. Dry rubbish, including bottles, paper wrappings, drug cartons, other plastics, were burnt behind the building (see Photograph 28).

Photograph 25. View from inside a paediatric surgery room, sink with soap, and reminders to practice hygiene (on the wall there are multiple notes

referring to hygiene (one says 'Stop sepsis today!!! Stop sepsis and use hand sanitiser today'; another one describes a 'good hand washing technique'; a third one to the right, issued by the Ministry of Health, provides instructions on how to separate medical waste) (7.12.2021)

Photograph 26. Open bins labelled with 'non infectious', 'infectious', and 'highly infectious' in paediatric surgery room (7.12.2021)

Photograph 27. Waste management site on the compound of the Hoima Regional Referral Hospital, sections for 'non infectious', 'infectious', and 'highly infectious' waste (7.12.2021)

Photograph 28. Burning of non-infectious, dry waste on the compound of the Hoima Regional Referral Hospital (7.12.2021)

Sister Lydia worked to decrease the risk of infection and contagion, including resistant infections, in a highly crowded hospital compound with an unreliable water and soap supply, and deteriorating building conditions. With her colleagues, they diluted the soap so that it would last until the next shipment arrived, and implemented a waste sorting system decreasing chances of contagion. She knew the space, its water and waste infrastructure, and her patients' background well. According to her, what they needed on top of a reliable supply of basic amenities, medicines, and laboratory capacity, was, for example, more trees in the compound that would provide shade in the afternoon, so that attendants could rest there, and the wards would be less crowded. Instead, intermittent donor support funded things like air-conditioned buildings that could not be used for care provision, that patients did not even have access to, or provided sanitiser that they could not make good use of. The hospital authorities could not funnel the money where it was needed the most and could not change the water infrastructure beyond the hospital compound. Instead, Sister Lydia and her colleagues had to rely on the patients' and their attendants' collaboration, and had therefore started efforts on patient education, highlighting the importance of washing hands, and using

toilet paper. Here, the focus on individual responsibilities and awareness did not come from a place of ignoring the circumstances but rather as a last resort after having tried to improve the conditions of the hospital.

Individual responsibility around water and sanitation

D-Lab staff studied the WaSH practices of individual residents within their household as potential drivers of AMR.[112] This approach stood in sharp contrast to the perspectives of regional WaSH experts and D-Lab's own field assistants who understood water and sanitation in much broader frames of reference.[113] Those experts spoke about water and sanitation in relation to limited resources and widespread poverty, population growth, or intermittent donor funding. An NGO worker who had spent close to a decade working on water and sanitation, told me that many families did not have the means to afford a pot big enough to boil their water, or that they might not be able to afford to use the little water they had to wash their hands every time they touched something potentially dirty[114]. He also spoke about the gendered labour of fetching and treating water as an important factor shaping the water and sanitation situation in residents' homes.[115] Interventions that the NGO worker supported included programmes which he expected to improve the economic situation of families and thereby their access to safe water [interview with male NGO worker , 20.1.2022, Hoima]. Another NGO worker spoke about the importance of decreasing the households' distance to water sources and the

[112] In D-Lab's protocol they refer to the 'Integrated Behavioural Model for Water, Sanitation and Hygiene', designed to work in 'infrastructure-restricted' settings (see Dreibelbis et al. 2013). This suggests that the study's authors consider the attribute of 'infrastructure-restricted' to be descriptive of the settings under study and to be an attribute that is stable, to be taken as a starting point rather than a question to be addressed.

[113] After a trip to Hoima in which I interviewed some of the WaSH experts, I met Rebecca back in Kampala. She asked me what I had come to learn and seemed to appreciate the WaSH experts' insights and found them relatable. She started talking about the village where her father was from. Food was often insecure, she told me, the rain had become unpredictable and often people had to go to bed hungry. She said that means were so limited that very few could afford to think about hand washing, she did not expect D-Lab to find out about such things.

[114] In his dissertation, Alade (2022) argues that many Nigerians resisted preventive health measures introduced by British colonial administrators in the early 20th century, in part because they were not able to afford them, which in turn shaped public health development in Nigeria.

[115] This is in line with de Wit et al. (forthcoming), who in their article on the WaSH sector, describe how the 'gender-in-WASH agenda' had 'encouraged women to become key active participants in water management', and 'later received pushback from feminist scholarship about the essentialising effects of such discourses that, instead of liberating women and giving them more control and autonomy, placed [an] ever-greater burden of their workload.'

need for more boreholes to be drilled [interview with female NGO worker, 17.1.2022]. In the hospital, Sister Lydia showed us the parallel water systems they had set up to increase the availability of water, the waste sorting system which decreased the chance of contagion from infectious waste, and she told me how they diluted the liquid soap to ensure there always was *some* soap available.

Insights into the social and economic lives of residents, into infrastructures of water, waste, and electricity and how these related to the (microbial) landscapes did not deter my interlocutors from highlighting the importance of WaSH practices of individual residents or patients. Sister Lydia even led patient education sessions, aiming to improve the sanitation practices of patients and their attendants in the hospital. And D-Lab's field assistants, including Robert who showed me around the Hoima field site, handed out WaSH items to their study participants and told them about the importance of hand washing. Robert and Sister Lydia knew the context well in which residents or patients ended up washing (or not washing) their hands. To them, altering this broader context laid out of scope. In line with my interlocutors' perception, a WaSH expert interviewed by de Wit et al. similarly described the development of such approaches, writing: 'Behaviour change approaches emerged as a low-cost solution to the failures of technological interventions and gaps in infrastructure. Centralised water treatment systems were too expensive and benefits would accrue only in the long-term, hence quick-fix solutions were proposed and sought in participation and health education, in behaviour change approaches and in household water treatment that was pushed in the 2000s' (de Wit et al. forthcoming).

There are ample critiques of global health approaches that focus on the behaviours and practices of individuals in the area of WaSH and beyond. De Wit et al. in their paper on the WaSH sector describe this process as individualisation and responsibilisation, tracing it back to 'the early 1990s, when epidemiological questions began to inform the study of human "hygiene behaviour" as a factor to overcome WASH-related disease transmission'. The attention to behaviour 'appeared to overlook the socio-economic and environmental conditions of the recipients upon which the practice of "hygiene" is dependent' (de Wit et al. forthcoming). Others have argued that

the attention to individual behaviours not only overlooks but actively obscures structural harms (Nabirye et al. 2021). Instead of attending to the structures, attention focuses on how people behave in the particular context in which they live, and global health mistakenly ends up framing the people and their practices under study as irrational, irresponsible, uneducated, or deficient in some other way (Nabirye et al. 2021, 3; Li 2007). As Anderson argues in *Colonial Pathologies,* interventions on hygiene also serve to create a racial hierarchy where the local population - in this case, in the Philippines - are portrayed as not only 'primitive' but also unclean (Anderson 2006).

More often through a focus on the use of antimicrobial medicines, rather than relating to sanitation behaviours, global health has rendered AMR into a behavioural issue in need of interventions on beliefs and behaviours. In their article on 'The politics of irrationality' taking the case of antibiotic use of chicken farmers in the suburbs of Kampala, Denyer Willis et al. lay out how the centring of apparent irrationality of individuals, in whose lives global health aims to intervene, does 'maintenance work' for the global health apparatus, keeping up the structures on which global health relies (Denyer Willis, Kayendeke, and Chandler 2023, 3). Global health depends on individuals needing intervention, so it can continue to provide it. The turning away from political neglect and infrastructural concerns stabilises a terrain of intervention, and thereby flattens the political, social but also biological and ecological landscape.

Conclusion

Since the advent of philanthropic funders and the introduction of strict evidentiary requirements, have small scale interventions geared towards changing individuals' behaviours become central to the operation of contemporary global health (Schmidt 2014). In the area of WaSH, this focus often translates to efforts of improving hygiene practices of individuals while disregarding the water or waste infrastructures that these individuals rely on (McMillen 2021). Despite AMR's well-known complexity, it often comes to be framed as an issue of behaviours of individuals too, including WaSH behaviours (Hinchliffe 2021).

In this chapter, I embed my analysis of the D-Lab study, particularly its work on WaSH as potential driver of AMR into the context of its Hoima field site. The study assessed individual WaSH practices, such as hand washing and food hygiene through a set of observational data collection methods. These observational data were meant to allow for the tracing of bacterial pathways through the households of their study participants, and thereby provided D-Lab researchers with insights into the connection between the bacteria they found in their biological samples. D-Lab researchers imagined that interventions informed by the study's data would also circle around WaSH practices. Changes in water infrastructures that would decrease scarcity of water, or other more structural concerns seemed out of scope.

In contrast to D-Lab's approach, I was confronted with perspectives on WaSH and bacterial pathways in much broader terms of reference at my site visits in the D-Lab's Hoima field site. Access to piped water was unreliable, and unaffordable to many, so that residents had to rely on other sources of water. These other sources provided untreated water only, and few had the means to boil or otherwise treat the water. The population was growing quickly, and the water filtration plant could not keep up with the growing demand. Robert, a former field assistant of D-Lab, led me through the area and laid out to me a complex set of factors that shaped the region's water stream from which nearby residents fetched water. At the regional hospital, the head nurse showed me how they managed infection prevention and control in the context of water and soap scarcity. WaSH experts who worked in the region of D-Lab's Hoima field site understood WaSH challenges within much broader terms of reference, laying far beyond individuals' sanitation practices.

The researchers who designed the D-Lab study of course knew that their study participants in Hoima were mostly poor, and could likely not afford to access piped water, and that the local water infrastructures were likely unreliable. They still chose to investigate WaSH practices within the household as a means to understanding the development and spread of AMR. Broader concerns such as political neglect, poverty, and infrastructural challenges lay outside D-Lab's scope. D-Lab's did not seek engagement with experts on WaSH and sanitation in the region. With the exception of the head nurse at the hospital, the experts on WaSH that I had a chance to learn from during my time

in Hoima, had not heard of D-Lab. Sister Lydia knew of D-Lab's work as well as of other projects on resistant bacteria, but they did not ask her about her perspective on AMR and its drivers. D-Lab' data collection apparatus was geared towards the production of narrow, numerical data and did not allow for the investigation of broader concerns.

My engagement with WaSH experts in Hoima, and their perspective on water and waste, and the microbes they contain, allowed me to unpack what D-Lab chose (not) to investigate. AMR is an ecological event, happening in our environments and in our bodies (Landecker 2016). Not only past usage of antibiotics but also 'other aspects of industrialization may be driving antibiotic resistance indirectly; exposure to heavy metals or disinfectants can drive the same gene exchange processes in soil bacteria' (Landecker 2016, 40). Hoima's water and waste infrastructures shape the regions bacterial composition. To focus on sanitation practices of individuals pulls away attention, and funding, from understanding and addressing more structural concerns. D-Lab, and global health more generally, stabilises a terrain of intervention, geared towards changing the behaviours of poor individuals. In the process, they write out the very context that my interlocutors knew made the residents sick in the first place.

Conclusion

> So, I'm saying, what may make the risks become bigger is that the space is reducing in terms of land. And then the population is continuously increased. That means people are going to start keeping the animals in quite limited spaces. Now, when there is limited space, the degree of interaction increases within the animals themselves. (E: of course) and then there are also getting more to interact with a number of contaminants. Some from their own refuse, and others from the environment. So that means that the chances of exposure to pathogens increase. (E: yes). And so, when the chances of exposure to the disease agents, causing agents, increase then that means that the attempts of subjecting these animals to drugs, say anti-microbials, is also going to increase. (E: yea, of course). But remember all this is increasing but without an increase oversight, in supervision in who does what, and what type. So, that means that the resistant bugs are going to develop say from the animals they get discharged to the environment, from the environment they can come back to the animals, they can come back now to people from the environment, or to people, cross-over to people from animals or from the environment. (E: yea) So, in summary, the risk for development of anti-microbial resistance is projected to increase exponentially in the near future. Especially in our communities that live under small economies. Where a farmer would do, would make all efforts to take full charge of the animal in terms of nutrition, in terms of healthcare, and all that because he does not have an extra coin to pay for this other service.
> [Transcript from phone interview with Jamil, 16.2.2021]

Anti-microbial medicines have 'moved […] into the fabric of lives and healthcare systems around the world', they constitute an 'infrastructure' that our lives depend on (Chandler 2019, 9). These medicines prevent and cure infections globally, in humans, animals, and even in agriculture. They act as a 'quick fix for care, productivity, hygiene and inequality' (Denyer Willis and Chandler 2019) thereby enabling life as we know it. Their use has changed our microbial landscapes irrevocably, as the microbes including bacteria, fungi, and viruses in our world continue to find ways to evade the effect of these drugs (Landecker 2016). In the early phone interview cited above, Jamil, a

veterinarian by training, paints a grim future of AMR, in which land use, animal husbandry practices, animal-human-environmental relations, economic concerns and political developments produce increasing risks of AMR.

Jamil's predictions regarding the impending increase in AMR are in line with much of global health research and policy around the issue. Within global health research however, the focus is more on AMR's global reach, and its implications for global health security. In response, there has been a growing effort of global health research on AMR. As laid out in the introduction to this thesis, a myriad of entangled inequalities shapes microbial landscapes across the globe, as well as possibilities of diagnosis, care, and surveillance (see for example, Kirchhelle et al. (2020)). Despite these complex configurations and the resulting multiplicity of AMR, global health tends to frame it as a global, coherent object. It measures and counts AMR, producing metrics on its spread and impact. The making of AMR into this coherent object (which can be counted) in global health research is the topic of this thesis.

In the introduction to the edited book *Metrics: What Counts in Global Health*, Adams stresses the importance of ethnography in global health; she writes, 'ethnographic research – because it enables a focus on single cases in all of their singular and idiosyncratic complexity but also because it enables a focus on other kinds of evidence writ large – produces empirical data that form not only an evidence base but an evidence base that is sometimes more truthful, proposing alternatives to the evidence-making from metrics work. Ethnographic materials are a potential source of alternative evidence that not only contrasts with the kinds of evidence required for good metrics work but also sometimes unseats its hold on truth.' (Adams 2016b, 11). Following Adam's invitation, in this thesis, I ethnographically followed the making of evidence on AMR within the context of D-Lab in between the UK and Uganda. In chapter 1, I examined the complex scholarly context of evidence in global health, and AMR both in Uganda and in recent global health history. Chapter 2 outlines the specific context of D-Lab's operations in Uganda, and the methods appropriate to my study, reviewing ethical, field, and pandemic contexts and temporalities of my research.

Summary of main findings

Over the four empirically grounded chapters (chapter 3 to 6) I trace concepts, tools, data, and narratives within D-Lab as they move from desks and offices, to field encounters, and back again. Overall, in this thesis, I argue that we make AMR in such a way that we obfuscate the very conditions it emerges from. Each chapter contributes to the overall argument, by shedding light on an aspect of the research.

In chapter 3, I attend to the construction of standard sites, in particular field sites, communities, and households, from which AMR is made to emerge. The project standardises the spaces, drawing lines across otherwise blurry boundaries, and idealises interspecies relations. AMR is rendered into an object contingent upon these spatial configurations, that the project imposes on its field sites. Through standardising spaces and relations, the project recursively standardises AMR. The making of a standard AMR, in a standard household is meant to expand the scope of validity of the evidence to a space much greater than the one under investigation. Thereby, the standard setting is constructed in such a way that it minimises the specific contextual factors that shape any one place, and its microbial landscape.

In chapter 4, I focus on the labour of putting the protocol, including the standard sites, to work in D-Lab's Ugandan field sites, at the time of COVID-19. Specifically, I focus on the adaptation of data collection procedures that allows the field teams, and the laboratory teams to put the protocol to use in the conditions they find themselves in. Far from only implementing a protocol, the Ugandan researchers provide creative translational labour, adapting procedures as they go along. The COVID-19 pandemic expanded the need for adaptive labour. It demanded, for example, that the field assistants build rapport and collect data while wearing protective equipment, and after screening their study participants for symptoms of COVID-19. Within D-Lab, reflections of local researchers regarding their (pandemic) fieldwork do not feature in the data. Rather, they worked under precarious conditions that impeded their ability to challenge assumptions the project is based on. The rigid data making apparatus produces an AMR that ostensibly exists independently from the conditions in which the data has been made.

In chapter 5, I move more closely to D-Lab's object of research, focussing on the One Health framing of AMR within the project. D-Lab collected biological samples from human, animals, and the environment, and through observational data traced the pathways through which microbes travel across the three spheres in the households of their participants. Many of D-Lab's study participants lived closely with animals and grew vegetables in their compounds. Despite the obvious microbial entanglements, D-Lab's graphical representations, in particular the project's maps, depict the three spheres as spatially separate. And in the project's logic, they are seen as separable (such as through increased levels of sanitation). The maps build on an inherited figurative apparatus of global health which centres a logic of separation. Here, I refer specifically to Wagner and Lanoix' work on sanitation (Wagner and Lanoix 1958). The representation as separable forecloses our ability to reimagine health as 'One.' Thereby, not the porosity of boundaries serves as the starting point when studying, and indeed, intervening on AMR, but the imagined possibility of their (re)-inscription.

In chapter 6, I attend to 'WaSH' within D-Lab and in its field site in Hoima. Within the households of its study participants, D-Lab collected data on sanitation facilities, and observed and recorded so-called WaSH practices. The project focussed on individual behaviour, e.g. hand hygiene, to understand, and later intervene into AMR. In a series of interviews with WaSH experts outside D-Lab, as well as through conversations and site visits with D-Lab researchers themselves, it became clear that the landscape in which D-Lab's study participants lived was subjected to registers of contamination, and malfunctioning infrastructures. In many of the households, water scarcity was the norm. D-Lab's research apparatus was geared to understanding AMR relating to individual behaviours, in the spaces of households. The wider historical, social, and political environment, including malfunctioning infrastructures, or intermittent donor funding which shape the microbial landscapes, were out of scope.

Throughout the four main chapters, I suggest a refined understanding of AMR as an object emerging from global health research practices. As many scholars have shown, the colonial legacies of the field of global health research shape its current practices (see for example (Crane 2020, 2011, 2010)). Here, I

illustrate how the continued inequality of global health has implications for the evidence made, in particular with regards to AMR. Despite AMR reflecting past attempts at managing microbes (and therefore emerging from particular contexts), it comes to be understood as an object that is detached from its historical, social, or political context. In a landscape marked by poverty, and malfunctioning water and waste infrastructures, D-Lab investigated AMR as an issue that is shaped by practices of residents within their households. It turned its attention away from the larger political and historical factors shaping the microbial landscapes of its field sites. The unequal distribution of funding and other resources across the Global North and South, as well as attribution of authority and expertise along the same lines, marginalise the input of researchers from the Global South. Their precarious position in this set-up makes it difficult to challenge the status quo.

Research under pandemic conditions and limitations of the study

My focus on the Uganda-based part of the study came at the expense of a more comprehensive approach. A more thorough engagement with UK-based and Malawi-based researchers would have allowed for the inclusion of a more diverse range of perspectives (geographical, but also regarding the specific research labour provided at the various different levels of the collaboration). Such a set-up would likely have produced a broader but potentially less focussed account of the research labour through which AMR is made.

Both my ethnographic fieldwork, as well as the data collection of D-Lab in Uganda happened during early phases of the COVID-19 pandemic, starting in March 2020. The pandemic and the unprecedented shift in circumstances considerably changed my original plans of fieldwork, and it altered D-Lab's approach to data collection too. While I had planned to do fieldwork during D-Lab's data collection, our schedules ended up being misaligned. Therefore, my account of D-Lab's fieldwork practices is based mostly on narratives of the involved researchers, and not, as I had expected, on participant observation. The misalignment of our fieldwork schedules took away the opportunity of

participation. I had planned to administer a survey on antimicrobial usage[116] in the area in which D-Lab collected their data. The survey data might have been taken up within D-Lab, and it would have allowed me to gain more of an insider status within the collaboration. This role might also have allowed me to feedback some of my findings as I would have been working in a more linear fashion. D-Lab's data collection and analysis were also shaped by pandemic conditions. The pandemic and delays in the start to fieldwork, and in the shipment of supplies made the project's timelines tighter than they would have been otherwise. It is possible that field assistants would have had the opportunity to sort through some of the data before the end of their contracts, or that the data managers could have reached field staff during the time they were sorting through the data. Although, as I have shown in Chapter 4, this missed opportunity did not impede D-Lab's construction of AMR in its findings.

At the same time, COVID-19, and the ways in which it changed my work and D-Lab's came with insights that otherwise might not have been disclosed. My slow ethnographic research allowed me to build relationships through sustained engagement. I iteratively adjusted the modes through which I was engaging with the researchers, thereby expanding my field, and my timelines. This stood in stark contrast to D-Lab's management of pandemic conditions, where the rigid apparatus of research did not allow for adjustments. Without the COVID-19 pandemic, the rigidity would not have become as legible. My view from the end of the project meant that I was studying its legacies rather than its unfolding. This made the exclusion of the locally hired researchers from data analysis tangible (see chapter 4), which might not have been so clear had I stayed with my original focus.

Futures of global health research and AMR

In this thesis, I argue that studying AMR as a global object, through global health collaborations, frameworks, and research practices, reproduces the structures that it emerges from in the first place. To break out of this set-up would require shifts in global health research, and its epistemic practices, and,

[116] I was going to employ 'the drug bag method', for reference see Dixon et al. (2019).

relatedly, in our understanding of AMR.[117] Such shifts would involve acknowledging that we cannot understand, study and intervene without first recognising that AMR emerges from historical and political developments. It would also involve recognising AMR as a systemic issue, which takes on particular local forms in any one place and time.

How do we get there?

When I asked Jamil about the future of AMR, he gave me the response I cite at the opening of this chapter. His projection of the development of AMR in the setting of rural western Uganda is grim and very specific. The factors he describes which shape the development and transmission of resistant bacteria are systemic: economic development and population growth shape the use of land and animal husbandry practices. Animals are being kept in ever smaller spaces, and microbes are travelling faster from one host to the next. This is increasing the pressure on farmers to employ more anti-microbials which, in turn, increase the pressure on microbes to develop resistance. Jamil's narrative of AMR as a systemic, multifaceted issue did not make it into D-Lab. He was hired to collect samples and observational data for the project. His insights and reflections, such as those laid out here, did not feature in the project's evidence.

For global health to study AMR in its complexity – including both the systemic nature of the issue, and the local forms it takes – it would need to listen to researchers like Jamil. Jamil would need to be in a position to shape the conceptualisation of the study he is working within. Such a study would not intend to produce evidence that can be easily employable in a large geographical context. The point of him conceptualising it, would be that he knows the setting particularly well. Such a study would give up on ideals of scalability (Ehrenstein and Neyland 2018). In other words, research would need to slow down (Adams, Burke, and Whitmarsh 2014). The focus on individual practices only sustains in a research space in which broader factors are not investigated – the farmer in Jamil's example might employ large amounts of antibiotics, but the reasons he does so lie well beyond the

[117] Such shifts have been called for within the decolonising global health movement, see for example Oti and Ncayiyana (2021), Krugman (2023), Hirsch (2021), Herrick and Bell (2021) Chaudhuri et al. (2021), Mogaka, Stewart, and Bukusi (2021).

individual. They cannot be understood by studying his individual behaviour as if they it did not relate to broader concerns.

Throughout my four data-based chapters, I have shown how closely attended labours of standardisation, intimately responsive acts of translation and interpretation, local constructions of One Health, and despairing attempts to adhere to WaSH norms produce a discursive object named AMR. This object leaves unanswered many of the crucial social, political, and economic questions about managing the burden of infection experienced across human, animal, and microbial landscapes in western Uganda. The voices engaged in the local and ongoing construction of discourse around AMR in this setting demand our attention. A de-centring of the research in which researchers in the Global North no longer conceptualise and thereby dominate the studies, would give way to a slower, more careful approach, open to iterative adjustments. In such a set-up, residents who live closely with animals, and manage their health as 'one', and researchers who engage with those residents, would inform an analysis of what One Health is about, rather than understanding their 'interspecies intimacy' (Shukin (2009), cited in (Hinchliffe 2015, 30)) as dangerous, and to be intervened upon in the name of global health security.

Put more succinctly, based on this thesis, I recommend the following changes to AMR research:

- I suggest a move away from the aspiration of producing geographically scalable evidence on AMR. Highly localised research, which takes the specific conditions of any one place and time as a starting point is best positioned to understand AMR as emerging from localised histories and ecologies, as well as to identify ways of living with resistant microbes.
- Such smaller-scale research will depend on in-depth understandings of specific local contexts. Rather than being (at most) added as an addition to bio-medical evidence, knowledge around the local context need to feature centrally in a research project that is to produce evidence on AMR. This will require a shift and a de-centring of research hierarchies, where researchers who are often employed to work with already designed data collection tools instead co-develop the research studies.

- These shifts of de-centring research, that I suggest as necessary for research on AMR cannot occur without a broader acknowledgement of their importance within global health. Stakeholders such as research funders will have to acknowledge the need to rebuild the institutional, financial, and epistemic structures through which global health evidence is made.

The suggested highly localised, slow mode of research could give way to a framing which lets go of 'colonial thought and violence that obscure[s] structural harms and instead pinpoint[s] blame on individuals themselves' (Nabirye et al. 2021). AMR is a material proof of the impossibility of upholding microbial boundaries. A slow and attentive approach to research might give space to boundary fluidity that AMR is forcing us to reckon with.

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Appendices

Appendix 1. Informed consent form for ethnographic observations and interviews

Appendix A1.

Informed consent form for ethnographic observations and interviews

Protocol Title: Making evidence on antimicrobial resistance: a historical and ethnographic study across the UK and Uganda
Site of Research: Hoima (Uganda) and additional interviews in the UK
[redacted]
Version Date: V6.0, 17 April 2021

Background and rationale for the study
Esther Rottenburg from the London School of Hygiene & Tropical Medicine (LSHTM) is carrying out a study to understand how we make evidence on antimicrobial resistance (AMR), specifically within the context of transnational research collaborations. This study will be conducted mainly in Hoima town and the surrounding more rural areas, with additional interviews to be conducted in other parts of Uganda and in the UK. The study will take around two years. The study is funded by the Medical Research Foundation National PhD Training Programme in Antimicrobial Resistance Research (MRF-145-0004-TPG-AVISO). This information shall help you to decide whether you want to be part of this study. Participation is voluntary and you may chose to participate at your own free will. You are free to choose not to participate in the study, or to stop taking part at any point. If you decide not to take part in this study, you can tell one of the study team your wishes and there will be no penalty to you. This is your choice. It will not be reported to anybody in LSHTM or any partner organisation, or in the community. It will have no influence on your present or future involvement with LSHTM or any partner organisation.

Purpose of the study and intended participants
I would like to learn about research on AMR, and how collaborating across field sites, countries and continents as well as academic disciplines works. In my study, I listen, engage in conversations, observe and analyse documents. You are involved in AMR research in a transnational and multi-disciplinary research collaboration, and therefore I would like to learn from you. In total, I expect to work with 15 to 30 researchers over the duration of my study who are knowledgeable about the research in question here. Participation might include interviews, messaging or allowing me to join in on the research work. The duration of active participation will vary depending on how much you would like to be involved.

Procedures - what will happen if I take part in this study?
If you choose to participate, I would like to come with you to your work and participate in research related activities, e.g. at meetings; at the recruitment and trainings of staff; or accompanying you when collecting samples or other forms of data. I will take notes during observations and I would also like to talk to you about my observations and may ask you questions about what I am seeing during the time I am with you. I am interested to observe and hear about your experiences and opinions. There are no right or wrong answers. I simply want to understand your experiences with regards to doing research on AMR. Due to the COVID-19 pandemic, there is an option that some of our contact might be over the telephone, via video conferencing, email or messaging (e.g. WhatsApp).
I might also ask you if I can interview you more formally. If you choose to be interviewed, I would like to do one or two (maximum 3) interviews with you. Again, there is the option for interviews to be conducted remotely, over the telephone, via video conferencing, email or messaging. Each interview will roughly take between 30 to 90 minutes but may exceed that. We can do the interview wherever you choose. This can be your workplace, or somewhere else. You may also choose a time for the interview that is good for you. I will use an encrypted digital recorder for the interview, if you allow me. If, at any point, you would like the recorder turned off, I will do so, and you will not be asked for an explanation.
During the interview, I will ask you:

- About your research on AMR and methodologies used
- About your ideas on drivers of AMR and possibilities of interventions
- About your experiences working in multi-disciplinary and/or transnational collaborations

Our discussion will be open, and it is important for me to hear your personal views. Anything you find interesting or of concern will be interesting to me. If I ask you a question that you do not want to answer, you are free not to answer. If you want to say

things we did not ask about, feel free to do so. If you choose not to take part, you will not have any disadvantage from this. If you would like to be updated about findings of the study, please do let me know and I will share updates with you.

Confidentiality - how will the information collected in this study be used?

The findings will contribute to an understanding of how we make evidence on AMR. Data gathered in this study will be kept confidential and only be used for research purposes. Findings will be shared with other researchers in an anonymised form.

In case we will do interviews, you can choose to make the recordings, notes and transcripts of your interviews available to future researchers. If you do so, they will be deposited in a local archive of your choosing, or in the archives of the London School of Hygiene and Tropical Medicine. You can choose to restrict access to this information for a number of years. In this case, the recordings, notes and transcripts will be kept safely and nobody except the researcher involved in this study will have access to them until that time.

Your name will not be included in our reports and publications unless you explicitly wish so (see below). We will conceal your identity as far as the law allows. Unless you tell me that you wish that your name is mentioned, we will not use any details that might identify you, such as your position, age or gender in reports and publications. All recordings, notes, and transcripts will be kept safely and nobody except the researcher involved in this study will have access to them. Nobody else from LSHTM or any partner organisation, or the community will be given information related to your name. All recordings, notes, and transcripts will be kept under strict lock and key, and information on computers will be kept confidential with password protection respectively. However, the School of Health Sciences Research and Ethics Committee and the Uganda National Council for Science and Technology (UNSCT) may have access to private information that identifies the research participants by name where applicable. Your participation and what you say will not affect your ongoing and future involvement with LSHTM or any partner organisation. If you have any further questions, you may also contact the Chairperson of the School of Health Sciences Research and Ethics Committee (MakSHSREC) on [redacted] or Uganda National Council of Sciences and Technology on [redacted].

What risks can I expect from being in the study?

Taking part in this study does not expose you to any risk. If you are uncomfortable with my presence, please do let me know and I will make adjustments. If I ask you a question that you do not wish to answer, you can skip questions or stop the conversation. You can choose to stop taking part in the study altogether at any time. I will ensure that I do not communicate information that can be related to you to other people in your work environment. To make sure that what you say does not negatively affect your reputation or your work, **you have the following rights:**

- To ask that we not use your name in research reports and publications
- To skip any question you don't want to answer
- To stop an interview at any time
- To drop out from the study at any time

Costs, compensation and reimbursement

You will not be asked to pay any money in order to take part in the study. Taking part is free and voluntary. If you have to travel for study related purposes, you will be reimbursed with 20 000 USX to cover the transportation costs. You will also receive lunch allowances during the time of your active participation in the study. If you incur any costs due to your remote participation, you will be reimbursed.

Are there benefits to taking part in the study?

There are no direct benefits from taking part in this study. However, you may find taking part interesting as it gives you a chance to reflect on your work in research on AMR.

Who can answer my questions about the study or my rights as a research participant?

If you would like to ask questions related to this study, you can always contact:

[redacted]

If you would like to address your questions to someone who is independent of the study, contact [redacted]

If you have questions regarding your welfare and rights as research participants, you may also contact the Chairperson of the School of Health Sciences Research and Ethics Committee (MakSHSREC) [redacted] or Uganda National Council of Sciences and Technology on [redacted]

If you have any questions about the study right away, please ask them now. If you have questions later, please telephone, send a text message or write an email.

Ethical approval of the study

This study has been approved by Makerere University School of Health Sciences Research and Ethics Committee/ IRB which is an accredited Ugandan based Research and Ethics Committee/IRB as well as by the Ethics committee of the London School of Hygiene and Tropical Medicine.

STATEMENT OF CONSENT/ASSENT

.....has described to me what is going to be done, the risks, the benefits involved and my rights regarding this study. I have been informed about the study in which I am voluntarily agreeing to take part. In the use of this information, my identity will be concealed, unless I wish for my name to appear. I am aware that I may withdraw at anytime. I understand that by signing this form, I do not waive any of my legal rights but merely indicate that I have been informed about the research study in which I am voluntarily agreeing to participate. **A copy of this form will be provided to me.**

	Yes	**No**
I agree to participate in this research. Participating in this research means that I agree for study personnel to observe my activities and actions that relate to my work in research.	[___]	[___]
I agree to be interviewed about my opinions, thoughts and experiences regarding bio-medical research.	[___]	[___]
I agree to my interviews being recorded when this is appropriate and I give my permission.	[___]	[___]
I agree that short anonymized direct quotes from my responses may be used in reports and publications emerging from this research.	[___]	[___]
I agree to photographs of medicines, houses, farms or livestock when this is appropriate.	[___]	[___]
I agree to be identified by name in research reports and publications.	[___]	[___]
I agree to make my interview recordings, transcripts and notes available to future researchers. If YES the following restrictions apply: _____ number of years	[___]	[___]

Participant:

Name…….. Signature of participant ……..

Date (DD/MM/YY)……

Interviewer administering consent:

Name …….. Signature of Interviewer ……..

Date (DD/MM/YY)……..

Appendix 2. Informed consent form for interviews with researchers (outside D-Lab)

Appendix A3.
Informed consent form for interviews with researchers

Protocol Title: Making evidence on antimicrobial resistance: a historical and ethnographic study across the UK and Uganda
Site of Research: Hoima (Uganda) and additional interviews in the UK
[redacted]
Version Date: V5.0, 17 April 2021

Background and rationale for the study
Esther Rottenburg from the London School of Hygiene & Tropical Medicine (LSHTM) is carrying out a study to understand how we make evidence on antimicrobial resistance (AMR), specifically within the context of transnational research collaborations. This study will be conducted mainly in Hoima town and the surrounding more rural areas, with additional interviews to be conducted in other parts of Uganda and in the UK. The study will take around two years. The study is funded by the Medical Research Foundation National PhD Training Programme in Antimicrobial Resistance Research (MRF-145-0004-TPG-AVISO). This information shall help you to decide whether you want to be part of this study. You are free to say no without explanations and you may withdraw at any time. This is your choice. It will not be reported to anybody in LSHTM or any partner organisation, or in the community. It will have no influence on your present or future involvement with LSHTM or any partner organisation.

Purpose of the study and intended participants
I would like to learn about research on AMR, and how collaborating across field sites, countries and continents as well as academic disciplines works. In my study, I listen, engage in conversations, observe and analyse documents to understand how evidence is made on AMR. You have been involved in AMR research and therefore I would like to learn from you about your research. The aim of the interviews is to reach a better understanding of past and ongoing research related to AMR. We plan to carry out about 10-20 in-depth interviews with researchers throughout the study period who might be based in Hoima or otherwise be knowledgeable about the research context in question here. Participation will consist of a scheduled interview. This information will help understand the findings from my ethnographic field work with a research collaboration better and answer any questions arising from the fieldwork.

Procedures – what will happen if I take part in this study?
If you choose to participate, I would like to do one or two interviews with you. These interviews can be either remote interviews via the telephone, video conferencing or email, or in person interviews. Each interview will roughly take between 45 to 90 minutes but may exceed that. We can do the interview wherever you choose. This can be your workplace, or somewhere else. You may also choose a time for the interview that is good for you. I will use an encrypted digital recorder for the interview, if you allow me. If, at any point, you would like the recorder turned off, I will do so, and you will not be asked for an explanation.
During the interview, I will ask you:

- About your research on AMR and methodologies used
- About your ideas on drivers of AMR and possibilities of interventions
- About your experiences working in multi-disciplinary and/or transnational collaborations

Our discussion will be open, and it is important for me to hear your personal views. Anything you find interesting or of concern will be interesting to me. If I ask you a question that you do not want to answer, you are free not to answer. If you want to say things we did not ask about, feel free to do so.
If you choose not to take part, you will not have any disadvantage from this, and your name and your decision will not be taken forward. Your decision not to take part in this study will not influence your future involvements with LSHTM or any partner organisation. If you would like to be updated about findings of the study, please do let me know and I will make sure to share updates with you.

Confidentiality
You can choose to make the recordings, notes and transcripts of your interviews available to future researchers. If you do so, they will be deposited in a local archive of your choosing, or in the archives of the London School of Hygiene and Tropical Medicine. You can choose to restrict access to this information for a number of years. In this case, the recordings, notes and transcripts will be kept safely and nobody except the researcher involved in this study will have access to them until that time.
Your name will not be included in our reports and publications unless you explicitly wish so (see below). We will conceal your identity as far as the law allows. Unless you tell me that you wish that your name is mentioned, we will not use any details that might identify you, such as your position, age or gender in reports and publications. All recordings, notes, and transcripts will be kept safely and nobody except the researcher involved in this study will have access to them. Nobody else from LSHTM or any partner organisation, or the community will be given information related to your name. All recordings, notes, and transcripts will be kept under strict lock and key, and information on computers will be kept confidential with password protection respectively. However, the School of Health Sciences Research and Ethics Committee and the Uganda National Council for Science and Technology (UNSCT) may have access to private information that identifies the research participants by name where applicable. Your participation and what you say will not affect your ongoing and future involvement with LSHTM or any partner organisation. If you have any further questions, you may also contact the Chairperson of the School of Health Sciences Research and Ethics Committee (MakSHSREC) on [redacted] Uganda National Council of Sciences and Technology on [redacted]

What risks can I expect from being in the study?
Taking part in this study does not expose you to any risk. If you are uncomfortable with any questions, you can skip questions or stop the conversation. You can choose to stop taking part at any time. To make sure that what you say does not negatively affect your reputation or your work, **you have the following rights:**

- To ask that we not use your name in research reports and publications
- To skip any question you don't want to answer
- To stop an interview at any time
- To drop out from the study at any time

Costs, compensation, and reimbursement
You will not be asked to pay any money in order to take part in the study. Taking part is free and voluntary. You will be compensated with 20 000 UGX for the time this interview will take. If you have to travel for study related purposes, you will be reimbursed with 20 000 USX to cover the transportation costs. If you incur any costs due to your remote participation, you will be reimbursed.

Are there benefits to taking part in the study?
There are no direct benefits from taking part in this study. However, you may find taking part interesting as it gives you a chance to talk about AMR research.

Ethical approval of the study
This study has been approved by Makerere University School of Health Sciences Research and Ethics Committee/ IRB which is an accredited Ugandan based Research and Ethics Committee/IRB as well as by the Ethics committee of the London School of Hygiene and Tropical Medicine.

Who can answer my questions about the study or my rights as a research participant?
If you would like to ask questions related to this study, you can always contact:
[redacted]
If you would like to address your questions to someone who is independent of the study, contact [redacted] you have questions regarding your welfare and rights as research participants, you may also contact the Chairperson of the School of Health Sciences Research and Ethics Committee (MakSHSREC) [redacted] or Uganda National Council of Sciences and Technology on [redacted]
If you have any questions about the study right away, please ask them now. If you should have questions later, please telephone, send me a text message or write an email.

STATEMENT OF CONSENT/ASSENT

.....has described to me what is going to be done, the risks, the benefits involved and my rights regarding this study. I have been informed about the study in which I am voluntarily agreeing to take part. In the use of this information, my identity will be concealed, unless I wish for my name to appear. I am aware that I may withdraw at anytime. I understand that by signing this form, I do not waive any of my legal rights but merely indicate that I have been informed about the research study in which I am voluntarily agreeing to participate. **A copy of this form will be provided to me.**

	Yes	**No**
I agree to be interviewed about my opinions, thoughts and experiences regarding bio-medical research.	**[___]**	**[___]**
I agree to my interviews being recorded when this is appropriate and I give my permission.	**[___]**	**[___]**
I agree that anonymized direct quotes from my responses may be used in reports and publications emerging from this research.	**[___]**	**[___]**
I agree to be identified by name in research reports and publications.	**[___]**	**[___]**
I agree to make my interview recordings, transcripts and notes available to future researchers. If YES the following restrictions apply: _____ number of years	**[___]**	**[___]**

Participant:

Name .....

Signature .....

Date ..... (DD/MM/YY)

Interviewer administering consent:

Name .....

Signature .....

Date ..... (DD/MM/YY)

Appendix 3. Informed consent form for interviews with D-Lab's point of contact

Appendix A5.
Informed consent form for interviews with [redacted] points of contact

Protocol Title: Making evidence on antimicrobial resistance: a historical and ethnographic study across the UK and Uganda

Site of Research: Hoima (Uganda) and additional interviews in the UK

[redacted]

Version Date: V5.0, 21 April 2021

Background and rationale for the study
Esther Rottenburg from the London School of Hygiene & Tropical Medicine (LSHTM) is carrying out a study to understand how we make evidence on antimicrobial resistance (AMR), specifically within the context of transnational research collaborations. This study will be conducted mainly in Hoima town and the surrounding more rural areas, with additional interviews to be conducted in other parts of Uganda and in the UK. The study will take around two years. The study is funded by the Medical Research Foundation National PhD Training Programme in Antimicrobial Resistance Research (MRF-145-0004-TPG-AVISO). This information shall help you to decide whether you want to be part of this study. You are free to say no without explanations. You may also withdraw at any time. This is your choice. It will not be reported to anybody in LSHTM or any partner organisation, or in the community. It will have no influence on your present or future involvement with LSHTM or any partner organisation.

Purpose of the study and intended participants
We would like to understand how researchers make evidence on antimicrobial resistance and how the context they are working in shapes what they find. The specific context that I am interested in is Hoima. In my study, I listen, engage in conversations, observe and analyse documents. I will use the information collected to understand how the context of Hoima is reflected in the work of bio-medical researchers. This will be valuable to interpret the findings and design interventions to reduce AMR.
You have been a point of contact for researchers on AMR and I would therefore like to learn from you. The aim of the interviews is to reach a better understanding of Hoima, and Uganda more broadly, as a context to do bio-medical research. We plan to carry out about 5-15 in-depth interviews with stakeholders throughout the study period, who might be based in Hoima or otherwise be knowledgeable about the research context in question here. Participation will consist of a scheduled interview. This information will help contextualize the findings from my ethnographic field work with a research collaboration.

Procedures – what will happen if I take part in this study?
Taking part is free and voluntary. If you choose to participate, I would like to do one or two interviews with you. These interviews can be either remote interviews via the telephone, video conferencing or email, or in person interviews. Each interview will roughly take between 45 to 90 minutes but may exceed that. We can do the interview wherever you choose. This can be your workplace, or somewhere else. You may also choose a time for the interview that is good for you. I will use an encrypted digital recorder for the interview, if you allow me. If, at any point, you would like the recorder turned off, I will do so, and you will not be asked for an explanation.

During the interview, I will ask you:

- About your experience with researchers in Hoima, both in the past and at this moment
- About your ideas about which infrastructures bio-medical researchers in Hoima rely on (e.g. for the transportation or analysis of samples)
- About your ideas on drivers of AMR in Hoima and possibilities of interventions

Our discussion will be open, and it is important for me to hear your personal views. Anything you find interesting or of concern will be interesting to me. If I ask you a question that you do not want to answer, you are free not to answer. If you want to say things we did not ask about, feel free to do so. If you would like to be updated about findings of the study, please do let me know and I will make sure to share updates with you.

If you choose not to take part, you will not have any disadvantage from this, and your name and your decision will not be taken forward. Your decision not to take part in this study will not influence your future involvements with LSHTM or any partner organisation.

Confidentiality
You can choose to make the recordings, notes and transcripts of your interviews available to future researchers. If you do so, they will be deposited in a local archive of your choosing, in the archives of the London School of Hygiene and Tropical Medicine. You can choose to restrict access to this information for a number of years. In this case, the recordings, notes and transcripts will be kept safely and nobody except the researcher involved in this study will have access to them until that time.
Your name will not be included in our reports and publications unless you explicitly wish so (see below). We will conceal your identity as far as the law allows. Unless you tell me that you wish that your name is mentioned, we will not use any details that might identify you, such as your position, age or gender in reports and publications. All recordings, notes, and transcripts will be kept safely and nobody except the researcher involved in this study will have access to them. Nobody else from LSHTM or any partner organisation, or the community will be given information related to your name. All recordings, notes, and transcripts will be kept under strict lock and key, and information on computers will be kept confidential with password protection respectively. However, the School of Health Sciences Research and Ethics Committee and the Uganda National Council for Science and Technology (UNSCT) may have access to private information that identifies the research participants by name where applicable. Your participation and what you say will not affect your ongoing and future involvement with LSHTM or any partner organisation. If you have any further questions, you may also contact the Chairperson of the School of Health Sciences Research and Ethics Committee (MakSHSREC) on [redacted] or Uganda National Council of Sciences and Technology on [redacted].

What risks can I expect from being in the study?
Taking part in this study does not expose you to any risk. If you are uncomfortable with my presence, please do let me know and I will make adjustments. If I ask you a question that you do not wish to answer, you can skip questions or stop the conversation. You can choose to stop taking part in the study altogether at any time. I will ensure that I do not communicate information that can be related to you to other people in your work environment. To make sure that what you say does not negatively affect your reputation or your work, **you have the following rights:**

- To ask that we not use your name in research reports and publications
- To skip any question you don't want to answer
- To stop an interview at any time
- To drop out from the study at any time

Costs, compensation, and reimbursement
You will not be asked to pay any money to take part in the study. You will be compensated with 20 000 UGX for the time this interview will take. If you incur costs to participate, such as transportation costs, you will be reimbursed with 20 000 UGX. If you incur costs related to remote participation, you will be reimbursed too.

Are there benefits to taking part in the study?
There are no direct benefits from taking part in this study. However, you may find taking part interesting as it gives you a chance to reflect on research on AMR.

Who can answer my questions about the study?
If you would like to ask questions related to this study, you can always contact:
[redacted]
If you would like to address your questions to someone who is independent of the study, contact [redacted]. If you have questions regarding your welfare and rights as research participants, you may also contact the Chairperson of the School of Health Sciences Research and Ethics Committee (MakSHSREC) [redacted] or Uganda National Council of Sciences and Technology on [redacted]
If you have any questions about the study right away, please ask them now. If you should have questions later, please telephone, send me a text message or write an email.

Ethical approval of the study
This study has been approved by Makerere University School of Health Sciences Research and Ethics Committee/ IRB which is an accredited Ugandan based Research and Ethics Committee/IRB as well as by the Ethics committee of the London School of Hygiene and Tropical Medicine.

STATEMENT OF CONSENT/ASSENT

.....has described to me what is going to be done, the risks, the benefits involved and my rights regarding this study. I have been informed about the study in which I am voluntarily agreeing to take part. In the use of this information, my identity will be concealed, unless I wish for my name to appear. I am aware that I may withdraw at anytime. I understand that by signing this form, I do not waive any of my legal rights but merely indicate that I have been informed about the research study in which I am voluntarily agreeing to participate. **A copy of this form will be provided to me.**

WE WILL GIVE YOU A COPY OF THIS SIGNED AND DATED CONSENT FORM

	Yes	**No**
I agree to be interviewed about my opinions, thoughts and experiences regarding bio-medical research in Hoima and Uganda more generally.	[___]	[___]
I agree to my interviews being recorded when this is appropriate and I give my permission.	[___]	[___]
I agree that short anonymized direct quotes from my responses may be used in reports and publications emerging from this research.	[___]	[___]
I agree to be identified by name in research reports and publications.	[___]	[___]
I agree to make my interview recordings, transcripts and notes available to future researchers. If YES the following restrictions apply: _____ number of years	[___]	[___]

Participant:

Name .....

Signature .....

Date ..... (DD/MM/YY)

Interviewer administering consent:

Name .....

Signature .....

Date ..... (DD/MM/YY)