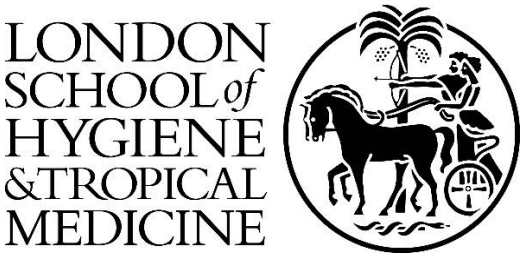

Antibiotics in Society: a multi-sited ethnography in rural and urban Uganda

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Declaration by student

I, Susan Nayiga, 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. This work has not been submitted previously for an academic qualification.

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Abstract

Background: Antimicrobial resistance (AMR) has risen high on the global health agenda in recent years. Governments around the world have been required to develop plans to address AMR, including antibiotic stewardship programmes. With antibiotic use increasing globally, and increasing awareness of the multiple arenas in which these medications hold significance, a holistic understanding of the nature of our reliance on antibiotics is needed. The aim of this study was to describe how antimicrobials intersect with life, livelihoods and health care for humans and animals in rural households in Uganda.

Methods: I employed a multi-sited ethnographic approach. To explore patterns of antibiotic use, I led a series of antibiotic surveys, enrolling 100 households in rural Tororo, 174 residents in urban Kampala and 115 pig and poultry farms in peri-urban Wakiso. In order to explore the significance of antibiotics and how antibiotic use is linked to wider social, economic and political trends in modern Uganda, I carried out ethnographic fieldwork in rural Tororo district in eastern Uganda over 14 months. I conducted participant observations, participant feedback meetings, and health worker interviews within homesteads, private clinics, government health centres, veterinary drug shops and animal markets. I compared findings from the research in Tororo with parallel ethnographic research, which I supervised over 10 months, in an informal settlement in Kampala and among pig and poultry farmers in peri-urban Wakiso.

Findings: Antibiotics were used frequently across the study sites, although the types and volume of antibiotics used by residents and farmers varied widely between the rural Tororo, urban Kampala and peri-urban Wakiso. Social and economic factors that shaped antibiotic use included the imperative to take opportunities and the discourse of betterment in today's modern Uganda society, the insecurities that people encountered in their everyday lives and availability of resources and professional and patient expectations in health care settings. Antibiotic use was one of the ways that people took

opportunities in a landscape where clinical research and humanitarian projects presenting medicines among other opportunities have become a way for people to better themselves for decades. With a vision to transform Uganda into a modern, independent, resilient and self-sustaining economy, Ugandans are persistently encouraged to take up opportunities availed through government and non-governmental programmes. This taking-of-opportunities had become an end in itself. In this context, the insecurity in peoples' everyday lives which drives antibiotic use, was reinforced by the pervasive rhetoric of opportunity. In lower-level health facilities in Tororo where 'care' was characterized by delivery of medicines, clinical practice was shaped by availability of resources, and professional and patient expectations, as much as by the clinical guidelines. Clinical guidelines were present, and known in the health facilities, but seemed to co-exist with clinical practice rather than dictate it.

Conclusions: Antibiotic use is central to the way people sustain everyday life in modern Uganda. The contextual information reflecting the multiple dimensions and connections involved with antibiotic use, provided by this thesis contributes to a growing literature that connects pharmaceutical practices with national and global systems. This research provides insights that can inform locally relevant interventions seeking to optimize the use of antimicrobials and to curb AMR in Uganda and elsewhere.

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Abbreviations

AMR	Antimicrobial Resistance
AMIS	Antimicrobials in Society
CDDEP	Centre for Disease Dynamic, Economic and Policy
CIA	Critically Important Antimicrobials
FAO	Food and Agriculture Organisation
GARP	Global Antibiotic Resistance Partnership
GAP	Global Action Plan
IDRC	Infectious Diseases Research Collaboration
LMICs	Low and Middle Income Countries
GHSA	Global Health Security Agenda
NAP	National Action Plan
NDA	National Drug Authority
MDG	Millennium Development Goal
MoH	Ministry of Health
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
NRM	National Resistance Movement
OIE	World Organisation for Animal Health
UNAS	Uganda National Academy of Sciences
SAPs	Structural adjustment programmes
SDG	Sustainable Development Goals
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation

Chapter 1. Introduction

Increasing use of antimicrobials is of great concern to policy makers and world health leaders because of the growing threat of antimicrobial resistance. With antimicrobial use increasing for humans and animals, and antibiotic resistance genes spreading between humans, animals and the environment, the problem has become an archetype case for a 'One Health', involving coordination of sectors and actors to realise gains in health for humans, animals and the environment (World Health Organisation, 2015). Calls for social science to shed light on the reasons for reliance on antimicrobials globally have led to an increase in qualitative research focused on specific 'inappropriate use' scenarios, such as in routine hospital care or by informal drug sellers (Tompson and Chandler, 2021). Few studies have taken a holistic approach to antimicrobial use that takes peoples' everyday lives as the starting point, observing how antimicrobials intersect with life, livelihoods and healthcare for humans and animals. This thesis addresses this gap. By following the preoccupations and opportunities, the highs and lows of daily life for villagers in rural Tororo, day wage urban workers in urban Kampala and commercial poultry and piggery farmers in peri-urban Wakiso, I trace out the significance of antibiotics and unpick how these medicines encapsulate – at once conveying and folding into – wider social, economic and political trends in modern Uganda.

The thesis combines my ethnographic journey, located in homesteads, private clinics, government health centres, veterinary drug shops and animal markets, with my research commitment in leading a multi-sited project on the roles of antibiotics in Ugandan society. In this introductory chapter, I introduce the problem of increasing use of antimicrobials that has become of great concern to policy makers and world health leaders, because of the threat of antimicrobial resistance. I describe how widespread use of antimicrobials has been framed predominantly as an individual behavioural problem. I then discuss how educational and behaviour based interventions have had limited success, which

suggests the need to conceptualise and address the problem beyond individual behaviour. To address this need for wider-angle approaches, I describe the value of holistic methods and conceptual tools of anthropology for understanding antimicrobial use. Finally, I detail my research aims and questions, and provide a summary of the structure of this thesis.

1.1 Motivation for this research

My interest and experience in the topic of this thesis is longstanding. I have been working in health research in Uganda since I graduated with my social science undergraduate degree from Makerere in 2006, and I joined the Clinical Epidemiology Unit to complete my dissertation project for my Masters in Epidemiology at Makerere in 2008. Since then, I have worked in infectious diseases and healthcare improvement research, with a short time also working in the Ministry of Health for the Government of Uganda. From 2010 to 2013, I led a team of social scientists at IDRC to carry out a process evaluation of a large health centre trial called the ACT PRIME study (Chandler et al., 2013; Chandler et al., 2017; Nayiga et al., 2014; Staedke et al., 2013; Staedke et al., 2016). This trial aimed to improve healthcare delivery – particularly for febrile illness – in selected government health centres in Tororo, eastern Uganda. The study, part of the ACT consortium funded by the Bill and Melinda Gates Foundation, initiated my longer term engagement at health facilities in this resource poor area of the country. As part of the evaluation team, my colleagues and I spent time at health facilities talking to health workers and patients and sitting in on consultations. During that time, particular observations stood out: drug stock outs limited activities at the health facilities; water and hygiene were equally as big challenges for healthcare workers; and antimicrobial prescribing seemed to occur – and be expected – in place of other forms of care. We found that children seeking care for fever at public health facilities were prescribed an antimalarial or an antibiotic in 86% of consultations; and that 31% of patients who tested negative by malaria rapid diagnostic tests (RDTs) were prescribed antimalarial treatment (artemether-lumefantrine)

(Chandler CIR et al., 2017). In addition, introducing RDTs for malaria reduced the unnecessary use of antimalarials but increased the use of antibiotics (ibid). These observations suggested that medicines may play a larger role than simply a curative one in this area.

In 2016, with colleagues led by Prof. Clare Chandler, Prof. Sarah Staedke and others, we submitted an application to the UK Economic and Social Research Council for a grant to establish an Antimicrobials in Society Programme, with the aim of bringing fresh perspectives to social studies of AMR. This application was successful, providing funding to conduct empirical studies in Uganda and Thailand to understand the role of antimicrobials in daily life using an anthropological approach. I am the local principal investigator of the Antimicrobials in Society (AMIS) Uganda study that was initiated in 2017 and completed in Uganda in July 2021. We work as a team of three Ugandan social scientists, two medical anthropologists based in the UK, and one Uganda based American clinician. Through this study, we have explored the role of antimicrobials in daily life from three locations with each focusing on a different perspective. In Wakiso, a peri urban location, Miriam Kayendeke led the research engaging with commercial poultry and piggery farmers. In Kampala, Christine Nabirye led the research which engaged with day wage urban workers residing in an informal settlement. In Tororo, the rural area where I had previously worked, I led the research focused on healthcare in rural households and health facilities. My work in Tororo forms the core of my PhD thesis. Throughout my PhD research, and as a team leader, I engaged in the design and analysis of the research in all three sites of rural Tororo, urban Kampala, and peri-urban Wakiso, through comparing how antimicrobials are entangled with life in each. This allowed me to reflect on the findings from Tororo, and to ask questions about this setting as compared to the other two study sites. This process was also helpful in enabling me to think about things differently and deal with the effects of being very familiar with this setting. Chapters 4 and 7 of this thesis draw together findings from across the three study sites.

1.2 Increasing use of antimicrobials

Antibiotic data from over 70 countries were compiled by Klein *et al.* (2018), showing an increase in consumption of antibiotics by humans of 65% between 2000 and 2015 (Klein et al., 2018). Additionally, an increase in consumption of antibiotics for humans of 35% was reported between 2000 and 2010 (Van Boeckel et al., 2014). Between 2000 and 2010, India, South Africa, China, Brazil and Russia were responsible for over half of global antibiotic consumption (Van Boeckel et al., 2014). Furthermore, data on antibiotic consumption among humans collected between 2000 and 2015, indicated that the antibiotic consumption rates in low and middle income countries has risen to levels typically seen in high income countries (Klein et al., 2018). Explanations of increasing antibiotic use globally carry an implicit teleology that situates individuals as rational actors in the face of quantifiable economic and knowledge resources. This observed increase globally has been attributed to increased availability of antibiotics in pharmacies and drug stores, increased knowledge about illness and available treatments, and rising incomes that have improved access to antibiotics (Center for Disease Dynamics Economics and Policy, 2015; Uganda National Academy of Sciences, 2015). The burden of infectious diseases resulting from poor water, sanitation and hygiene standards greatly contributes to the demand for antibiotics in developing countries (Araya et al., 2016). Additionally, increased consumption of animal protein has been associated with accelerated use of antibiotics in agriculture (Center for Disease Dynamics Economics and Policy, 2015).

In Uganda, rates of antibiotic use in public health facilities are high, with data indicating that over half of all visits to a public health facility result in an antibiotic prescription (Foster et al., 2008; Kiguba et al., 2016). In addition, on average 2.67 medicines are prescribed for each patient, with antibiotics accounting for 28% of prescriptions (Foster et al., 2008). Furthermore, a study of 1,400 children under-five years of age who presented to 20 health centres in Tororo, indicated that 53% of children who did

not undergo rapid diagnostic testing for malaria were prescribed an antibiotic. Moreover, two-thirds of children who had a negative read out on malaria rapid diagnostic test were also prescribed an antibiotic (Chandler et al., 2017). In Uganda, despite the existence of legal restrictions on where antibiotics can be sold, these medicines can be obtained over the counter without a prescription in many drug stores and pharmacies (Mukonzo et al., 2013; Ocan et al., 2014). A study conducted in 170 registered drug shops in Mukono district between August and October 2014, for example, indicated that over 90% of shops sold antibiotics, most commonly amoxicillin and trimethoprim sulfamethoxazole (Mbonye AK et al., 2016). In settings where malaria diagnostic testing is available, antibiotics are actually prescribed more frequently, especially in cases when the test for malaria is negative, both in health facilities and in drug shops (Batwala et al., 2011; Chandler et al., 2017; Mbonye et al., 2016). Our earlier work on this topic underscored that in Uganda, as in many other malaria-endemic settings, most presentations of fever result in prescription of at least one antimicrobial medicine (Burchett et al., 2017; Hopkins et al., 2017). This raised the question of whether these medicines have significance beyond simply targeting a known pathogen, as well as the need for interventions that aim to change human use of medicines to go beyond technologies of communication, whether with devices or through improvements in counselling (Chandler et al., 2017; Nayiga et al., 2014).

Global consumption of antibiotics in agriculture and livestock rearing has also been reported to be on the rise. In 2013, consumption of antimicrobials in food animals globally was estimated at 131,109 tonnes, and which is likely to increase to 200,235 tonnes by 2030 (Van Boeckel et al., 2017b). Globally, antimicrobials are used in large quantities in animals to enhance growth and for prophylaxis (Van Boeckel et al., 2017b). In Uganda, data on use of antimicrobials in livestock are limited. Frequent use of antibiotics has been reported in veterinary practice for treatment, prophylaxis and as additives in animal feeds, with tetracycline and penicillin most commonly used (Uganda National Academy of Sciences, 2015). One study included in the AMR situational analysis conducted by the Uganda National Academy

of Sciences in 2015, reported traces of penicillin in 13% of 384 milk samples obtained from milk cooling centres in Mbarara and Masaka districts, and in 18% of edible bovine tissue samples obtained from abattoirs or slaughter slabs in the same districts (ibid). It was also reported that sulphonamide residues were detected in 98% of chicken egg samples collected from 60 poultry farmers in and around Kampala, in a study carried out between December 2002 and March 2003 (ibid). In addition, antibiotics were frequently used by 97% of poultry farmers evaluated in a study conducted in peri-urban Wakiso (Bashahun and Odoch, 2015), for routine treatment of animals by 66% of farmers in rural Nakaseke, who reported routinely using tetracycline (Mukasa et al., 2012), and for treatment and disease prevention by 35% of livestock keepers from 6,000 rural agricultural households in central, eastern, northern and western Uganda (Mikecz et al., 2020). Data from the Uganda National Drug Authority (NDA) indicated that in 2010, 3.343 tonnes of antibiotic active ingredient were imported for therapeutic use in animals (Queenan et al., 2016). Additionally, data from the NDA indicated that tetracyclines and sulphamides were the largest classes of antibiotics in use among livestock in Uganda (ibid).

1.3 The problem of increasing use of antimicrobials

The rising use of antimicrobial medicines is held responsible for the growing problem of AMR seen around the world. The increase in antimicrobial use has long been considered a problem for economic and safety reasons, but antimicrobial resistance has reignited the focus on antibiotic overuse as a problem (Bud, 2006; Landecker, 2016). AMR renders treatment of infectious diseases with certain antibiotics ineffective, undermines measures aimed at preventing and curing fatal diseases, and threatens the ability to conduct complicated procedures such as surgeries with minimal risk (World Health Organisation, 2015). As such, AMR contributes to poor health outcomes, such as prolonged illnesses and longer stays in hospital and increased mortality (ibid). An estimated 700,000 people die every year of drug resistant infections; indeed, by 2050, AMR may contribute to 10 million lives lost

annually due to resistant infections (O'Neill, 2016). Addressing the overuse of medicines is now a priority for global health leaders; in 2015, the United Nations Member states adopted the Global Action plan on AMR (World Health Organisation, 2015).

In Uganda, AMR has been detected among women presenting at a regional referral hospital for delivery or postpartum care (Bebell et al., 2017), healthy children under five years of age from selected communities in Iganga and Mayuge districts in Eastern Uganda (Kateete et al., 2020), stored uropathogenic *E. coli* isolates from the Clinical Microbiology Laboratory, Department of Medical Microbiology, College of Health Sciences Makerere University (Katongole et al., 2019; Katongole et al., 2020). A situational analysis on AMR in Uganda conducted by the Uganda National Academy of Sciences in 2015, indicated that resistance to commonly used antibiotics such as penicillins, tetracyclines and contrimoxazole was above 50% in some cases. The same report indicated a high prevalence of multi drug resistant bacteria, including methicillin-resistant *Staphylococcus aureus* (MRSA) and extended-spectrum beta-lactamase (ESBL)-producing bacteria. The reported prevalence of MRSA varied from 2% to 90%, while prevalence of ESBL ranged from 10% to 75% among analysed isolates from patients presenting at selected referral hospitals in Central, Western and Northern Uganda (Uganda National Academy of Sciences, 2015). Increasing resistance to gram-negative enterobacteria against carbapenems was reported to range from 4% to 30% (ibid). Additionally, high rates of resistance to first-line antibiotics have been reported among Staphylococcus aureus and gram-negative organisms in a study of blood culture isolates collected at Mulago National Referral Hospital between June 2013 and October 2014 (Kajumbula et al., 2018). Of the 3,197 blood specimens that were collected, an organism was isolated in 462 (14%). Of these 60% (279/462) were gram-positive cocci, and commonly *Staphylococcus aureus* (127/279), of which 32% (41/127) were methicillin-resistant (MRSA). Of the 17 *Salmonella* spp. isolated, multidrug resistance was found among 3 of 5 *Salmonella* typhi, and 6 of 12 nontyphoidal *Salmonella* isolates. High rates of antibiotic resistance have also been reported in a study

where a retrospective analysis of culture and antibiotic sensitivity test results was conducted between January 2016 and December 2018, among patients presenting in Mbale and Soroti regional referral hospitals (Obakiro et al., 2021). Of the 3,092 microbiology records that were analysed, 1,305 samples yielded clinical isolates. Escherichia coli and K. pneumoniae were resistant to amoxicillin/clavulanate (83.5%; 64.6%), cefotaxime (74.2%; 52.7%), ciprofloxacin (92.1%; 27.8%), gentamicin (51.8%; 76%), imipenem (3.2%; 10.5%), tetracycline (98%; 74.5%), and trimethoprim-sulfamethoxazole (74.1%; 74.3%), respectively. Staphylococcus aureus and S. pneumoniae were resistant to cefoxitin (44.4%; 40.9%), chloramphenicol (69.1%; 27.6%) clindamycin (21.5%; 24.4%), gentamicin (83.2%; 66.9%), penicillin (46.5%; -) tetracycline (85.6%; 97.6%), trimethoprim-sulfamethoxazole (88%; 91.3%), and vancomycin (41.2%). In studies of livestock farming conducted in Uganda, 35% of Enterococci and 46% of E. coli isolates from food producing animals were resistant to erythromycin, gentamycin, tetracycline and ampicillin (Byarugaba et al., 2011a). Multi-drug resistance to sulphamethoxazole, tetracycline, streptomycin and ampicillin has also been reported in chickens (Byarugaba et al., 2011b.). In dairy cows, multi-drug resistance has been reported in Staphylococcus aureus isolates, with 71.4% of the isolates showing resistance to penicillin (100%), neomycin (85.7%), and tetracyclines (71.4%) (Kasozi et al., 2014).

Following the initiation of the World Health Organisation (WHO) Global Action Plan on AMR in 2015, outlining mechanisms for containing AMR, a country assessment of efforts to curb AMR was conducted in 2015 in Uganda by the Global Health Security Agenda (GHSA), revealing that there were no coordinated efforts to address AMR (Uganda National Academy of Sciences, 2015). Subsequently, a situational analysis of AMR was conducted in Uganda, aiming to develop an action plan for AMR to draw stakeholders together. The situational analysis of AMR in Uganda, supported by the Uganda National Academy of Sciences (UNAS) and the Center for Disease Dynamic, Economic and Policy (CDDEP), under the Global Antibiotic Resistance Partnership (GARP)-Uganda, revealed increasing trends in AMR (ibid).

The report also highlighted limited awareness among the public, policy makers, prescribers, and other professionals about AMR and its consequences. Uganda completed its Joint External Evaluation by GHSA in June 2017, and the results were discussed at the 4th GHSA High Level Ministerial Meeting that was held in Kampala in October 2017. In 2018, Uganda's National Action Plan (NAP) on AMR was launched by the Ministries of Health, Agriculture, Animal industry and Fisheries and Water and Environment, emphasising the need to promote the prudent use of antimicrobial agents. The national action plan summarised activities to characterize and situate the AMR problem in Uganda, guided by numerous international actors and frameworks. To implement the national action plan, five national technical working committees were formed, one of which is the Antimicrobial Stewardship, Optimal access and use Technical Working Committee constituting officials from the Ministries of Health, Agriculture Animal industry and Fisheries and Water and Environment and partners from the World Health Organisation, academic institutions and non-governmental organisations led by the Ministry of Health, Health Services and Pharmacy department. The national action plan includes a strategic objective to optimise the use of antimicrobial drugs through effective stewardship practices (Government of Uganda, 2018). Achieving optimal antimicrobial use is understood to require 'strengthening technical and regulatory frameworks, ensuring availability of appropriate medicines and changing behaviour among prescribers, dispensers and consumers'.

As a member of the Ugandan Technical Working Committee on Antimicrobial Stewardship, Optimal Access and Use, a key challenge that we have faced with implementation of stewardship activities is what and how to implement these given the limited resources. Stewardship activities targeting the general public have been limited to messages aired during the World Antimicrobial Awareness Week on the dangers of 'misusing' antibiotics. In healthcare settings, clinical guidelines have been adopted throughout the health system aiming to optimise antibiotic use. However, beyond disseminating clinical guidelines in some health facilities, not much progress has been made in implementing other

stewardship intervention activities such as supporting proper functioning of medicines and therapeutics committees in all healthcare facilities; disseminating antimicrobial stewardship working manuals and procedures; and supporting the implementation of antimicrobial stewardship through training, supervision, and monitoring.

1.4 Antimicrobial use – An individual behaviour problem

In the global public health community, AMR is currently framed as a problem arising from irrational use of antimicrobials by healthcare providers, who are said to be prescribing drugs injudiciously, and consumers who are misusing them. According to the World Health Organization (2002), the irrational use of medicines among healthcare providers involves 'use of too many medicines per patient, inappropriate use of antimicrobials, often inadequate dosage for non-bacterial infections, over-use of injections when oral formulations would be more appropriate, and failure to prescribe in accordance with clinical guidelines.' Among patients, irrational use of medicines is said to involve 'inappropriate self-medication, often of prescription-only medicines and non-adherence to dosing regimens'(1) (World Health Organisation, 2002). Given this framing, it is not surprising that amidst rising threats of AMR, global health actors like the WHO and the Food and Agricultural Organisation of the United Nations have placed emphasis on the need to address individual practices that accelerate the spread of AMR (Food and Agriculture Organisation of the United Nations, 2016; World Health Organisation, 2015; World Organisation for Animal Health, 2015). In human healthcare, these practices have been said to include inappropriate prescribing and dispensing, poor hygiene and infection prevention and control practices, and rampant sale of these medicines over-the-counter – which is seen as enabling self-medication (World Health Organisation, 2015). In animals, the problem has been reported as widespread use of antibiotics for therapeutic and non-therapeutic purposes (Food and Agriculture Organisation of the United Nations, 2016; World Organisation for Animal Health, 2015).

In the Uganda national action plan, behaviour change is emphasised, just like we see in many of the materials that form blueprints from multi-agency organisations, such as global action plans and awareness campaigns from the WHO and FAO. Uganda's national action plan that was launched in 2018, mirrors the WHO global action plan principles and strategic objectives. Consistent with the 'rational-irrational' framework, the Uganda national action plan highlights that the main factor driving AMR is 'misuse' of antimicrobials. This misuse is characterised by self-medication and unrestricted access to medicines. The NAP proposes to address these seemingly inappropriate practices by improving awareness about AMR among health care professionals and the general public, promoting access to antimicrobials and ensuring they are used appropriately. In agriculture and veterinary medicine, emphasis has been put on providing prescription guidelines, putting in place stewardship programmes, restricting use of these medicines as growth enhancers, regulating the supply chain and monitoring antimicrobial residues in food (Government of Uganda, 2018). Breaking out of this behaviour change model way of thinking is a huge challenge – for AMR just as it is for many other areas of health promotion, in which the received wisdom has its roots in forms of biopolitics[1] established during colonial times (Palanco Lopez and Chandler, 2020).

1.5 The need for anthropological approaches in understanding antimicrobial use

The shift in thinking on how to address problems like antibiotic use not as an issue of poor behaviour or lack of education, requires a different toolkit from that dominant in our public health paradigm. In anthropological approaches, we find an appetite for bringing fresh perspectives and an extensive toolkit for changing assumptions, for shedding light on existing ways of thinking, and on bringing into the frame different voices, artefacts, connections and values. The realities of peoples' lives and livelihoods, and

[1]'Biopolitics is a political rationality which takes the administration of life and populations as its subject: "to ensure, sustain, and multiply life, to put this life in order".' (Adams, 2017)

how these are connected to wider social, economic and political factors, are of great interest in anthropology (Singer et al., 2019). Indeed, anthropology often aims to bring to the fore what is taken for granted as common sense. In other words, to make the familiar strange (Rosaldo, 1989). Anthropological work emphasizes local context, and anthropologists studying AMR are, therefore, interested in the practices around use of antimicrobials that make sense when understood in different contexts (Denyer Willis and Chandler, 2018).

Anthropologists have studied antimicrobial use around the world since the 1950s, with anthropological work on the topic picking up momentum in the 1980s and 90s (ibid). One of the most influential studies that has already advanced thinking about medicines is Susan Reynold's Whyte's research, based on long-term ethnographic fieldwork in Uganda, which aimed to understand the use of medicines and the meaning that people attached to medicines. She argued that giving and taking of medicines is a social act, as much as it is a medical one. As a social act, medicines use has implications on social relationships and peoples' image in society (Van der Geest and Whyte, 1989; Whyte et al., 2002). Whyte's work also demonstrates that beyond individual beliefs, medicine use is shaped by cultural, political and economic systems (Denyer Willis and Chandler, 2018). Her research involved spending long periods of time engaging in ethnographic fieldwork, underscoring the value that ethnographic work brings to the understanding of medicines, in particular antimicrobial use (Van der Geest et al., 1996). Ethnographic research can reveal insights that may be difficult for individuals to articulate or pinpoint due to their familiarity with their daily practice, and thus reveal how these activities are connected to social and wider contexts (Maanen, 1988). Ethnographic analysis is fundamental to understanding the processes involved in health decision-making and the social, cultural and economic context of everyday life (Das, 2007; Lock and Kaufert, 2006). Multi-sited ethnography offers the opportunity to 'follow' our research objects or subjects, in this case antibiotics, across multiple sites (such as homesteads, informal

settlements and farms) and dichotomies (such as local, global, system level), enabling us to gain a holistic understanding of complicated research subjects and objects (Marcus, 1995).

In response to the dominant framing of medicines use as rational or irrational in the public health discourse, anthropologists have questioned the usefulness of these categories. Some have argued that medicine users have their own form of rationality that is best understood within their context. Here, anthropologists have provided evidence on the logic behind consumers' use of medicines (Whyte et al., 2002). For example, consumers identifying symptoms that can be managed with a simple pain killer and those that may call for a more drastic action, like rushing to the nearest health facility where a blood test can be provided; or consumers making judgements on when to stop giving medicines like for malaria, a caregiver may decide to stop administering medicines early if the body temperature drops, and the child starts playing again. As demonstrated by these examples, people's treatment practices seem to reflect what makes sense in *their* context; which is neither universally rational nor irrational. Other anthropologists have questioned the rational/irrational framework, asking what additional work these categories are doing, such as to discipline populations, and how they reflect wider values such as who has the authority to define rationality (Chandler and Hutchinson, 2016).

There is still, however, a gap in understanding how antimicrobials seem to address the social, economic and political problems today. My supervisor, Clare Chandler has proposed that antibiotics are entangled with our present day infrastructure, and that they perform roles in society that actually enable particular forms of life (Chandler et al., 2016). She highlights examples of ways in which antimicrobials enable modernity, via productivity, scale and standardization (Chandler 2019). Antimicrobials may enable quick recovery from illness, so that people can return to work quickly; they can be added to animal products that can then be exported in large quantities across the world; and they may also guard against infection in places where sanitation practices are poor. Chandler and Denyer Willis (2019) argue that antibiotics

are used to fill gaps in health care, hygiene and productivity in settings where resources are scarce. However, an in-depth description of how this occurs in everyday life remains a gap in the literature. There is a need to understand the details of the relationships between these medicines and wider social, economic and political forces, and how this plays out in everyday lives. It is important to understand what it is about life today that sustains or is sustained by antimicrobial use.

1.6 Research aim and questions

This thesis aims to describe the role of antimicrobials in Ugandan society with a focus on domestic life, care providers and livestock in a rural setting. It focuses on societal rather than individual behavioural factors that shape the ways antimicrobials are deployed in Ugandan society today. To achieve this aim, the thesis asks the following research questions:

1. How and which antimicrobials are used domestically, for people and animals?
2. What problems has antimicrobial use become a solution to at the domestic as well as societal level?
3. What is at stake for human and animal care providers when prescribing or dispensing antimicrobials?
4. How do the ways antimicrobials are entangled with life in a rural Ugandan setting compare with urban Kampala and peri-urban Wakiso?

1.7 Contribution of thesis

This is the first study to use anthropological approaches to investigate antimicrobial use in rural Ugandan households with a focus on what it enables in the social, economic and political life. As such, this thesis provides a locally relevant perspective on the role of antibiotics for Ugandan society more generally. This thesis focuses on humans and animals, consistent with the One Health model that is advocated as an integrated and holistic approach for achieving objectives related to tackling AMR. It

also provides evidence on the likely consequences of restricting medicines in Uganda, thereby informing future interventions to avoid unintended consequences.

The main argument of this thesis is that antibiotic use is at the centre of the way people enact care and sustain everyday life. Antibiotic use is shaped by wider social, economic and political factors beyond individual actors such as consumers and prescribers. This study uses multi-sited ethnography to investigate antibiotic use in rural and urban settings, and how these medicines are used to care for humans and animals. In doing so, it enables a holistic understanding of the reality of everyday life in Ugandan households and farms, and how antibiotics are woven into this everyday reality from the perspective of study participants. By describing the entanglement of antibiotics with efforts for survival and betterment in modern Uganda – as well as the enactment of care for humans and animals – this study provides contextual information required to inform future interventions seeking to optimize the use of antimicrobials as a measure to curb AMR.

This thesis also contributes to the body of literature that recognizes the value of detailed and engaged social research in understanding complex problems, such as antimicrobial use. The theoretical insights offered by anthropology can help to closely examine what is often taken for granted about antimicrobial use and its entanglements with life. Studying antimicrobial use in a rural setting also adds to the limited evidence on the phenomenon of rising antibiotic use, and the ways in which these medicines are used to care for households comprised of humans and animals in such settings.

This thesis also contributes to literature on the One Health model, that seeks to promote a holistic approach to address health challenges to achieve optimal health for humans, animals and the environment. Here, I discuss antibiotic use for humans and animals demonstrating how the distinction between antibiotics for humans and those for animals is arbitrary when it comes to providing care in Uganda. Considering use of antibiotics in humans alongside their use in animals in Uganda makes sense,

as in many domestic settings animals are considered members of the household and sometimes the illnesses in animals mimic those in humans. These insights could inform stewardship interventions tailored for rural domestic settings, where animals are part of the family.

1.8 Thesis structure

Chapter 2 is a literature review. In this chapter, I summarise existing literature on how and why antibiotics are used in Uganda, describing not only antibiotic use among humans and in animals, but also the public health discourse around antimicrobial resistance as a global health threat. In addition, I describe the dominant approaches applied to address antimicrobial use, including the One Health approach, attempting to view antimicrobial use as a problem of interconnectedness, and how social theory can be used to address antimicrobial use as a problem of interconnectedness.

In **Chapter 3,** I describe Uganda and the three study sites of the AMIS Uganda project including rural Tororo, urban Kampala and peri-urban Wakiso, from where my findings are drawn.

Chapter 4 opens with my theoretical orientation, describing how social theory helps me go beyond the dominant frame for understanding antibiotic use and AMR in public health dichotomised as appropriate/inappropriate use of medicines to thinking about antibiotics themselves, and how they are *deployed* to do social and economic work, as well as simple curative work. It is upon this foundation, that I then present my ethnographic methods. I also explain my positionality, drawing from my experience doing 'ethnography at home'.

In **Chapter 5**, I describe findings from the antibiotic survey conducted to understand the patterns of antibiotic use in rural households. I compare the use of antibiotics to treat humans and animals in the rural setting where this research was conducted, with urban Kampala and peri-urban Wakiso. By describing the differences in patterns of antibiotic use across these settings, I introduce the reader to

the variations in antibiotic use patterns, which lay the foundation for an in-depth understanding of the relationships between people, animals and medicines that this thesis brings to the fore. A manuscript entitled 'Use of antibiotics to treat humans and animals in Uganda: a cross-sectional survey of households and farmers in rural, urban, and peri-urban settings', based on this chapter has been published in the peer-reviewed journal *JAC-Antimicrobial Resistance.*

Chapter 6 is a description of findings of my ethnography fieldwork in households focusing on antibiotic use among humans and animals, supported by findings from feedback discussions held with residents and district officials working in human health, veterinary medicine and agriculture. In this chapter, I describe how taking antibiotics in rural households relates to social and economic imperatives to 'take opportunities'. A manuscript entitled 'Taking opportunities, Taking medicines: antibiotic use in rural Eastern Uganda', based on this chapter has been submitted, revised, and re-submitted to the peer-reviewed journal *Medical Anthropology.*

Chapter 7 reports the findings of my ethnography fieldwork in lower-level government health care facilities and interviews with health care providers. I describe antibiotic prescribing in a context of scarcity, at a time when health workers are under pressure to make decisions around treatment and care using guidelines laid out by antimicrobial stewardship programmes, to achieve the goal of optimising antimicrobial use in healthcare settings. A manuscript entitled 'Reconciling imperatives: Clinical guidelines and the enactment of good care in lower-level health facilities in Tororo, Uganda', based on this chapter has been submitted to the peer-reviewed journal *Global Public Health.*

In **Chapter 8,** I draw on ethnographic fieldwork conducted across the rural, urban and peri urban sites of the AMIS Project, to render visible the insecurities that people encounter in their everyday lives, and how they drive reliance on antibiotics. Using the concept of (in)security, I draw attention to the everyday experiences of insecurity that receive less attention in the current global discourse, but should

be brought into conversations about Global Health security. This paper entitled 'Securing everyday life: Antibiotics countering risks in rural, urban and peri-urban settings in Uganda', is in preparation for submission in the journal *Globalisation and Health*.

In **Chapter 9,** I conclude this thesis with a discussion of the implications of my research findings for health social sciences, AMR policy and practice, and public health research. I then highlight the strengths and weaknesses of this thesis and close the chapter with reflections on my PhD journey.

Chapter 2. Literature Review

This chapter reviews the global discourse around antimicrobial resistance and how this problem has been framed, approaches that have been employed to address the problem, social science research on AMR and antimicrobial use, and the contribution of social theory in addressing this problem.

2.1 Antimicrobial resistance- A global health threat

AMR is referred to as a global health threat in the current public health policy discourse and in the media. AMR undermines the advances of 'modern medicine' as well as the sustainability of efforts to combat infectious diseases. Antimicrobial medicines are instrumental in the prevention and treatment of infectious diseases which can be fatal, and ensuring that complicated procedures like surgery and chemotherapy are successfully performed with minimal risk. However, the discourse around AMR has become defined by an apocalyptic narrative that conceptualises antimicrobial 'misuse' and 'overuse' – among both humans and animals – as a global 'threat', leading towards what many have termed a 'post-antibiotic era'. For example, the WHO in the Foreword of their Global Action Plan on AMR write that 'without harmonized and immediate action on a global scale, the world is heading towards a post-antibiotic era in which common infections could once again kill' (World Health Organisation, 2015).

Lord O'Neill, a UK-based economist tasked by the UK government to draft a report on AMR, has defined AMR as an economic and security threat that should be a priority for global leaders now and for years to come. Based on models (Kamradt-Scott A et al., 2017), the O'Neill report projected that AMR-related mortality rates will grow exponentially. The report estimates that by 2050, in the absence of intervention, the mortality rate due to AMR will rise to over 10 million annual deaths. The rates presented in the report, however, have been called into question as overestimates. Moreover, the report is focused on the short and long term *economic* impacts of AMR, arguing that AMR will lead to

aggregate losses of more than USD 100 trillion globally (O'Neill, 2016). Thus, O'Neill's influential report proposes increasing production of more effective antibiotics as one action to address the problem of AMR.

The threat of AMR has been depicted as the 'return to the dark ages' (p1) of public health and also described as 'sleepwalking back' (p11), suggesting that we have been driven – with and without our knowledge – back to something that did not seem critical in the past (Brown and Nettleton, 2016). According to Landeker (2016), AMR was not seen as a critical problem because of the hope that stronger antibiotics would be produced or the existing ones would be modified in case of resistance. She argues that the bacteria of today have different 'interrelations, capacities and distributions' and so there is need to understand their ecologies and patterns (p3). With the evolving nature of bacteria, developing stronger antibiotics is likely to become more difficult (Landecker, 2016). The AMR crisis dates back to the 1940s, when penicillin began to be more widely used and the first cases of penicillin resistance were identified (Bailey and Cavallito, 1948; Bud, 2006; Landecker, 2016). In fact, Alexander Fleming in his Nobel lecture in 1945 said, 'The time may come when penicillin can be bought by anyone in the shops. Then there is the danger that the ignorant man may easily under dose himself and by exposing his microbes to non-lethal quantities of the drug make them resistant'(Fleming, 1945).

2.2 Antimicrobial resistance in Uganda

In Uganda, the narrative on AMR has mirrored the global narrative, depicting AMR as a threat. AMR has been perceived as a threat that requires urgent action, because of the poor health system, poor hygiene and sanitation systems, and limited access to clean water (Government of Uganda, 2018). Currently, over 50% of Ugandans lack access to safe water, while 64% lack improved sanitation facilities (Life Water, 2020). In addition, it is thought that with resistance to commonly used antibiotics, access challenges will worsen. Most people will not be able to afford more effective, but expensive, antibiotics

given the high levels of poverty – 27% of the population are reported to earn less than 1.25 US dollars a day (Uganda National Bureau of Statistics, 2017). The high burden of infectious diseases, including HIV/AIDS and tuberculosis, is also of great concern as these contribute to the rise in resistant infections (Government of Uganda, 2018). According to the Uganda AIDS Commission (2019), the national prevalence rate of HIV/AIDS is 5.6%, while the prevalence of tuberculosis is estimated at 253 cases per 100,000 people by the Uganda National Population tuberculosis prevalence survey, conducted in 2014/2016. Uganda's economy, highly dependent on agriculture and livestock farming, is under increasing stress from rising burdens of bacterial infections in animals whose treatment is threatened by resistant organisms (Uganda National Academy of Sciences, 2015). Over 70% of households in Uganda rear livestock (Queenan et al., 2016), while the total number of households involved in agriculture in 2009 was estimated at 3.95 million, up from 3.2 million in 1996 (Uganda Bureau of Statistics and Ministry of Agriculture, 2010).

Amidst heightened concerns about AMR in Uganda, we have seen stakeholders from different sectors including the human health, veterinary, agriculture, water and environment, and the Uganda Wildlife Authority, coming together to deliberate on issues concerning AMR. Notably, Uganda's experience managing epidemics of zoonotic diseases, such as Ebola, positioned her as a regional model for other African countries since the launch of the GHSA in 2014. As an example, Uganda provided technical support during the West Africa Ebola epidemic, sharing training curricula, guidelines, standard operating procedures, and reporting tools. Uganda was among the first countries to go through the GHSA assessment in 2015. The 2015 GHSA assessment drew attention to AMR as a high priority area and made recommendations for addressing the gaps existing gaps. The AMR situational analysis was carried out by UNAS in the same year, in response to one of the GHSA recommendations on AMR. In 2016, UNAS was engaged by the WHO to develop the Uganda AMR NAP. Also in 2015, the One Health Framework policy document was finalized, and a memorandum of understanding was signed by the

Ministry of Agriculture, Animal Industry and Fisheries, Ministry of Health, Ministry of Water and Environment and Uganda Wildlife Authority to mutually promote the One Health approach to predict, prevent and control zoonotic diseases in Uganda. The following year, in 2016, saw the beginning of the annual National AMR conferences in the country, organized by different academic institutions and attended by close to 500 stakeholders from ministries, government departments, hospitals, NGOs, the private sector and academic institutions. These meeting have been held annually since 2016 to date.

In 2017, the 4th GHSA High Level Ministerial meeting was hosted in Uganda, and the results of the Joint External Evaluation by GHSA were discussed, putting AMR high on the national agenda. This was a turning point for AMR in Uganda. Following the GHSA Ministerial meeting, funding targeting AMR related activities in Uganda increased. One example was the Centres for Disease Control and prevention (CDC) funded Global Health Security Partner Engagement Project, which aimed to support health systems in Uganda to develop capabilities to respond to infectious disease outbreaks. The programme supported ministries of Health, Agriculture, Animal Industry and Fisheries, and other government departments to address the areas for improvement identified by the 2017 Joint External Evaluation in prevention of emergence and spread of AMR, and strengthening the national laboratory system, biosafety and biosecurity, disease surveillance, outbreak preparedness and response. Other funding has come through the Fleming Fund Country Grant. In 2018, we saw the development and launch of various AMR policy documents, including the AMR National Action Plan (NAP) (2018) and the Uganda One Health Strategic Plan (2018-2022). In 2019, the composition of the AMR-NAP Governance structure was agreed on, with the National AMR Committee reporting to the One Health Platform, and members of the AMR national technical working committees were officially appointed. The technical working committees drew in key stakeholders, including researchers and people working in various government departments and NGOs, to support the implementation of activities meant to curb AMR as laid out in the NAP.

2.3 Dominant approaches in addressing antimicrobial use

Several approaches have been undertaken over the years to address antimicrobial use globally. In 1989, the International Network for Rational Use of Drugs (INRUD) was formed to come up with strategies for improving medicine use especially in low income countries (Laing, 1990). The INRUD materials and guidelines largely focus on changing behaviour of health care providers and consumers with regard to prescription and use of antimicrobials. The focus on 'inappropriate' behaviours of consumers and prescribers using antimicrobials by global health actors, has resulted in adoption of technological, behavioural and health system-based interventions to address the 'overuse' of medicines. This is clearly reflected in the WHO's Global Action Plan (2015) on AMR. Objective four, for example, focuses on optimising use of antibiotics, putting emphasis on the introduction of affordable rapid diagnostic tools to inform the prescription of antibiotics in humans and animals. To address prescriber behaviour, the focus has been on regulation of use of antibiotics by restricting them to being handled by only qualified health professionals in humans and animals. Other strategies targeting prescriber behaviour have included the introduction of essential medicine lists, stewardship programmes in hospitals, and enforcement of policies to govern use of antimicrobials in humans and in animals. Behaviour-based approaches and technological interventions have also been promoted by other global health actors like the World Bank, UK Department of Health and the O'Neill Report, emphasised improving public awareness globally, restricting critically important antibiotics (especially in agriculture), and encouraging the introduction of new rapid diagnostic tests (O'Neill, 2016; Public Health England and Department of Health, 2015; World Bank, 2017). Whilst these reports draw attention to behavioural dimensions and take into consideration the social, economic and political reasons why antibiotic use is so prevalent, these factors are given less attention in the proposed solutions to address the widespread use of antibiotics. This may explain why some behaviour-based and educational approaches have had limited success in reducing the unnecessary use of these medicines, as described below.

In 2015, Haynes and McLeod published a systematic review of reviews of educational interventions that targeted both the general public and prescribers, and aimed to change the public's behaviour and knowledge of antimicrobial use and resistance. Their review indicated a mixed picture of whether patient education, clinician education or a combination of both were more effective in bringing about a decline in inappropriate antibiotic prescribing (Haynes and McLeod, 2015). The review suggested the effects of public health campaigns that targeted both healthcare professionals and the public were modest in reducing antibiotic prescribing, and showed that simple, single-intervention studies (such as those involving the use of educational materials, audit and feedback) generally resulted in slight changes in prescribing practices. Another systematic review conducted by Price *et al* (2018) on effectiveness of interventions that aim to change AMR awareness and stewardship behaviours amongst the public, indicated that interventions targeting school children and parents had notable potential, but for the general public the picture was less clear (Price et al., 2018). However, some behavioural interventions including antimicrobial stewardship programmes in hospitals, have been somewhat successful in altering prescription practices. Davey and colleagues conducted a systematic review of interventions aimed at improving antibiotic prescribing practices for hospital inpatients by enablement (such as giving feedback or advice) and/or restriction (such as applying rules) techniques, which included 221 studies mostly from North America or Europe (Davey et al., 2017). This review indicated a 15% increase in compliance with antibiotic prescribing policy in the intervention arm, as compared to the control arm in 29 randomised control trials. In addition, the duration of antibiotic treatment decreased by 1.95 days from 11 days to 9.1 days. Among the non-randomized studies, the interventions led to improvement in health worker compliance with antibiotic policy in routine clinical practice. Another systematic review of interventions and behaviour change techniques aimed at improving antibiotic prescribing in long-term care facilities conducted by Crayton *et al.* (2020), including 19 interventions, suggested the most

promising intervention types were persuasion, enablement, education and, behavioural change techniques as feedback on behaviour and restructuring the social environment (Crayton et al., 2020).

While several interventions have been implemented to increase awareness and address healthcare provider and consumer practices with regard to use of antimicrobials, only limited success has been demonstrated, and nothing convincing about how best to change behaviour has emerged (Haynes and McLeod, 2015; Holloway et al., 2016; Price et al., 2018; World Health Organisation, 2003). These challenges with interventions and implementation underscore that the widespread use of medicines is a complex problem. As many studies have demonstrated, simple technological, behavioural or systems-based interventions do not seem to work in the ways they were intended. For example, studies have demonstrated the continued unnecessary use of antimalarial treatment in the presence of microscopy or rapid diagnostic tests (RDTs) (Ansah et al., 2010; Bisoffi et al., 2009; Chandler et al., 2017; Chinkhumba et al., 2010; Manyando et al., 2014; Reyburn et al., 2007; Sserwanga et al., 2015). In addition, findings from studies conducted across sub-Saharan Africa have shown that while the introduction of RDTs for malaria may reduce unnecessary use of antimalarials, it may also drive up unnecessary use of antibiotics (Bruxvoort et al., 2017; Hopkins et al., 2017). These findings reveal that medicines use among prescribers may not necessarily be improved by restricting medicines using diagnostic testing, often considered a simple solution to 'over prescription' of antimicrobials by WHO and other global actors. Despite the adoption of technological, behavioural and systems-based approaches to addressing the widespread use of antimicrobials globally, increased consumption of these medicines continues to be reported (Klein et al., 2018; Van Boeckel et al., 2014). This suggests that there is need to look beyond individual behaviour to understand the reasons why people rely on these medicines. Detailed and engaged social research is required to understand this complex problem.

2.4 The One Health approach: An attempt to address AMR as a problem of connectivity

World health leaders and policy makers have advocated for a One Health approach in efforts to address AMR (Gibbs, 2014). The One Health framework promotes collaborative effort by health science professionals to realise gains in health for humans, animals and the environment. Antimicrobial use in humans, animals and the environmental sectors are understood to be major drivers of AMR and resistant bacteria spread, within and between these sectors and across the world. Most classes of antimicrobials used to treat human infections are also used in animals. As such, the One Health approach to address AMR makes sense, considering the interdependence and connectivity between the human, animal and environmental aspects. Collaboration of disciplines between the human, animal and environment health is not new (Murray et al., 2014), but can be traced back to 400 BC when Hippocrates, the Greek physician, highlighted the link between human health and seasonal and environmental factors (Miller, 1962). The term 'zoonosis', described by the German physician Virchow in the 19th century, highlighted the interdependency between human and animal health. Virchow went on to introduce the term *One Medicine,* underscoring the importance of collaboration between human and animal medicine. The concept of *One Medicine* gained popularity when parasitologist Shwabe (1984) argued that human and animal health were closely linked, and as such needed to be studied jointly (Schwabe, 1984). This understanding was extended by Zinsstag and colleagues (2011), who recognised One Medicine as an extension of comparative medicine highlighting that 'there was no difference of paradigm between human and veterinary medicine' (Zinsstag et al., 2011). Unlike the concept of *One Medicine*, zoonosis and the idea of dependency between human and animal health were widely accepted by health professionals, although not often used with regard to AMR.

In 2004, health experts from around the world met for an international symposium in the United States named the 'One World, One Health: Building interdisciplinary Bridges to Health in a 'Globalised world'. At this symposium, the 12 recommendations of One Health referred to as the 'The Manhattan Principles' were developed emphasising the interdependency between humans, domestic animals and wildlife populations (Centers for Disease Control, 2004). In the subsequent years, the One Health approach was adapted widely to address zoonoses. In addition, it became the basis upon which international organisations such as the World Health Organisation (WHO), the World Organisation for Animal Health (OIE) and the Food and Agriculture Organisation of the United Nations (FAO) were brought together. This was reflected in the coordinated response of the three international organizations during the H151 avian influenza pandemic in early 2000s. In 2010, the WHO, OIE and FAO signed a tripartite agreement 'for sharing responsibilities and coordinating global activities at the human-animal-ecosystems interface' (Zinsstag et al., 2012). Following these events, the One Health concept has been adopted into global research and policy networks, embraced by international health agencies and incorporated into the AMR policy agendas (Gibbs, 2014) (p.85). The World Health Organisation Global Action Plan on AMR, highlights the need for a One Health approach involving coordination of international sectors and actors including human and veterinary medicine, agriculture, finance, environment and well-informed consumers (World Health Organisation, 2015). The World Health Organisation Global Action Plan on AMR promotes the establishment of multi sectoral coalitions to address AMR at local or national level, and participation in such coalitions at regional and global levels (ibid). Furthermore, the European One Health Action Plan against AMR emphasizes the One Health approach and defines it as 'a term used to describe a principle which recognises that human and animal health are interconnected, that diseases are transmitted from humans to animals and vice versa and must therefore be tackled in both. The One Health approach also encompasses the environment,

another link between humans and animals and likewise a potential source of new resistant microorganisms' (p 4).

Some scholars have argued that the current application of the One Health approach in the policy arena, proposes a top-down approach with the human sector dominating veterinary medicine (Craddock and Hinchliffe, 2015). They explain that the One Health approach prioritises scientific evidence produced by biomedical professionals. Other forms of knowledge that are equally important to human, animal and environmental health are given less importance. For instance, the role of social science is relegated to establishing the best ways to deliver and communicate already established knowledge. Craddock and Hinchliffe (2015) argue that for One Health to be successful, there is need for equal engagement of all actors. They highlight the need for careful consideration of the complex cultural and economic relations that people have with animals, requiring social science-led analyses of the configurations that shape health outcomes (Craddock and Hinchliffe, 2015). The One Health concept has also been criticized for putting greater emphasis on transmission of disease than the socioeconomic and cultural aspects of health and risk to diseases (Hinchliffe, 2015). Hinchliffe 2015 argues that there is need for the One Health concept to move beyond an interdisciplinary approach, to consider multiple approaches to understanding disease and draw together a wide range of experiences with health and disease to inform relevant recommendations for addressing health challenges (ibid). While the application of the One Health concept to AMR is still a recent development, it has led to analyses that focus on different dimensions (sectors, countries, disciplines) of connectedness in trying to understand AMR. However, despite the recognition of AMR as a One Health issue that should be tackled with a multi-sectoral approach, we still see a real focus on changing individual behaviour when it comes to addressing AMR (Hinchliffe, 2021).

2.5 Social science on antimicrobial resistance and antibiotic use to date

Social science research has made great contributions to the understanding of AMR and antibiotic use practices among patients, healthcare professionals and farmers. Social science studies have rendered visible the social, economic, political, and historical factors that shape antibiotic use, and emphasised the need to go beyond focusing on individual practices when addressing this complex problem (Denyer Willis and Chandler, 2019). In the global AMR discourse, 'inappropriate' individual practices related to antibiotic use have been framed, in part, as arising from lack of knowledge on AMR. As an example, in global AMR policies such as the WHO AMR Global Action Plan, the information gap that is considered most important is that of AMR and its consequences. Social researchers have highlighted gaps in information among medicine users on which antibiotics to use and the sensitivity profile of certain antimicrobials (Pearson and Chandler, 2019). Social scientists have shown that providing knowledge on AMR is not enough to bring about a change in antibiotic use practices among users and prescribers. Instead, social science research has drawn attention to social factors affecting AMR and use of antibiotics in LMICs including unregulated environments, multiple markets and unique localised conditions, including economic, political, cultural and organisational factors that reinforce practices and continue to drive AMR (Broom and Doron, 2020).

In healthcare settings, social science research has revealed that antibiotic decision-making is a social process that is shaped by cultural and contextual factors (Charani and Holmes, 2019). This work shows that involvement of allied healthcare professionals in stewardship interventions is limited by cultural boundaries, and that cultural differences between specialities and healthcare professionals shape the shared knowledge among these professionals, resulting in variations in care. Stewardship activities primarily target doctors and pharmacists, leaving out lower health worker cadres such as nurses. In addition, the need to maintain good relations with patients and concerns for patient safety, as well as

institutional pressures to generate revenue, shape the way antibiotics are prescribed (Chen et al., 2020b). In the community, they have shown how fragmented local health care landscapes provide a channel for accessing antibiotics informally (Charoenboon et al., 2019). In animal use, antibiotic use has been linked to protecting investment in livestock and livelihoods, limited access to affordable formal veterinary care, and easy access to antibiotics (Chauhan et al., 2018).

Social science work has shown that raising awareness may have unintended negative consequences such as health workers shifting to second-line antibiotics that they consider strong enough to counter resistance (Pearson and Chandler, 2019). Social scientists have questioned the effectiveness and sustainability of the impact of handwashing and hygiene knowledge and awareness campaigns, whose effects have been reported to be mixed (Denyer Willis and Chandler, 2019; Pinto J et al., 2020). They have demonstrated the challenges faced in attempting to reduce antibiotic use through knowledge and awareness programmes alone. For example, a locally adapted educational scheme implemented in villages in PDR Laos and Thailand had a very limited effect on behaviour, but instead increased antibiotic use and excluded the less privileged groups, both unintended outcomes (Charoenboon et al., 2019; Haenssgen et al., 2018).

Social scientists have also provided a wealth of ethnographic evidence on antibiotic use practices and how these relate to lives and livelihoods in a wide range of LMICs, including rural China (Chen et al., 2020a), South Africa (Manderson, 2020), public and private hospitals in India (Broom and Doron, 2020; Broom J et al., 2020), community settings in Mozambique (Rodrigues, 2020) and Bangladesh (Lucas et al., 2019; Nahar et al., 2020). Other social science studies have traced the link between antibiotic use and livelihoods, including antibiotic use in small holder poultry production in Bangladesh (Masud et al., 2020), among dairy farmers in India (Chauhan et al., 2018), and poultry farmers in Guatemala (Snively-Martinez, 2019). These studies explore reasons why people use antibiotics, including self-care, and

efforts to counter the uncertain environment and living conditions they are embedded in. These studies also highlight the important role played by the informal healthcare system in providing access to antibiotics, and describe the socioeconomic and therapeutic landscapes within which people make decisions on antibiotic use (Lucas et al., 2019; Nahar et al., 2020; Rodrigues, 2020).

Together, these social science studies underscore the need for interventions addressing antimicrobial use to be informed by local understanding if they are to have an equitable and sustained impact, and to minimize unintended consequences. The continued focus on changing the behaviour of medicine users has detracted attention from societal factors that drive antibiotic use such as inadequate sanitation and hygiene infrastructure, limited access to good quality health care and problems of poverty and inequality (Broom et al., 2020; Denyer Willis and Chandler, 2019; Haenssgen et al., 2020). In the next section, I describe social theories that can help to tune in to and make sense of the positions of antibiotics in peoples' lives.

2.6 Social theory relevant to antimicrobial use studies

Critical global health has begun to consolidate as a field over the last two decades, pulling together scholars concerned about the ways that global health is done, including health research, development and human rights (Biehl, 2007; Farmer, 1997; Ferguson, 1994). This builds on and expands approaches in Critical Medical Anthropology (Baer, 1982,1989; Baer et al., 1986) which propelled forward analyses that attended to the political and economic drivers of ill-health in given contexts, a move that raised the gaze from individual beliefs and behaviours as determinants of ill-health (Farmer, 1997; Singer, 1996; Singer and Baer, 1995). The growing body of critical global health scholarship reflects increasing concerns with globalisation and its effects, and concerns that the well-intentioned aims of northern practitioners in health and development are in fact perpetuating inequalities that serve themselves more than those intended to receive aid (Biehl and Petryna, 2013; McKay, 2018; Nguyen, 2010). These scholars have

documented the ways in which the global health enterprise itself contributes to ill health. Through empirical research and theoretical investigations, anthropologists, historians, epidemiologists and human rights scholars have rendered visible the inequality, injustices and violence that emerges as transnational health and development projects are implemented (Nguyen, 2010; Prince and Otieno, 2014; Whyte et al., 2013). By understanding local realities, we have gained insights on how everyday life experiences are shaped by global systems and policies. In critical global health, the focus is on understanding local realities and how they are linked to larger systems, goals and agendas. Emphasis is put on the way that global health initiatives impact care, health systems and governance. Such analysis brings to the fore the unintended consequences of 'magic bullet' approaches, such as health initiatives that target specific diseases (Cueto, 2013; Moran-Thomas, 2013; Nguyen, 2010), 'project based' care (Whyte et al., 2013), and forms of governance that are produced through partnerships between state and non-state actors (Brown, 2015).

Following the declaration of the UN Millennium Development Goals and the emphasis on the link between health and development, the global health field saw changes in players, ways of intervening in health care and new partnerships between state and non-state actors (Biehl and Petryna, 2013; Birn, 2009). During this era, non-state actors mostly in the private sector such as nongovernmental organisations and pharmaceutical companies became dominant players in global health providing resources for state and public health systems that were by now chronically lacking resources post-structural adjustment of the 80s and 90s. These changes in global health actors led to changes in the land scape of care from government-led to project-led care (Whyte et al., 2013). The priorities of the funders and donors tended to dominate as local priorities were sidelined (Farmer, 2011; Ferguson, 2006). Transnational agencies with fixed agendas have implemented interventions in settings where people are grappling with multiple disease conditions and social and economic problems that may not be prioritised by these agencies (Pfeiffer, 2013; Prince and Otieno, 2014). As a result, transnational

agencies sometimes end up leaving people worse than they found them as Biehl and Petryna (2013) have described that 'Global health interventions leave people behind, not only by limiting access to the services provided, but also by producing a parallel system of care and governance that undermines other avenues for care that might take into account broader systemic factors'. As improving treatment access has become a main goal of global health interventions and evidence-based medicine and development of metrics has been emphasised, scholars of critical global health have examined the ways that numbers have formed the basis of measuring success and designing new programmes (Reubi, 2018a), how numbers have obscured the complexities of peoples' everyday lives (Adams, 2013; Reubi, 2018b) and the way certain disease categories such as non communicable diseases have received less attention in global health enterprise despite their heavy burden (Herrick, 2016). Adams (2013) describes what the emphasis of evidence-based medicine has done saying, 'evidence-based medicine has created a platform for the buying and selling of truth and reliability, abstracting clinical caregiving from the social relationships on which they depend'. Standardised models for specific diseases that can be applied across countries have been developed and less attention paid to the local social aspects of disease and patients' health outcomes (Moran-Thomas, 2013). Scholars in critical global health have drawn attention to the fragmented approaches that have been undertaken by transnational agencies (Brown, 2015; Pfeiffer, 2013; Prince and Otieno, 2014) . Integrated approaches to health-related challenges where the social, economic and political determinants of health are addressed are advocated.

In this section I consider three key areas in critical global health that that are pertinent in understanding antibiotic use including pharmaceuticalisation, development and global health, and inequality and entrepreneurship, and describe social theories that address each of these areas. These three areas were chosen because taken together they reflect antimicrobial use as a multi-dimensional problem with each

area of focus drawing out a different dimension of the problem that I focus on in my research. I start by looking at pharmaceuticalisation, processes of pharmaceuticalisation, and the way pharmaceuticals come to support and fill gaps that are linked to broken infrastructures in society. This is followed by a section on development and global health that describes theories of the ways in which global health and development programmes fall short in their design and implementation, resulting in unintended negative consequences such as reinforcing inequalities in the communities where they work. Lastly, I focus on theories of precarity and social suffering that anthropologists have used to understand medicine use among populations who are marginalised and deprived.

2.6.1 Pharmaceuticalisation

The processes of pharmaceuticalisation

Scholars have examined the way that pharmaceuticals have taken centre stage in global health efforts in the 21st century, in contrast to the previous century where they played a smaller role in the framing of global health actors such as the World Health Organisation (Biehl, 2009; Greene, 2015; Nguyen, 2010; Petryna and Kleiman, 2006; Rajan, 2017). Today, global health efforts are focused on increasing access to medicines for infectious diseases such as HIV/AIDS, malaria and tuberculosis. Pharmaceuticalisation has been described as 'a process of attributing power to medicines beyond their active ingredients' (Whyte et al., 2002). Pharmaceuticalisation has also been described as 'the process by which social, behavioural or bodily conditions are treated or deemed to be in need of treatment, with medical drugs by doctors or patients' (Abraham, 2010). Pharmaceuticalisation of global health is linked to globalisation, neoliberalisation and the materiality of diseases of great public health concern such as HIV/AIDS and multi resistant tuberculosis. Gaudilliere and Rajan (2021) consider the ways that capitalisation of health plays out globally through pharmaceuticalisation (Gaudilliere and Sunder Rajan, 2021). They argue that capitalisation of health has to do with turning health into an asset that can be invested in and a form of value that can be grown. As a result, we increasingly see health being

addressed globally by focusing on increasing access to and consumption of drugs and that this is mediated institutionally through public policies that define and harmonise priority diseases and standard practices further reinforcing the circulation of pharmaceuticals. With medicines becoming the centre of focus in global health, came the dilemma of overuse of medicines in some countries, while challenges emerged of access and underuse in others (Greene, 2015). The essential medicines concept led by the WHO, was developed following the 1975 World Health Assembly to address the problem of over-and under-use of pharmaceuticals globally. According to Greene (2015), the essential medicines concept faced criticism first from the International Federation of Pharmaceutical Manufacturers Associations, for implying that medicines not included were not essential, and later during implementation, when access to some essential and new medicines was limited especially in developing countries.

Anthropologists have studied how pharmaceutically-centred models of public health emerge, and how they shape national and local public health interventions and impact on the health of people in their everyday lives. Biehl (2007) explores how shifts in policy from a focus on prevention of diseases only to the incorporation of universal treatment for AIDS in Brazil, brings to the fore the possibilities and inequalities that come with a magic bullet approach to public health (Biehl, 2007). On the one hand, this policy saw a substantial reduction in mortality due to AIDS and reduction in AIDS-related services, but the delivery of antiretroviral treatment also had detrimental effects of being irregular and reinforcing inequalities. Inequalities are reinforced as people are excluded based on their ability to afford medicines available from the private sector, when essential medicines are discontinued in the public sector.

Anthropologists such as Whyte have shown how interpersonal networks and variations in AIDS care also emerge, shaping individual experiences with care (Whyte et al., 2013). In addition, new forms of subjectivity and social relations that are closely linked to accessing pharmaceuticals and other benefits

provided by global humanitarian organisations emerge as has been described by Nguyen using the term 'therapeutic citizenship' (Nguyen, 2005). In addition, Whyte (2006) describes the dilemmas that came with the availability of AIDS treatment in Uganda in the early 2000s as people had to make painful choices regarding who needs treatment and who can have it (Whyte et al., 2006). While free ARV treatment came into the country through donor research and treatment programmes, the inclusion criteria for receiving them excluded many. Health workers had to make judgements of who might be able to afford ARVs and inform them about their availability. Given the limited availability of financial resources, families had to choose who of the many HIV patients in the family would be prioritised for assistance to enable them to access treatment and how this might affect other members of the family. ART treatment was considered medicine for the rich people that have connections that can enable them to access ARVs.

Patients may also be excluded from care if they are perceived to be unlikely to adhere to treatment, amidst concerns about drug resistance (Biehl, 2007). As such, a form of individualised pharmaceutical care emerges. In addition, with the focus on promoting universal access to medicines, less attention may be paid to addressing inadequacies in the public health infrastructure, as well as treatment of AIDS-related opportunistic infections. Anthropologists draw attention to the negative consequences of introducing 'magic bullets' without concurrent efforts to improve quality of life (Biehl, 2007), advocating holistic approaches that address poor infrastructure and social factors that affect peoples' health. They have also studied the political economy of pharmaceuticals in public health, which includes collaborations at various levels with international agencies, pharmaceutical companies, development agencies, and public and private entities to ensure access to available medicines, as well as new medicines under development (Biehl, 2007). At the community level, individuals work closely with local AIDS organisations. The transactions at these levels are legitimised by a discourse of peoples' rights to life saving medicines. Similarly, Nguyen (2010) describes the unintended consequences of mass HIV

treatment in West Africa where international and local organisations responding to the AIDS epidemic engaged in a process of triage considering some lives worthy of receiving treatment while others were left to go without treatment (Nguyen, 2010). Relating triage in the case of HIV treatment to 'a virulent mutant of earlier forms of colonial and postcolonial discrimination', Nguyen describes triage as being about politics and therapeutic sovereignty. Triage in the case of HIV treatment creates physical exclusion, economic inequality, and biological differences within social groups.

Moreover, with increased availability of ARVs came other effects such as complaints of hunger among patients on ART amidst limited access to food. In his work among HIV patients enrolled in treatment programmes in Mozambique, Kalofonos (2008) describes how on one hand more lives were saved and people were living longer while on the other, complaints of hunger while on antiretroviral treatment prevailed with people claiming all they ate were ARVs (Kalofonos, 2010). This goes to show the dehumanising effects that may arise from programmes that target biological conditions while neglecting the political and social conditions that continue to subject people to poverty and suffering. Conditions of poverty make it challenging for patients to adhere to treatment regimens especially in cases where patients are on treatment for life like we see with HIV (Cousins, 2016; Kalofonos, 2010; Prince, 2012) . The practice of adjusting dosages based on the availability of food has been noted by Prince (2012) in her work among HIV patients in Kisumu Kenya (Prince, 2012). Amidst struggles of families to secure a meal a day, the food supplements provided by ART programs for their patients were shared by the whole family. When the food supplements were discontinued, people reported experiencing an increase in hunger and yet they could not take their ARVs without food. Similarly, Marsland (2012) describes the struggles of HIV patients in rural Tanzania to fulfil the requirements of feeding well and resting enough that contradicted their everyday realities of limited access to food and garden work to make a living (Marsland, 2012). Through their stories, HIV patients associated their CD4 counts with their levels of hunger; a rise in the CD4 count was associated with being able to have meals. Patients are often blamed

for practices that have been described as irrational such as noncompliance to prescribed treatment and self-medication and this draws attention away from the roles that global and national policies as well and regional markets play in shaping the medical environment (Das and Das, 2006). Das and Das (2006) show that the medical environment in urban neighbourhoods in Delhi is a product of global and national processes of health policies drawn based on the ways that the health of the poor is imagined. As an example, they show that healthcare practitioners prescribe antibiotics for short durations and are not always in position to diagnose serious diseases. These practices are shaped by poor regulation by the state, patterns of household incomes and the continuous changes of biomedicine and traditional medicine which together create the local ecology of care. An understanding of the use of pharmaceuticals in this context calls for an understanding of this complex ecology. Building on the idea of understanding the local when it comes to the use of pharmaceuticals, Ecks (2014) shows how psychiatrics in the Indian metropolis of Calcutta use 'mind food' as a metaphor when describing psychopharmaceuticals to patients to persuade them to take them (Ecks, 2014). Mind food is linked to digestion which is appealing to lay beliefs in India that health comes from taking a healthy balanced diet. Referring to psychopharmaceuticals as 'mind food' is convincing because it does not go against existing local beliefs around food as a path to a healthy life. However, referring to psychopharmaceuticals as mind food may have unintended consequences of encouraging undesirable practices such as increasing or decreasing the dose without a health workers' instructions and stopping use of these medicines when people feel better.

Medicines as care

Anthropologists have written extensively about how health care globally has been reduced to the giving of medicines. This is evidenced by public health policy documents that still focus heavily on developing new medicines, improving use of medicines, developing point of care tests, and improving laboratories (Chandler et al., 2016). As an example, the WHO Global Action Plan against Antimicrobial Resistance

focuses on increasing access to medicines, rational use of medicines, and development of new treatments. The focus is rarely on improving the health of people. With increasing concerns about the protection of vulnerable medicines, there is a focus on changing the behaviour of individuals, including patients, prescribers and farmers, around antibiotic use in order to minimise the development and spread of AMR (Chandler, 2019).

Anthropologists have long studied the relationship between humans and medicines. Their research gives insights on the work that pharmaceuticals do in health and health care, and in the different spaces and places where medicines are deployed. Medicines have been described as providing a concrete solution to ill health as they have the power to heal (Van der Geest and Whyte, 1989). Medicines are social objects, and as substances they have power over people and relationships (Whyte et al., 2002). Research conducted by anthropologists has revealed that consumers have their own rationale for using medicines. Consumers apply logic when they self-medicate for common illnesses, or stop treatment when symptoms resolve (Kamat, 2006; Nichter, 2008). Anthropologists have also shown peoples' perception of the strength and efficacy of medicines based on their colour, taste and formulation (Whyte et al., 2002). These beliefs tend to contradict what health professionals would consider rational or appropriate. Furthermore, anthropologists have drawn attention to local beliefs and practices about medicines and have called into question the thinking that biomedical knowledge is 'true' and superior to local beliefs (Chandler et al., 2016).

Anthropological research has shown that medicines are central to the provision of biomedical care and other forms of care. The practice of health workers providing what they believe to be a 'strong' medicine, has been linked to their desire to maintain authority and status as professionals (Whyte et al., 2002). This authority is further maintained by writing prescriptions which allow patients to access medicines. Anthropologists have also examined the concept of care and use of medicines and

technology. Their work has contributed to an understanding of the complexity of care and the 'tinkering' involved in everyday life as people try to discover what treatment works. Providing care calls for practices that are flexible and adaptable to the local conditions. It involves trying one thing and the other until one finds something that works, something described as 'practical tinkering' and 'attentive experimentation' (Mol et al., 2010) (p.13). Care practices are not only reserved for experts, but are available to everyone through experience and experimentation. Care consists of embodied practices that emerge from carefully attending to and adapting to the situation at hand (ibid). The concept of tinkering allows us to understand how medicines are used as a vehicle for delivering care.

Care beyond medicines

Anthropologists have worked extensively with the concept of care. Aryn, Myers et al (2015), describes care as 'an affectively charged and selective mode of attention that directs action, affection, or concern at something, and in effect, it draws attention away from other things' (Aryn et al., 2015)(p11). Anne Marie Mol advocates for a notion of care that is centred on the everyday realities of living with a disease (Mol, 2008). She argues that the logic of choice complicates healthcare management systems and distracts from what really matters in the provision of good care. She says that 'good care is not a matter of making well argued individual choices but is something that grows out of collaborative and continuing attempts to attune knowledge and technologies to diseased bodies and complex lives' (p2).

Furthermore, medical anthropologists have focused on how care functions within humanitarianism (Stevenson, 2014; Ticktin, 2011). For example, care can also do harm if it does not take into consideration what is valued in that context. As Stevenson (2014) states, 'I conceive of care as the way that someone comes to matter and the corresponding ethics of attending to the other who matters' (p3). Lisa Stevenson argues that through employing this definition we can even see colonialism as a kind of care – here colonial institutions envisioned their intervention as a kind of care. Anthropologists have

shown that practices that we see as part of care are best understood within their context (Aryn et al., 2015). Aryn (2015), for example, writes that 'what care looks and feels like is both context-specific and perspective-dependent'(p1). This suggests that understanding care practices in different places calls for careful attentiveness.

Medicines as infrastructure

Some anthropologists have drawn attention to the infrastructural nature of antibiotics (Chandler, 2019; Landecker, 2016). Larkin (2013) describes infrastructures as 'objects that create the grounds on which other objects operate'(p. 329) (Larkin, 2013). Drawing on this perspective, understanding antibiotics as infrastructures calls for attentiveness, as they may not be readily linked to the things that they support in society. This infrastructural approach highlights the way antibiotics are put to use to fill gaps arising from inequalities, as well as gaps in health care systems and sanitation and hygiene systems (Denyer Willis and Chandler, 2019). This line of thinking is drawn from the work of Star and Bowker (2000), who argue that infrastructure tends to disappear and can only be made visible when we identify the characteristics of efficient infrastructure through inversion (Bowker and Star, 2000). As an example, with attention being drawn to AMR as a global public health concern, antimicrobials and the work they do are brought into the spotlight. This can be considered a moment of inversion allowing us to see what is made possible by their presence in societies, economies and, health care that previously went unnoticed (Chandler, 2019). The focus on antimicrobials has brought to the fore how medicines have become a form of care such that restricting one antimicrobial (antimalarial) leads to increased prescription of another (antibiotic) (Chandler et al., 2017; Hopkins et al., 2017). Antibiotics are entangled with the systems of labour and production, enabling quick recovery so that people can return to work soon after an illness, and ensure the stable delivery of standardised products in animal production (Chandler, 2019; Chandler et al., 2016). Considering antibiotics as infrastructure allows us to examine what is at stake and the likely consequences of restricting or removing these medicines. It also shifts focus from the

individual to wider social, economic, political, and societal factors that must be addressed if unnecessary use of antibiotics is to be curtailed. This leads us to realise how narrow the focus on human behaviour alone is for understanding antimicrobial use. The increasing pharmaceuticalisation of global public health continues to reinforce these medicines as infrastructure.

Medicines beyond social objects

Susan Reynolds Whyte has been carrying out research on medicines and health in Tororo – the same area of eastern Uganda as much of my own PhD fieldwork – for the last 30 years. Her influential thinking on medicines was captured in her acclaimed book's title, 'The Social Lives of Medicines', in which she in collaboration with colleagues follow Appadurai's notion of the 'social lives of things', constructing medicines as substances that have an active social life (Whyte et al., 2002). Whyte and colleagues state that 'medicines are substances. As things they can be exchanged between social actors, they objectify meanings, they move from one meaningful setting to another. They are commodities with economic significance, and resources with political value. Above all they are potent symbols and tokens of hope for people in distress' (2002:5). Through this research, the symbolic aspect of medicines is illuminated in considerable detail. Whyte's work, however, leads to wider questions about *how* medicines get deployed to make certain kinds of social, political and economic life possible.

2.6.2 Development and Global Health

Development has been described as implying improvements in wellbeing, living standards and opportunities, but can also refer to historical processes of commodification, industrialisation, modernisation, or globalisation (Edelman and Haugerud, 2005). Since the 1980s, several programmes led by governments, private investors and donors have been rolled out in LMICs to improve their social, economic and political landscapes. Contrary to their goal of improving peoples' lives, these programmes have often reinforced the underlying problems and failed to improve outcomes. Anthropologists of

development such as Tania Murray Li, have pointed to the unintended consequences of institutions meant to foster development, that often have their own priorities which sometimes contrast the with the priorities of the local people (Murray Li, 2007). As development institutions considered by Murray Li in this account prioritise productivity and improving the landscape, the local people end up being resettled from their ancestral land to less fertile areas, are excluded from their motherland and forced to join large-scale agricultural activities where pay is uncertain. Murray Li emphasises that little attention is paid to the social tension that emerges and struggles of the local people with landlessness, indebtedness and vulnerability (ibid). Efforts of national governments in LMICs to promote local development by partnering with foreign donors and development organisations, involve little consideration for cultural way of life of the local people (ibid). The local people are often excluded from decision-making processes, allowing development partners to pursue their interests. Foreign development partners such as the World Bank come with a neoliberal agenda, promoting competition for resources. Far from the promise of socio-economic development, initiatives of development partners often leave the local people poorer, indebted, landless and economically tortured (Murray Li, 2007).

In addition, anthropologists such as James Ferguson have observed that development projects are often designed by experts with little knowledge of the historical and political realities of the local areas they aim to help. As such, many fail or lead to unintended consequences, such as strengthening bureaucratic state power and reconfiguring political realities of poverty and powerlessness into technical problems that require solutions by development experts (Ferguson, 1994). Ferguson notes that development projects aiming to foster economic stability sometimes fail to align with the goals of the local regions where they operate. The approaches undertaken by development experts are often rooted in the assumptions made about the LMIC (Ferguson, 1994). In addition, the basis for determining successful development programmes is biased based on back dated justifications regarding how they led to improved programmes (ibid). Less developed states are classified based on examining them in a

vacuum outside of their important geographic, cultural, and historical contexts, which leads to some detrimental economic decisions; as was done in the case of Lesotho, by cutting off regional economic ties to the massive grain and labour markets to avoid reinforcing South African Apartheid (Ferguson, 1994). Ferguson highlights that the sociological outcomes of these development projects need to be considered. Local socio and economic legacies are destroyed, as complex anthropological problems are reduced to technical ones and technical solutions prescribed. Ferguson and Murray Li's work emphasizes that development programmes need to understand the local context and take into consideration local priorities, to avoid negative unintended consequences.

Anthropologists Biehl and Petryna (2013) have noted that the landscape of global health consists of donors, private organisations and research organisations, each with their own priorities (Biehl and Petryna, 2013). Programmes and interventions implemented to improve quality of life often reinforce inequalities in the communities where they operate through their narrow focus, limited to a specific disease or technology rather than addressing inadequacies in the public sector as a whole. Biehl and Petryna write that 'Global health interventions leave people behind, not only by limiting access to the services provided, but also by producing a parallel system of care and governance that undermines other avenues for care that might take into account broader systemic factors.'(Biehl and Petryna, 2013)(p.135). As an example of how programmes reinforce community inequalities, Pfeiffer (2013) describes the healthcare landscape in Mozambique after the intervention of the US President's Emergency Plan for AIDS Relief (PEPFAR),showing how it contributed to the creation of a fractured health system by funding lateral programmes existing within dilapidated health clinics (Pfeiffer, 2013). In addition, using the concept of structural violence, anthropologist Paul Farmer has emphasised the inequalities that people suffer because of systems and institutions of governance. He highlights how the narrow focus of development efforts that only address access to medicines, while neglecting the broken

health systems and the poor living conditions of people, reinforce these problems (Farmer, 2005; Farmer et al., 2006).

Global health projects end up improving the availability of medical resources to patients and health workers but in the process, they transform the landscape of care in the local setting in ways that may not be beneficial to the local populations. McKay (2018) describes how national policies in Mozambique are transformed as the state attempts to align with the priorities of donor programmes for instance expanding the use of community workers rather than training cadres of medical workers (McKay, 2018). Local medical officials spend more time trying to meet the multiple and conflicting donor requirements which takes away time that could be spent on the implementation of health services. Local expectations and standards of care are sidelined as the care and interventions provided by donors are informed by evidence based on global metrics. Much as donor projects make important treatments accessible, local health actors are left conflicted about how the work that they engage in with donor projects serves to address the local problems of primary health care. Similarly, Prince and Otieno (2014) describe the 'uneven playing field' that health workers in Kenya have to work in where global health projects have greatly invested in the care for a few prioritized conditions while other conditions remain neglected (Prince and Otieno, 2014). The inequality that exists between global health interventions and local public health systems is glaring. While health workers employed by the well-funded global health projects are paid good salaries, the ones working in the public health systems work under conditions of scarcity, are demotivated and often considering leaving. Health workers in the public health system develop a form of care that is good enough for the poor and is tailored to existing socio-economic conditions, medical technologies and the multiple health conditions that patients present with. Care outside global health projects is characterized by health workers losing patients because of absence of the required tools, equipment and medicines, managing big numbers of patients on the wards waiting

for their relatives to find money to pay for their diagnosis and treatment and sometimes paying from their own finances for costs of patients' treatment.

Anthropologists have also observed that global health programmes and interventions shape social relations as well as public health landscapes in resource-poor settings (Biehl and Petryna, 2013). Whyte (2013) describes 'the projectification of care' for HIV in Uganda where the landscape of care is dominated by foreign aid, donors and NGOs amidst the adoption of neoliberal policies (Whyte et al., 2013). In this context, she describes health as 'not a 'right' available to all, but a service open to those in the know, and health care interventions increasingly become a survival mechanism that extends beyond the medical and includes labour, food, and education' (p134). Beneficiaries of these programmes are not just patients but 'embedded actors', that have to navigate complex intertwined social networks. Through her work, the micropolitics in which health and healthcare are brokered, accessed and transformed is illuminated.

Global health has been critiqued as a post-colonial imperial project that continues to enable colonial dynamics today (Biehl, 2016). Inequality in access to resources and information flow has been cited in the case of the Ebola epidemic in Liberia where despite warnings about the risk of Ebola based on research carried out among Liberian rubber workers dating as far back as the 1980s, this information was never brought back to Liberia. Global health and global biomedicine have been described as closely linked to colonial practices and a way of 'managing the colonial aftermath' (Anderson, 2014). Applying a post-colonial lens to the understanding of global health allows us to see the ways in which colonial practices continue to play out in contemporary life. As an example, Jeremy Greene and colleagues note that 'the knowledge frameworks carried forward from colonial times continue to influence both who is invited to the policymaking table and how global health agendas are then prioritized' (Anderson, 2014). Similarly, Richardson (2010) examines the link between epidemics and the various forms of exclusion

that are evident in global health. He argues that the ways in which evidence is generated in public health including epidemiological modelling, generation of metrics and big data and epidemic responses enable the continuation of global inequities (Richardson, 2020). Long after former colonies have gained independence and even with the increased emphasis on decolonization in global health, traces of colonialism continue to manifest in the form of economic exploitation, institutionalized racism, research institutions that do not incorporate avenues for delivering clinical care and universities from overseas that extract academic capital from those in the Global South without making a proportional contribution to local healthcare institutions.

Global health has been characterised as a reflection of capitalist neoliberal world order as shown by the economic interests it comes with that manifest in the power struggles between public and private health agencies, each pushing for their interests and reinforcing the inequalities they seek to overcome (Biehl, 2016). The inequality and violence that comes with care provided under some humanitarian projects in global health has been highlighted by anthropologists (Didier, 2012; Stevenson, 2014; Ticktin, 2011). Certain forms of governance are produced as a result of humanitarian intervention. Nguyen (2010) describes 'government-by-exception' where certain people are excluded from care by 'a consortium of foreign donor governments, northern universities, hospitals, research institutes, churches, pharmaceuticals firms, and even the American military' as interventions and technologies are rolled out in global health (Nguyen, 2010). Brown (2015) describes the tension that arises from a form of shared governance between the Kenyan Ministry of Health officials and officials from organisations funded by PEPFAR (the President's Fund for AIDS Relief) as they navigate the differences arising from the ability to provide resources and the right to administer them (Brown, 2015). International agencies engage in providing health care services once provided by the state using state infrastructure as a way of strengthening local health systems. However, the differences between the two in infrastructure, salaries, staffing, equipment are striking. While partnerships between international agencies and local

officials are expected to be built on principles of reciprocity and equality, in reality the large disparities in availability of resources mean that local authorities have to negotiate forms of sovereignty and responsibility in these collaborative engagements.

2.6.3 Inequality and entrepreneurship

Precarity and uncertainty

Anthropologists have looked extensively at inequality and the resultant human suffering that people experience in their everyday lives. The theories of precarity and social suffering contribute to an understanding of the ways that certain groups of people who experience inequality find themselves in those circumstances, and how they find ways to survive. Precarity has been described as a condition of capitalism and neoliberalism which promote independence, individuality and self-responsibility. The vulnerable populations such as the homeless, migrant workers and the elderly are blamed for poverty, drawing attention away from the power relations and structural violence underlying the global political economy, and shifting responsibility of caring from broader social, political, and economic institutions. Butler (2010) describes precarity as "a politically induced condition in which certain populations suffer from failing social and economic networks, becoming differentially exposed to injury, violence and death" (Butler, 2010). Precarity entails a lack of stable work and steady incomes, unpredictable cultural and economic terrain and conditions (ibid).

By contrast, precarity has been described as the fate for most people today who have to face a life full of troubles with no end. Tsing (2015) describes precarity as 'Life without the promise of stability' (Tsing, 2015)(p2). She further describes precarity as 'a modality of being marked by indeterminacy that is less the exception than the condition of our times. Uncertain about where/when/how one will make do in the present, the precarious lack handrails for anchoring the future as well'. Similarly, precarity is associated with a life that is filled with uncertainty and no signs of progress, as described by Allison

(2016) who writes 'in this uncertainty of time, where everyday efforts don't align with a teleology of progressive betterment, living can be often just that. Not leading particularly anywhere, lives get lived nonetheless' (Allison, 2016). Allison's work in Japan focuses on the period from the early 1990s, during the recession when people experienced joblessness and unstable employment resulting in social isolation, as family life and structures deteriorated and people led precarious lives (Allison, 2013). Precarity is strongly linked to changes in the global economy that render people economically incapacitated, resulting in debt and scarcity as they struggle to provide care and maintain life (Han, 2011; Hayder, 2012; O'Neill, 2014). Stable and better paying jobs are out of reach for those in precarious circumstances, because of emergencies of everyday life that make adhering to strict conditions of wage labour employment frequently impossible (Miller, 2014). As such, people may be trapped in precarious day-wage labour that is flexible enough to accommodate the conditions of their uncertain life. Uncertainty has been shown to make life precarious. Whyte and colleagues (2015) write about the uncertainty that people receiving HIV care have to live through in Uganda where HIV treatment can only be accessed by people with particular social connections (Whyte and Siu, 2015). They describe the wellbeing of HIV patients as being contingent on people and institutions which creates more uncertainty. HIV care and treatment creates more dependence on social relations which both create and alleviate uncertainty. Certainty is attained in various ways, one of which is through a relationship with God. Among the Samias of Uganda, an understanding of good and evil helps people to cope with uncertainty with misfortunes in life believed to be caused by evil spirits and the good things in life being linked to God (Christiansen, 2009). Certainty is conditional, maintained by keeping a good relationship with God and never straying into evil practices. Everyday life in informal settlements in Kampala is characterised by precarity that takes the form of economic instability, lack of employment, living in fear of peoples' property being destroyed by government authorities, inadequate medical resources, poor sanitation, lack of food and constant flooding (Kayla, 2019). Cooperative survival has been described as a

function of life among the urban poor living in informal settlements in Kampala. This entails people depending on others for help to survive for instance sharing houses especially when flooding occurs. Frequent flooding and pollution in informal settlements in Kampala means that people suffer high rates of infection and disease. To cope with the challenges of ill health and ensure that they continue working, people rely on the piece meal use of medicines (Nabirye et al., 2021).

Social suffering

Social suffering has been described as the lived experience of pain, damage, injury, deprivation and loss (Wilkinson, 2005). Suffering takes on various forms, has diverse harmful effects and is shaped by cultural and social conditions of life (Kleinman et al., 1997; Wilkinson, 2005). In that sense, suffering can be a reflection of social structural oppression. Social suffering has been linked to peoples' state of physical and mental health, underscoring that health is a product of social processes and life events (Kleiman, 2006). Social suffering results from the effects that political, economic, and institutional power have on people, and how these powers shape responses to social problems (Kleinman et al., 1997). Furthermore, social suffering has been used to draw attention to the negative effects of neoliberal economic policies that include lack of proper housing, unemployment and low wages despite long hours at work (Bourdieu, 1999). Anthropologists have written about social suffering, describing the experience of people living in LMICs who grapple with poverty while living in the conditions of deprivation (Farmer, 1997). Social suffering describes the experiences of people living in poverty to illustrate how social experiences of ill health tend to receive little attention from those in power (Das, 2015; Kamat, 2013). In addition, scholars have emphasised the need to pay careful attention to the language and imagery used to describe human suffering in any material shared in the media or other public domain to avoid further marginalisation of those suffering (Chouliarki, 2006; Sontag, 2003). Material should be produced with the goal of delivering a 'moral education' and evoking in-depth analysis of social ills, while avoiding pity

and sympathy – negative consequences which may reinforce the power relations between those suffering and those witnessing the suffering (Halpern, 2002; Spelman, 1998).

Social suffering and co-morbidities

The concept of social suffering has also been used by anthropologists to describe peoples' lived experience of ill-health. In thinking about chronicity and the co-existence of multiple health conditions (co-morbidities), anthropologists have studied the experience of human suffering that involves patients, families, and communities affected by chronic diseases (Weaver, 2016). To address chronicity in the context of co-morbidity and multimorbidity, attention should be paid to multiple forms of suffering, of varying intensities, durations and frequencies, as well as those who share in and respond to the suffering (ibid). However, the definition of co-morbidities in global public health falls short, as it puts emphasis on overlapping disease categories such as diabetes and cancer. Does the overlap of lingering forms of ill health such as back pain and abdominal discomfort then count as comorbidity? This brings us back to the debate in anthropology of what counts as a disease in the first place. Some anthropologists have argued for the expansion of the definition of co-morbidity to include comorbid states of risk and perceived risk, for which people may or may not be engaging in treatment (Nichter, 2016). Conditions such as lack of clean water and scarcity of quality health care that predispose people to the risk of ill health, could be taken into consideration when conceptualizing co-morbidity. Some scholars have called for funders, scientists and researchers to consider the cumulative effect of several diseases as an area of focus. They argue diseases often cluster because of a common risk factors and handling each condition in isolation may complicate the care of such patients and have negative effects, as the common risk factor is missed as well as interactions of the different medicines taken (Witty and Watt, 2020).

The 'syndemics' perspective allows us to consider how social conditions and unjust structural relationships work together to propel what we see as a situation of being 'sick all the time' (Singer et al.,

2012; Singer et al., 2017). A syndemic approach has been suggested for understanding entanglements between disease/illness clusters, and how they are mutually re-enforcing at the biological and population level, arising from unfavourable social conditions and detrimental social connections (Singer and Clair, 2003). Singer and Clair (2003) describe synergistic effects between alcohol abuse, HIV infection, morbidity and mortality and of patients with hepatitis C virus co-infection (ibid). The syndemic approach was developed to push back against the dominant conception of diseases as distinct entities, attacking specific organs in the body, independent of other diseases and with no connection to the cultural and social context within which they occur (Singer, 2010) (p.25). The syndemic perspective enables us to consider how diseases interact with social, cultural and environmental conditions that contribute to the spread of disease (ibid). Singer says that, 'In syndemics, the health effects of co-morbid conditions are not additive, but multiplicative' (Singer, 2010) (p.26). Synergistic effects of alcohol abuse and behaviour disorders on the social health of families and the ways in which distressed individuals in the family affect each other, have been described in the context of post conflict in Northern Uganda (Meinert and Whyte, 2020). Family problems that people face are in themselves epidemics underscoring the importance of understanding how social conditions and connections reinforce trauma (ibid). These problems are so intertwined that establishing cause-and-effect linkage between, for instance, trauma and domestic violence is challenging, and solving one problem does not necessarily fix the others. A multi-sector approach is required to address syndemics.

Entrepreneurship

Medicines get entangled with wider economic and political landscapes in different contexts. Whilst the body of scholarship focusing on the economies of medical research participation has grown substantially (Aellah and Geissler, 2016; Prince, 2014; Stadler and Saethre, 2010), the connections between everyday use of medicines and wider cultures of opportunity and entrepreneurship are less well developed in

medical anthropology literature. Anthropologists engaging in the anthropology of work have examined the changes in the production and economic space in market-driven societies around the world, illustrating the ways that marginalized populations are often forced to navigate these changes and create new opportunities for themselves defined through informality, hustle, and precarity (Aggarwal 1995; Millar 2008; Preston-Werner 2008; Freeman 2014). Aggarwal (2015) describes efforts of Tibetan women working in the antique section creating new workspaces at the side-lines of the city when they are displaced as the government constructs shops (Aggarwal, 1995). They turn this change into an opportunity to negotiate prices with their customers, build social relationships, secure sponsorships as well as exchange information and knowledge as they interact with tourists in the antique market. This new workspace allows Tibetan women who are often marginalised to regain their respect and dignity in society as businesswomen and offers the flexibility they need to fulfil their social roles. Amidst increasing unemployment in Rio de Janeiro in Brazil, people living in precarity opt to work on the dump rather than seek formal employment as the dump offers autonomy of work, daily payment, flexibility if they are unable to work sometimes and allows them to attend to their social responsibilities (Millar, 2008). Older women in Costa Rican households embrace new forms of work that take the form of direct selling organisations (Preston-Werner, 2008). This new form of work enables women to overcome the social invisibility that they face and get economically empowered by offering them autonomy and giving them an identity.

In Nigeria, 'chasing money' is the order of the day as people make an effort to meet their basic needs (Peterson, 2014). Business is so unpredictable that in one moment, one can go from making huge profits, to barely surviving and to losing everything. People rely on loans to cope. Nonetheless, giving up is not an option as people keep hoping to make it big one day. Every life is defined by insecurity. The burden of managing insecurity falls solely on the individual. In a country where infrastructure has broken down and people have to meet their health care and education needs, everyday life and

business are a gamble. Thieme (2018) examines everyday experiences of youth in an informal settlement in Nairobi Kenya as they manage the insecurities associated with intermittent work (Thieme, 2018). With the meagre income the youth make from engaging in informal waste labour, everyday life is defined by improvising ways of survival. Living and working in precarious conditions, the youth get accustomed with depleting savings, starting over, recovering from crisis after crisis and dealing with unexpected job disruptions. Nevertheless, live is lived between opportunity, hope, setbacks, and disappointment. Taken together, these studies demonstrate how 'entrepreneurship' infiltrates social relations, citizenship and notions of the self.

2.7 Chapter Summary

In this chapter, I have walked through the framing of AMR as a threat both globally and in Uganda. Behaviour-based and educational approaches have been adopted to address the problem of unnecessary use of antimicrobials, but some of these have had limited success. The One Health approach has been an attempt to consider AMR as a problem of connectivity, that should be addressed from the human, animal and environmental perspectives, and across sectors and countries. I highlighted the contributions of social science research to understanding AMR and antibiotic use, emphasizing the importance of developing interventions to address antibiotic use, informed by an understanding of the local setting. This was followed by a focus on social theories that anthropologists have used to explore different dimensions of the problem of antibiotic use including pharmaceuticals, limitations of development programmes and inequality. I close the chapter with a description of my theoretical orientation informed by social theory regarding medicines as social objects and beyond, the anthropology of care, and the anthropology of opportunity and entrepreneurialism. In the next chapter, I describe the context of this thesis in Uganda, with a focus on development and the culture of opportunity, the health system and regulation of pharmaceuticals, and a description of the rural, urban and peri-urban sites of the AMIS study – where the data presented in this thesis was collected.

Chapter 3 Study setting

3.1 Introduction

In this chapter, I introduce Uganda as a country, with a focus on its key characteristics that shape my analysis, and on the three study sites of rural Tororo, urban Kampala, and peri-urban Wakiso.

3.2 Uganda

Uganda is a landlocked country straddling the equator in Eastern Africa. After 68 years of British colonial rule, Uganda gained independence in 1962. At the time of independence, Uganda was reported to have one of the most vibrant economies in sub-Saharan Africa, with most of the national revenue generated from exporting food and cash crops as well as animal products (Sejjaaka, 2004). Following independence, Uganda spent more than 20 years undergoing civil strife between 1966 and 1986, resulting in economic downturn, civil war and destruction of infrastructure (Ibid). Since 1987, Uganda has enjoyed a considerable measure of economic and political stability but continues to grapple with problems of corruption, dependence on foreign aid, poverty, social inequality, and ethnic intolerance (ibid). Today Uganda's economy still depends on agriculture which employs 72 percent of the total labour force, 77 percent of whom are women mostly residing in rural areas (Uganda National Planning Authority, 2015). Over the years, there has been a shift in focus by the Ugandan government from poverty reduction to wealth creation. The current national wealth creation project led by the Ugandan government, is aimed at creating a system that facilitates effective national socio-economic transformation with a focus on raising household incomes (Angina, 2019; Tabaro, 2018). To achieve this, the government has led a drive to transform the mindsets of people in subsistence homesteads to embrace the 'money economy' by going into commercial farming (Angina, 2019).

3.2.1 Development and Opportunity

Uganda has been identified amongst African countries as having adopted the neoliberal reform package most extensively (Harrison, 2006). Based on what is seen as an outstanding performance in implementing liberal economic reforms, Uganda has often been used an example that other developing countries that are in the early stages of adopting reforms should emulate (Kuteesa et al., 2009). When the ruling party, the National Resistance Movement (NRM), came to power in 1986 they promised to bring 'fundamental change', including transforming the economy from a peasant based economy to a modern industrial economy that would lead to a middle-class based society (Wiegratz et al., 2018). The first decade of the rule of President Museveni saw the roll out of the neoliberal reform agenda. Structural Adjustment Programmes (SAPs) were implemented in the late 1980s, followed by liberalisation, privatisation, 'de-regulation' and public sector reforms in the 1990s (Ddumba-Ssentamu, 2002). The SAPs were accompanied by continuous financial and technical assistance as well as persistent pressure to adopt reforms and incentives from donors, whose presence in the country is still felt to date (Wiegratz, 2010). The NRM government had considerable domestic and foreign support during the late 1980s to the mid-1990s, because they were seen as having ushered stability into the country and driven 'rapid' economic growth following several years of war.

The second decade of NRM rule (1996-2006) saw the country continue to 'thrive' when it came to implementing liberal economic reforms, being described by international financial institutions such as the World Bank as a 'development model' to be emulated by other African countries and beyond (Kuteesa et al., 2009). During this period, development reforms such as the 1997 Poverty Eradication Action Plan, the World Bank Poverty Reduction Strategy papers and the International Financial Institutions' original Heavily Indebted Poor Countries Initiative were rolled out (Government of Uganda et al., 1997; Wiegratz et al., 2018). Uganda being described as a success story, was based on official figures for economic growth and poverty reduction produced by the government and international

financial institutions (Government of Uganda et al., 1997). These figures attracted more donor support to the Ugandan government to strengthen efforts to boost the economy, address poverty and improve the living conditions of the poor (Wiegratz et al., 2018). Between 1990 and 2006 Uganda is reported to have received foreign aid equivalent to 11 percent of its GDP (UNU -WIDER, 2013).

Uganda is a founding member of the East African Community hosting three key institutions of the community including: the East African Development Bank that has a mandate to promote sustainable socio-economic development in East Africa; the Civil Aviation Safety and Security Oversight Agency whose role is to ensure that air transport services are safe, efficient and profitable; and the Inter-University Council for East Africa, that coordinates inter-university cooperation in East Africa (East African Community, 2021). In addition, Uganda is a member of other global communities including African, Caribbean and Pacific Group of States, the African Union, Common Market for Eastern and Southern Africa, The Commonwealth, Non-Aligned Movement, Organisation of Islamic Cooperation, United Nations, and World Trade Organization (ibid). Uganda is also a member of the Intergovernmental Authority on Development, which was established in 1986 by the six countries in the Horn of Africa, to combat drought and desertification and promote food security in the region (East African Community, 2021).

Following over thirty years of adoption of the neoliberal reform package, Ugandan society has transformed into a market society characterised by a significant dominance of monetary exchange (Wiegratz, 2010; Wiegratz and Cesnulyte, 2016). Ideas of entrepreneurialism and financial independence are advanced by the government, donors and non-governmental organisations through the media (Mabala, 2018; New Vision, 2020; The state house of Uganda, 2016,2017; Wiegratz, 2010). The push for people to start income generating projects and follow their aspirations, is a big part of the national project of socio-economic transformation that is anticipated to lead to a modern, independent, resilient,

and self-sustaining economy – as laid out in the national development plan (The state house of Uganda, 2012; Uganda National Planning Authority, 2020).

Notably, the drive towards a 'modernised' Uganda is happening amidst severe economic uncertainty, high prices of consumer goods and escalating expenditures on the basic services, such as health, education, transport, housing and communication, among others (The New Vision, 2008,2018; Xinhua, 2019). As a result of these pressures, many Ugandans feel an intense need to 'chase money' in order to survive and meet the basic needs of life, improve well-being and accumulate capital and assets. Unemployment and underemployment is very high (9.2% and 44% respectively) due to the shortage of formal sector jobs and high levels of population growth (Guloba et al., 2021). Competition and pressure have increased in many economic spheres, as many people have started businesses to meet the financial demands of everyday life (Mugisha, 2019). The Global Entrepreneurship Monitor (GEM) 2015 reported that Uganda is the most entrepreneurial country in the world, with 28% of adults owning a new business (Daily Monitor, 2021). However, most businesses are informal and small-scale, and are often not profitable; many suffer from high debt and a high business failure rate (50%) (Bertelsmann, 2018; Global Entrepreneurship Monitor, 2014; Lukolyo, 2019; Patton, 2016). With the severely difficult economic situation, the dominant thinking seems to be that opportunities to make money have to be taken up to be able to survive, within an increasingly monetised and unequal Ugandan society. The widespread notion that income generation needs to be prioritised, is also shaped by trends in other sectors such as courts, police posts, hospitals, schools, and housing markets, that are heavily commercialised. Money has become a solution to the increasing insecurity, uncertainty, risk, expenditures, and drive to live the modern life.

Infectious diseases, such as malaria, HIV/AIDS and tuberculosis, and neglected tropical diseases such as schistosomiasis, as well as respiratory and diarrheal diseases, are prevalent in Uganda (World Health

Organisation, 2018b). Communicable diseases account for over 50% of morbidity and mortality in the country, and the burden of non-communicable diseases is growing (World Health Organisation, 2018b). Across the country, there are wide disparities in health status, and linked to the differences in socioeconomic status, gender and geographical disparity (ibid). The health sector priorities have been aligned with the National Development Plan II, aiming to achieve Universal Health Coverage and promote a healthy and productive life for Ugandans, as a way of enhancing human capital development (Uganda Ministry of Health, 2015). The focus is on increasing three key outcomes: deliveries in hospitals; protecting children under one year from life threatening diseases; and stocking health facilities with essential medicines and health supplies. Uganda attained one of the Millennium Development Goal targets on child health: a decline in under-five mortality rate from 187 to 55 deaths per 1,000 live births between 1990 and 2015 (World Health Organisation, 2018b). Moreover, stunting rates fell from 38.3% in 1995 to 33% in 2011 (ibid). A decline in the maternity mortality ratio from 684 to 343 deaths per 100,000 live births was also reported over the period 1995 to 2015, but this did not meet the MDG target. In addition, Uganda attained some of the targets of MDG 6 on combating HIV/AIDS, Malaria and other diseases of achieving universal access to treatment for HIV/AIDS for all those who need it by the year 2010 (Uganda Ministry of Finance Planning and Economic Development, 2015).

3.2.2 The Ugandan health system

The Ugandan health system has undergone several changes since independence in 1962. Before independence, the biomedical health system was entirely funded by the British government and made up of health units and hospitals, established alongside home-hygiene and preventive programmes overseen by health inspectors (Tashobya and Ogwang Ogwal, 2004). Health facilities were led by a doctor and focused on curative care. Each district had a hospital where healthcare could be accessed free of charge, and the majority of biomedical care was sought and administered through this government-funded system (ibid). In addition to biomedical care, parallel healing systems such as

traditional healers and witch doctors existed, but their use deteriorated under colonial rule with the coming of the Christian missionaries, who viewed traditional medicine as uncivilised and evil and discouraged its use among the local natives (Palanco Lopez and Chandler, 2020).

The public health system deteriorated after independence during the 1970s and 1980s because of economic decline and bad governance, with most public health programmes collapsing and health facilities suffering staff and drug shortages (Kirunga Tashobya et al., 2006). During the 1990s, health sector reforms, specifically decentralisation, were implemented with the introduction of a multi-layered healthcare system including a national referral hospital, regional referral hospitals, a district hospital, and Health centre I-IV at the lowest levels (ibid). Following decentralisation, planning, mobilisation of resources and the management of health service delivery was left to the district authorities. With this approach to management, the running of district health services faced challenges of limited human, financial and logistical resources, and poor supervision and monitoring of health services at all levels (Kirunga Tashobya et al., 2006). With the poor performance of the public health system in the 1990s, there was a proliferation of private healthcare services in Uganda, including licensed and unlicensed private clinics and drug shops (Birungi et al., 2001). In addition, there was an emergence of people providing health care at home and an increase in self-medication (ibid).

Uganda had a well-functioning veterinary sector in the 1950s. The veterinary sector was strengthened during the outbreak of rinderpest in the 1950s, which prompted the British colonial authorities to intensify vaccination and surveillance activities (Palanco Lopez and Chandler, 2020). In addition, the British colonial authorities trained the local people as veterinary staff. Between the 1950s and 60s, the British colonialists provided farmers with aid, including grants and drugs, and encouraged them to move into commercial production as a way of boosting the economy. However, the British did not allow farmers to treat animals themselves, but encouraged them to seek assistance from the Veterinary

Office. The Veterinary Office consisted of professional veterinary officers, diploma-holding animal husbandry officers, and certified veterinary assistants, that worked with veterinary scouts as field assistants. Following the adoption of structural adjustment programmes in the late 1980s and early 1990s, clinical veterinary services were decentralised and privatised, while the civil service was downscaled (Ilukor et al., 2012). This meant that services such as spraying for tick control were privatised, while vaccination of animals against epidemic diseases, quarantines and vector control were left to the Ministry of Agriculture, Animal Industry and Fisheries (ibid).

The publicly funded health system in Uganda today is multi-layered with HCIIs at parish level, HCIIIs at sub county level, HCIVs at county level, district hospitals, regional referral hospitals, and a national referral hospital (Uganda Ministry of Health, 2011a). The health system runs on a referral basis, whereby cases that cannot be handled at one level of care are referred to a higher level. According to the Ministry of Health staffing norms, HC IIs should be run by an enrolled nurse and midwife, clinicians can be found in HCIIIs, while medical doctors are stationed in health centre IVs and district hospitals, and specialists in Regional Referral Hospitals and the National Referral Hospital. In reality, human resources remain a challenge in the Ugandan public health system, and many times the expected cadre of staff may not be found at a given level of care; for instance, HCIVs and hospitals lack doctors but have many clinical officers (Namaganda et al., 2015). Healthcare and medicines are provided free of charge in public health facilities, but medicine stockouts are common (Batwala et al., 2010). It is reported that 72% of the Ugandan population live within five kilometres of a health facility (Uganda Ministry of Health, 2015).

In addition to the government funded health system, the wider health sector is dominated by private healthcare providers. With the deterioration of the public health system for both humans and animals over the years (Birungi et al., 2001; Ilukor et al., 2012), it has been estimated that 60-70% of human healthcare services and all veterinary clinical services in Uganda are now provided by the private sector

(Birungi et al., 2001; Ilukor et al., 2012; Ssennyonjo et al., 2018). In addition, the favourable tax environment in Uganda, where no taxes are levied on imported pharmaceuticals both for humans and animals (Uganda Ministry of Health, 2011b) and the value of the pharmaceutical market has grown from US$ 276 million in 2010 (United Nations Industrial Development Organisation, 2010) to $414 million in 2017 (Pharmaceuticals export promotion council of India), enable the pharmaceutical industry to flourish while being dominated by imported pharmaceuticals.

3.2.3 Supply and regulation of pharmaceuticals in Uganda

The British colonial government played a big role in the supply of pharmaceuticals to their African colonies (Palanco Lopez and Chandler, 2020). Large pharmaceutical companies in the US and the UK opened branches in colonial Africa, many of which still exist in East Africa today (ibid). The British colonialists also controlled who could use or prescribe pharmaceuticals in their colonies, as noted with the penicillin Act of 1947. The supply and regulation of human and veterinary drugs was controlled by the government in colonial Africa. Human antibiotics for example, could only be accessed with a prescription in health centres approved by the Ministry of Health, while veterinary drugs could only be access through the Veterinary Office. However, the presence of private practitioners in the African colonies allowed alternative routes of access to pharmaceuticals. Between the 1950s and 60s, the increased demand for medicines for quick relief amidst an increased pace of life was reported in the UK (Palanco Lopez and Chandler, 2020), as has been noted in East Africa today (Denyer Willis and Chandler, 2019). In Uganda, there was an increase in private practitioners, treatment at home and self-medication, with the deterioration of the public health system in the 1990s (Birungi et al., 2001). In 1993, the Uganda National Drug Authority (NDA) was established to ensure that Ugandans could access quality, safe and effective medicines. In the same year, the National Medical Stores (NMS) was established to procure, store and distribute essential medicines and medical supplies to public health facilities.

The National Drug Authority and the National Medical Stores are the two statutory bodies in Uganda, that are mandated to handle issues related to pharmaceuticals (Uganda Ministry of Health, 2011b). Medicines for humans are provided at no cost through the public health system (World Health Organization, 2007). However, given budget limitations there are regular stock outs, which means patients have to purchase medicines prescribed in the public sector from the private sector (United Nations Industrial Development Organisation, 2010). Medicines in the private sector are distributed to the end users through over 477 pharmacies, about 5,263 registered drug shops, 1,500 clinics, and 114 hospitals (United Nations Industrial Development Organisation, 2010). The NDA Act places antibiotics in Group I of Class B drugs or controlled drugs that can only be legally prescribed by registered medical practitioners, dentists and veterinary surgeons (Uganda National Academy of Sciences, 2015). In addition, the authority to dispense controlled drugs is given to licensed pharmacies under the direct supervision of a pharmacist (ibid). Drug shops in Uganda are only authorised to sell class-C drugs (over the counter) that do not require a prescription (ibid). Drug shops are not authorised to sell antibiotics and injectable drugs. The NDA Licensing guidelines of 2019 state that drugs shops should be registered with the professional council and operated by individuals with a medical pharmaceutical or veterinary qualification.

Pharmacy technicians/dispensers, registered or enrolled nurses, comprehensive nurses, and registered or enrolled midwives are the only professionals allowed to operate human drug shops. However, in reality the people that prescribe antibiotics in Uganda include pharmacists, drug shop vendors, farm managers, veterinary assistants, animal husbandry officers, farmers, and feed makers (Uganda National Academy of Sciences, 2015). Antibiotics can be accessed by anyone without a prescription in licensed and unlicensed drug shops, community pharmacies, shops selling assorted items, shift markets, and from drug hawkers (Mbonye AK et al., 2016; Mukonzo et al., 2013). Whereas the National Medical Stores procures and distributes human drugs and supplies in the public sector across the country,

veterinary drugs and supplies seem not to have a proper distribution system, leaving the veterinary sector to be fully run by the private sector. The current drug regulatory framework, where the National Drug Authority regulates use of both human and animal drugs with oversight from the Ministry of Health, has been criticized for focusing on regulation of human drugs and neglecting the veterinary aspects of regulation. To address the concerns regarding existing gaps in regulation, on October 7th 2019 cabinet took a decision to put in place a separate authority based in the Ministry of Agriculture, Animal Industry and Fisheries, for regulation of veterinary medicines (Parliament of the republic of Uganda, 2019). However, the new authority is not yet operational.

3.3 The Antimicrobials in Society (AMIS) Project sites

The AMIS Uganda study was conducted in rural Tororo, urban Kampala, and peri-urban Wakiso (see Figure *1* below). In the next sections, I describe each of the three study sites.

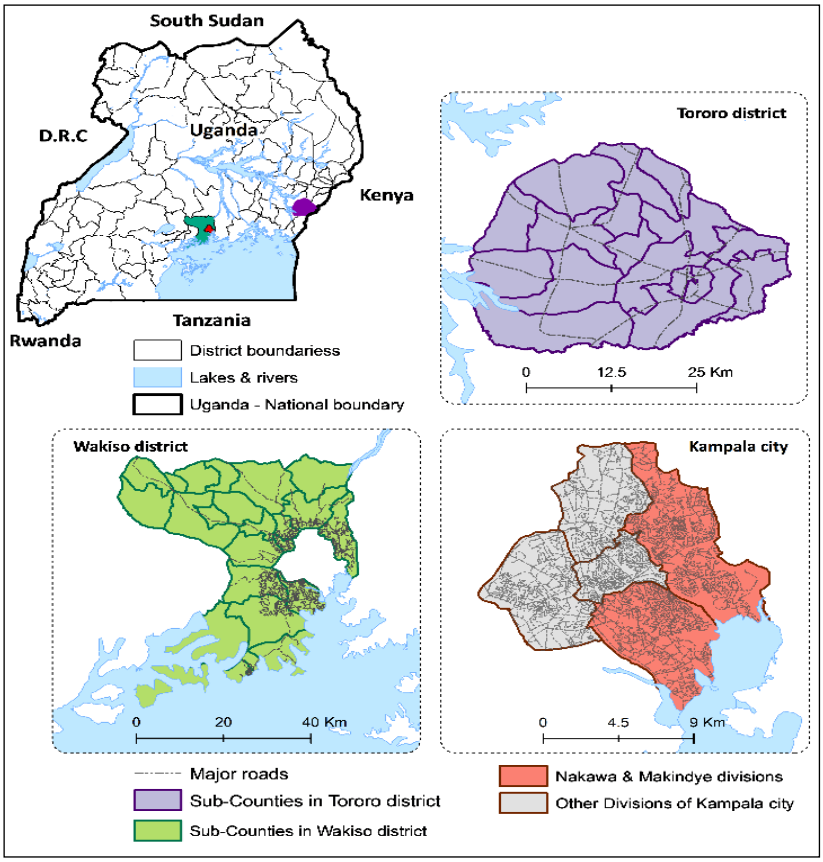

Figure 1. AMIS Uganda study sites

3.3.1 Tororo district

My research on healthcare in rural households and health facilities was conducted in Nagongera Sub County, a rural area in Tororo district. Prior to this study, our team had extensive experience conducting research in health facilities, through the PRIME and PROCESS studies funded by the ACT Consortium (Chandler et al., 2013; Okwaro et al., 2015; Staedke et al., 2013). In addition, Nagongera HCIV in Tororo is a site of the Infectious Diseases Research Collaboration's (IDRC) International Centre of Excellence in Malaria Research, where in-depth research on malaria transmission and epidemiology is ongoing through the PRISM2 cohort study (Kamya et al., 2015). As such, the study team had already established a strong relationship with the district health leadership and had local contacts that would make it easy to build rapport and access the local residents. My primary focus in this area was on residents and their healthcare providers in their everyday life, and the ways in which they used antibiotics to care for households, including humans and animals.

Tororo is a predominantly rural district bordering Kenya, with an estimated population of 517,080 residents living in 102,492 households (Uganda Bureau of Statistics, 2017a). The economy of Tororo is dependent on agriculture, with over 70% of the population involved in subsistence farming (Tororo District Local Government, 2015). Recently, prolonged dry seasons followed by abrupt heavy rains have resulted in poor crops. Poverty is widespread in Tororo, with over 50% of the population living on less than 1 USD per day (Tororo District Local Government, 2015). We observed that people lived 'hand-to-mouth', barely meeting the basic needs of food, health and education. Most families that we observed ate one meal a day, access to clean water was limited and people depended on unprotected wells shared by humans and animals.

The levels of poverty and poor infrastructure observed in Tororo are prevalent across Eastern Uganda, which has been reported to be the poorest region in Uganda since 2013 (Uganda Bureau of Statistics,

2019). The marginalization of Eastern Uganda is rooted in the North-South division of Uganda by the British colonialists. Eastern Uganda was considered a labour reservoir and was neglected when infrastructure and social services were developed and assets distributed (Lwanga-Ntale, 2015; Mamdani, 1983). Although 65 government health facilities exist in Tororo, they lack equipment and electricity and suffer from frequent stock-outs of supplies and absence of the required health personnel (Medicines and health service delivery monitoring unit, 2014). In Tororo, there is one doctor for every 43,144 residents compared to one doctor for every 20,000 residents at the national level (Tororo District Local Government, 2015).

The decentralization of Uganda in 1993/1994 resulted in districts taking on responsibility to plan and manage health service delivery and mobilize resources (Gonzaga, 1999). Subsequently, NGOs and the private sector proliferated, playing a larger role in the provision of health care (ibid). Twenty five percent of health units in Tororo are reported to be supported by NGOs (Gonzaga, 1999). Several research projects and NGOs have been implemented in Tororo district over the years. Some of the NGOs operating in Tororo have included PLAN international, Word Vision, Marie Stopes, The AIDS Support Organisation, Baylor Uganda, Danish International Development Agency, German Development Service, United Nations Children's Fund, United Nations Population Fund, United Nations Development Programme, World Bank, Swedish International Development Cooperation Agency, Africa 2000, Sexually Transmitted Infection Project, Church of Uganda Health Facilities- Christian Children's Fund, the Roman Catholic Church health facilities, the Red Cross and MIFUMI, among others (Gonzaga, 1999; Tororo District Local Government, 2015).

3.3.2 Kampala district

The parallel ethnographic research in Kampala as part of this project took place in a large informal settlement, Namuwongo, which is part of a low-income suburb located in Makindye division of Kampala

(London School of Economics and Political Science Blog, 2015). Informal settlements are defined based on the context, but the UN Habitat Programme definition is often used. Informal settlements are referred to as: 'i) residential areas where a group of housing units has been constructed on land to which the occupants have no legal claim, or which they occupy illegally; ii) unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing)'(UN-Habitat, 2015; United Nations, 2015). This definition promotes an interpretation of informal settlements as fundamentally illegal settings, precipitating the kinds of policing and heavy-handed approaches considered appropriate for illegal living.

Namuwongo is home to more than 20,000 city dwellers. The population in the informal settlement is diverse, including a mix of long-term residents and migrants from across Uganda and the neighbouring countries. Most residents engage in day-wage labour, defined as short term, irregular and/or contingent work, including market and food vendors, factory workers, hawkers, domestic workers, among others. Namuwongo is a popular space as it is located close to the Kampala central business district as well, as the wealthy neighbourhoods that are likely to provide informal employment for urban workers. It also offers affordable housing for residents working in the city and surrounding neighbourhoods. The informal settlement is surrounded by various sources of health care and medicines including private hospitals, government health centres, private clinics, pharmacies, and licensed and unlicensed drug shops.

In the 1990s, the informal settlement began extending further downstream from its original location, following a 'slum upgrading project' initiated by the government with support from UN-Habitat, which left many of the original residents unable to afford the new housing and subsequently drove them to 'unclaimed land' (Muchadenyika and Waiswa, 2018). Today, the settlement is separated by a railway line and located in a reclaimed wetland, surrounded on one side by the Nakivubo channel – which is the

main water channel that carries water and other waste from Kampala city to Lake Victoria – and bordering the wealthy neighbourhoods of Muyenga and Bugolobi. Namuwongo is characterized by poverty, poor housing conditions, flooding during the rainy season, and poor hygiene, which make the residents susceptible to frequent illness. Infectious diseases, including cholera and other diarrhoea-related illnesses, are an ongoing concern in the informal settlement, linked to a lack of clean water and poor sanitation infrastructures. The main source of water for home use in this settlement is unprotected springs, whose water has been reducing in volume over the years and often gets discoloured when it rains. There is a shortage of both public and private latrines in the settlement. Approximately five to ten families share a private toilet and most residents rely on public latrines, which they have to pay for 200 shillings (approximately 0.05 USD) for adult use and can only use during restricted hours. Informal toileting including the use of home bucket systems and polythene bags is common, as people cannot afford to pay each time they need to access a latrine.

3.3.3 Wakiso district

Wakiso district is a peri-urban area located in the central region of Uganda, approximately 20 kilometres northwest of Kampala (Wakiso District Local government). It surrounds Kampala capital city covering a total area of 280,772 hectares (Wakiso District Local government, 2018). Wakiso district is part of the Luwero triangle that was greatly affected by the five year war in the early to mid-1980s (Wakiso District Local government). It was formed through an Act of Parliament enacted in November 2000 bringing together Busiro, Kyadondo and Entebbe Municipality that formerly belonged to Mpigi district, with the goal of improving service delivery and enhancing local development as part of the strategy for sustainable wealth creation (ibid). The district is made up of 2 counties, 6 sub counties, 4 municipalities, 12 municipal divisions, and 9 town councils (Wakiso District Local government, 2018). The district's population is rapidly increasing from 907,988 in 2002, to housing nearly 2 million people today in 504,620 households – half of whom live in the urban areas (Uganda Bureau of Statistics, 2016,2017b;

Wakiso District Local government). In addition, Wakiso hosts the highest number of people working in Kampala city (Wakiso District Local government, 2018).

Wakiso district is an agricultural district that has undergone tremendous growth, currently ranked as a top producer of poultry and pigs in Uganda (Sabiiti and Katongole, 2016). Thirty six percent of the total households in Wakiso engage in both crop and livestock production and a further 24% in piggery and poultry (Wakiso District Local government, 2018). The district houses poultry and piggery farms of different scales and technologies of production including small, medium and large-scale farms, as well as those engaging in commercial, intensive and semi-intensive farming. Other economic activities in Wakiso include fishing, manufacturing, sand mining, tourism, commercial services and informal businesses (Wakiso District Local government, 2018). Wakiso has been ranked as having the highest GDP per capita in Uganda standing at $3,250, which is equivalent to 21% of Uganda's GDP (ibid). The district's proximity to Kampala city provides easy access to animal feeds and market for farm produce (Wakiso District Local government, 2016). The estimated monthly demand for pork in Kampala and Wakiso areas is estimated at approximately 12 metric tons, while that of poultry meat is estimated at 4,933,474 kilogrammes (Wakiso District Local government, 2018). In conjunction with this, Wakiso district has many private veterinarians and farmers that have extensive experience managing illness in animals and birds. Furthermore, there are also government veterinarians attached to each sub-county, and medicines for animals and birds are also easily accessed by farmers from Kampala district.

3.4 Chapter summary

In this chapter, I have described the context of this thesis research in Uganda, with a focus on development and opportunity, the Ugandan health system, and the regulation of pharmaceuticals. I have also described the three AMIS study sites of rural Tororo, urban Kampala and peri-urban Wakiso, where the data I draw on in this thesis was collected. As highlighted, the Uganda government aims to

transform the economy from a predominantly peasant one to a modern industrial economy. This desire has seeped into peoples' everyday lives across the three study settings emerging as a culture of opportunity and entrepreneurialism – as we shall see in the following chapters. I have drawn attention to the organisation of the Uganda public health system as multi-layered and described some of the existing challenges with shortages of medicines and supplies, as well as limited human resource. Uganda also has a dominant private sector. Regulation of human pharmaceuticals in the country is handled by the National Drug Authority, but an appropriate authority to manage veterinary medicines has yet to be established. I have described Tororo as a rural agricultural district with a history of donors, researchers and NGOs operating in the area for decades. In Kampala, I highlighted how the informal settlement came into being and the debilitating conditions within which people live. Wakiso is a peri-urban agricultural district that because of its proximity to Kampala, has been carved out as a model district for development and sustainable wealth creation, with a focus on livestock farming. In the next chapter, I describe the methods I used to collect data from Tororo, as well as and the methods employed in Kampala and Wakiso.

Chapter 4. Methodology

4.1 Introduction

In January 2018, I started my PhD journey using ethnographic methods to investigate the role of antimicrobials in everyday life, with a focus on residents and their healthcare providers in a rural setting. My PhD has been supervised by two medical anthropologists based at the London School of Hygiene and Tropical Medicine (LSHTM) and an LSHTM clinical epidemiologist based in Uganda. Our monthly supervisory meetings, held throughout my degree, have been a key source of guidance and input from experts in my field of study. Having senior researchers from differing disciplines and with vast experience and knowledge about the field of medicines use in Uganda and elsewhere, as well as methodology expertise and analysis techniques, has been invaluable in shaping how I approached answering the research question. The diversity that the senior researchers brought to this thesis, enabled me to attain a deeper understanding of the complex phenomenon of antimicrobial use in rural households, the urban informal settlement, and in commercial pig and poultry farms. This thesis draws upon anthropological approaches and, thus, before describing the methods used for my study, I will explain my own theoretical orientation.

4.2 Methods

To explore my research questions (see page 26), I used a range of methods within a multi-sited ethnographic approach. Specific methods included: 1) *Antibiotic surveys* to understand how and which antibiotics are used domestically, for people and animals; 2) In-depth *ethnographic fieldwork* involving participant observation and key informant interviews, to understand how antibiotics are intertwined in people's lives, with a focus on why, and how, people rely on them; 3) *Participant feedback discussions* carried out every 3 months to provide preliminary feedback on research findings, in order to elicit

feedback and discussion among participants and local public health officials; 4) *Documentary analysis* of relevant literature, policy documents and public health and media content, to contextualize ethnographic findings.

Ethnographic fieldwork provides opportunity for immersion and offers a rigorous iterative approach(Bernard, 2011b; Russell, 2011), ideal for understanding the roles of antimicrobials across a variety of social spheres and levels of scale. Multi-sited ethnography is an approach to studying a phenomenon of interest, in this case antibiotics, and how they intersect with life, livelihoods and healthcare for humans and animals, by following various paths across households, farms, animal markets, and healthcare facilities, and also drawing on materials from archives, documents and policy spaces. Recognising that households and farms are heterogeneous entities and always evolving (Guyer, 1981), we defined a household as people who prepare and have their meals together and sleep in the same dwelling. Farms were defined as a gazetted area of land and buildings or structures used for rearing animals. As my starting point for investigating the increasing use of antibiotics in Ugandan society, I took the everyday life and lived experiences of my study participants as my point of departure. What this means is that I paid attention to how antimicrobials are actually used in everyday life, without making assumptions about 'misuse' or 'appropriate' of antibiotics beforehand. This involved spending an extended period of time with my study participants visiting them on a daily basis, assisting them with simple chores at home or where they worked and having conversations with my study participants, and their families and close friends about their lives, health care practices, livelihoods and other aspects of life to gain an understanding of daily life. This also involved documenting this information, and reflecting and drawing conclusions on how and why they used antibiotics in the way that they did. In addition, I also held participant feedback discussions, as these provided an opportunity for richer discussions with participants and a better understanding of the study findings.

4.2.1 Antibiotic surveys

Antibiotic surveys were conducted to answer the following research question: *How and which antimicrobials are used, for people and animals in Tororo, Kampala and Wakiso?* Antibiotic surveys were also conducted in rural households in Nagongera, among day wage urban workers in Namuwongo, and among commercial poultry and piggery farmers in Wakiso, to understand what antibiotics participants were familiar with and used to treat illness in humans and animals. The antibiotic survey work also allowed me to identify households of particular interest for the ethnographic component of my work. I then conducted a cross-site analysis of the antibiotic survey findings presented in chapter 5 of this thesis. As such, in the next sections, I describe the recruitment, study procedures, data management and statistical analysis of the antibiotic survey data across the three study sites.

Recruitment

From November to December 2018, 100 participants were enrolled in Nagongera, while from May to June 2018, 174 and 115 participants were enrolled in Namuwongo and Wakiso, respectively (Figure 2). Potential participants were identified with the help of field guides, including local council leaders (LCs) and village health team (VHT) members in Nagongera and Namuwongo, and animal health workers in Wakiso. In Nagongera and Namuwongo, households were included if: (1) at least one adult (≥ 18 years) was present; (2) household members were permanent residents (lived in the area for at least 6 months); and (3) the adult agreed to provide written informed consent. In Wakiso, farms were included if the farm owner: (1) was present or could be reached by phone, and (2) agreed to provide written informed consent. Households and farms were excluded if an adult resident or farm owner could not be located after at least two visits. Participants were selected using convenience sampling, but we attempted to recruit a cross-sectional sample of the population in each study site.

Study procedures

Prior to the surveys, the study team met with local health and veterinary officials, as well as village leaders, to discuss the survey plans. The survey was conducted using the 'drug bag' method (Dixon et al., 2019). First, we visited local drug shops, pharmacies, private clinics, and public health facilities, and with the help of Ugandan pharmacists, compiled a list of antibiotics available for human and animal use. Subsequently, we purchased packets, bottles, tablets, capsules, and vials of the antibiotics reported to be most commonly requested. These medicines were put into a 'drug bag'; one for human antibiotics and another for animal antibiotics. During the surveys, we presented the drug bag to participants and asked them to 'pile sort' the medicines into four different categories, including drugs they: (1) recognised, (2) had ever used, (3) used frequently, and (4) needed, but could not get. While the participants sorted the medicines, we used a pre-set questionnaire to gather information about their experiences using these medicines.

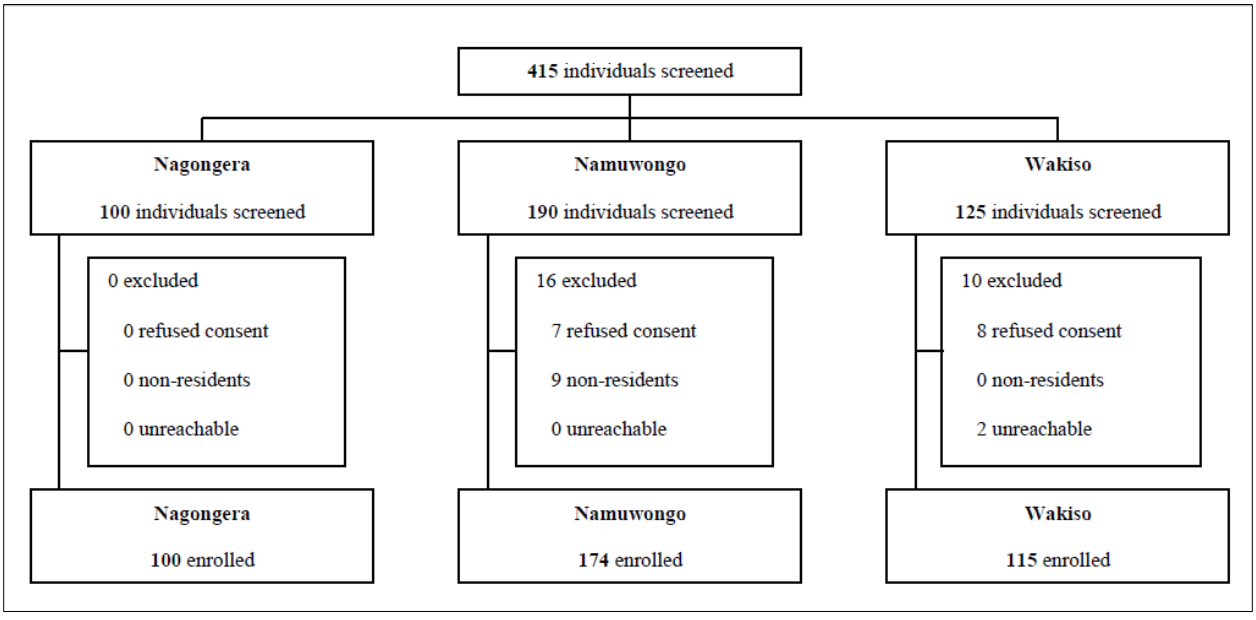

Figure 2. Antibiotic survey profile outlining the process of recruitment, screening, and enrollment into the study. In total, 100 participants were enrolled in Nagongera, 174 in Namuwongo and 115 in Wakiso.

Data management and statistical analysis

Data were collected using hand-held tablets which were programmed using Open Data Kit (ODK) (accessible at www.opendatakit.org)**.** We classified antibiotic use into two categories: (1) Any antibiotic use (ever used): defined as taking any antibiotic, for any indication, with any dosage, with or without a prescription, as reported by participants; and (2) Frequent antibiotic use: self-reported by study participants during the pile sorting exercise and defined during analysis as antibiotic use within the past month. Questionnaire data were transferred daily from the tablets to a password-protected laptop. At the end of the survey the complete databases were stored on a secure server at the Infectious Diseases Research Collaboration (IDRC) in Kampala. Data were analysed using STATA 14 (StataCorp LLC, College Station, Texas, USA).

Antibiotics for human use were categorised using the WHO AWaRe classification, (World Health Organisation, 2017) as (1) Access: first- and second-choice antibiotics for common infections that should be widely available, affordable and quality-assured; (2) Watch: first- and second-choice antibiotics recommended for a specific and limited number of indications, given their association with antimicrobial resistance; and (3) Reserve: antibiotics that should be treated as a 'last resort', limited to highly specific patients and settings, and used only when all alternatives have failed. The WHO AWaRe classification aims to inform effective antimicrobial stewardship and ensure access to necessary antibiotics and appropriate prescribing (World Health Organisation, 2017). Antibiotics used for animals were interpreted using the WHO list of critically important antimicrobials for human medicine (WHO CIA), which classified antimicrobials as (1) critically important, (2) highly important, or (3) important, based on their indications for treatment of humans. This list aims to ensure that antimicrobials, particularly those classified as critically important, are used with caution both in human and veterinary medicine (World Health Organisation, 2018c).

In the analysis, descriptive statistics were generated, and proportions were reported for each variable. Chi-squared tests were used to compare participant characteristics between the study sites. Prevalence ratios (PRs) were generated for comparisons of data on prevalence of any antibiotic use, frequent antibiotic use, different antibiotics used, and the source of antibiotics, between the study sites. The PR in our study was the ratio of the outcome of interest (proportion of participants that reported any antibiotic use, frequent antibiotic use, use of different antibiotics, and source of antibiotics), divided by the proportion of participants surveyed in a given geographic location.

4.2.2 Ethnographic fieldwork

The ethnographic fieldwork constituted the core of the research that informed this thesis. I carried out the fieldwork in Tororo, as well as supervising the fieldwork in Kampala and Wakiso. The ethnographic fieldwork I undertook in Tororo aimed to answer the following questions: *What problems has antimicrobial use become a solution to at the domestic as well as societal level? What is at stake for human and animal care providers when prescribing or dispensing antimicrobials?* To answer these questions, participant observation and interviews were conducted with residents of Nagongera sub-county, whom I had built connections with during the antibiotic survey and through their healthcare providers.

Participant-observation is an established anthropological method that aims for the researcher to immerse themselves in a different setting. It involves the observation of, and participation in, people's routines and activities in order to produce data about what they *do* (as opposed to just say), and also to understand *why* they do what they do in context (Bernard, 2011a; Geertz, 1973). Participant observations seemed the most holistic research method to investigate antibiotic use in rural settings, and how these medicines are used to care for humans and animals (Geertz, 1973; Russell, 2011). Through the use of participant-observation, I was able to produce a 'thick description' (Geertz, 1973) of

antimicrobial use in everyday life, fostering an appreciation of the everyday realities within which antimicrobial use is embedded.

Recruitment

Ethnographic fieldwork in Tororo took place between November 2018 and October 2020, extending my previous work in the area for the past decade. I had made contact with the primary residents that were selected for participant observations during the survey, and they expressed interest in participating in longer-term research. My primary contacts also linked me to their family members and friends. I endeavoured to spend time with a range of individuals with different livelihood activities and ages to capture different experiences and perspectives, such as those who were young and old, from monogamous homes and from polygamous ones, those that had attained some level of formal education and those that had not. Although, inevitably participant observation ends up producing a partial account from the perspectives of the individuals the researcher is most connected to (Pelto and Pelto, 1996). Partiality was not seen as a problematic bias, however, but was addressed through reflexive practice involving acknowledging my own position as an ethnographer (Rabinow, 1977).

The sources of healthcare where participant observations were conducted, were selected based on where household residents sought care for themselves and their household members, including humans and animals. I conducted participant observation in health centre IIs in Nagongera sub county, where residents reported regularly obtaining health care. I also spent time in a private clinic that was popular among residents, and was described as where they obtained medicines when there were stock outs at the government health centres. During my fieldwork in households, I did not observe the treatment of animals by animal health workers. However, my discussions with residents revealed that they obtained care and medicines for animals from animal health workers that they met at the weekly mobile markets,

some of whom also operated veterinary drug shops. This led me to carry out observations of treatment of animals at three mobile markets and one veterinary drug shop.

Study procedures

For the participant observations with residents, I focused on three households as my primary participants. The consenting process was continuous, with participants providing written consent at recruitment and re-confirming consent verbally during the fieldwork period. I worked with a local resident as my research assistant, visiting the households for 6 to 8 hours three days a week, over a period of 12 weeks. I spent at least four weeks in each of the participating households. During my time in the households, I paid particular attention to health and care practices, access to water and sanitation, work, animal husbandry (including any use of antibiotics) and interactions with others, including sexual relationships. I also paid attention to illness episodes and followed people's treatment seeking activities, when they occurred, to understand how illnesses were treated, with a specific focus on how antibiotics and other treatments were positioned within these scenarios, and how power dynamics and social position within the household shaped this. I maintained continuous contact with households beyond my fieldwork period by 'passing by' when visiting the local health facilities and through telephone calls at least once every three weeks. This approach enabled me to develop a closer relationship with the participants over time.

In addition, I carried out participant observations and health worker interviews in two Health centre IIs. Health centre IIs are based at parish level, often led by an enrolled nurse working with a midwife. They run an out-patient clinic managing common diseases in the community and offering antenatal care. I visited the health centres for 5 to 7 hours, three days a week, over a period of 8 weeks. During my time at the health facility, I positioned myself in the consultation room assisting with simple administrative tasks, such as transferring patient information from the patient book to the Outpatient Department

register during consultations. This enabled me to observe first-hand interactions between health workers and patients, witnessing the process of diagnosing and treating patients. Written consent for participant observations and interviews was obtained from health facility staff at once at recruitment. Healthcare provider interviews were conducted remotely using phone calls because movement to the field had been restricted because of the COVID-19 pandemic. Through these interviews, I was able to fill the gaps in the data collected through the participant observations and gain a better understanding of the findings.

Safety while in the households in Tororo was a real concern for me following reports of rampant insecurity in the area. To ensure safety while in the field, I worked closely with a village health team member as my research assistant during the participant observations. My research assistant was a wife, mother and respected member of the community. She joined me for all my visits to households, markets and sources of treatment in the local area. Before the start of field activities, I visited the local leaders including the sub county chief and the local council leaders at the village, parish and sub county levels and shared my study plans. Fieldwork was conducted between 8am and 5pm as these hours were considered relatively safe by residents. It was important for me to ensure that I complied with what was considered acceptable by the community in terms of my dress code and general conduct when engaging with residents.

Data management and analysis

I took field notes during the observations, and later typed these in detail in Microsoft Word documents which I uploaded to NVivo 12 for coding. I did the coding of fieldnotes alongside fieldwork, and an iterative approach was used for the analysis. Following the first three months of ethnographic fieldwork, an interim analysis was carried out and a summary of the initial findings produced. This analysis built on

the previous analyses conducted and informed the next phase of fieldwork. I developed themes from the fieldnotes.

4.2.3 Participant Feedback discussions

After each phase of fieldwork, I held feedback meetings with selected participants and district officials for human health, veterinary medicine and agriculture in a convenient venue, where I shared the findings from the fieldwork and solicited feedback on my findings. I held four participant feedback meetings: two after the antibiotic surveys in January 2019 and two meetings three weeks after participant observations in August 2019; two with residents and two with district officials. The participant feedback meetings followed interim analysis, and allowed for richer discussions with participants and a better understanding of the study findings.

Written consent for participation in the participant feedback meetings was obtained on the day of the meeting. Discussions were recorded using a digital voice recorder. Audio recordings of the participant feedback meetings were transcribed directly in an MS Word document in English and later uploaded to NVivo for coding. Transcripts from the participant feedback meetings were coded into themes developed from the fieldnotes.

4.2.4 Documentary analysis

I carried out documentary analysis on material retrieved from literature reviews and a range of media in the public domain. Literature reviewing involved analysis of academic and policy papers, anthropology papers, books and reports about antibiotic use, the history of the Rational Drug Use Framework in Uganda, and anthropology literature relevant to the use of medicines. I also reviewed literature on the history of the health and veterinary sectors in Uganda, to understand changes that have taken place in policies and how these sectors are organised. Furthermore, I reviewed literature on the political and economic history of Uganda to understand the socio-economic shifts that have shaped Ugandan society.

Media reviews involved collecting and analysing media articles related to AMR, as well as information shared via the social media platforms such as Face book and YouTube. The media content included newspaper articles and written material. The media reviews provided an understanding of current discourses around AMR policies, initiatives as well as discussions on AMR by policy makers, researchers and the general public. Collection and analysis of media content was conducted throughout the study period by saving the material that I came across when I visited Facebook and YouTube every week, and those that were shared by colleagues. I uploaded the media materials to NVivo and included a summary of the content covered. Documentary analysis informed the analysis of the findings from the ethnographic fieldwork, as well as guiding subsequent fieldwork.

4.2.5 Comparative study

The AMIS Uganda project, within which this research was embedded, involved fieldwork I supervised, conducted in an informal settlement in urban Kampala and a farming setting in peri-urban Wakiso, to understand the role of antimicrobials in everyday life. The comparative research presented in this thesis, involved conducting a multi-sited analysis of data emerging from participant observations conducted across the three study sites. To allow for cross site analysis, cross the three study sites the same methods and approaches were undertaken starting with medicine surveys, participant observations and interviews and participant feedback discussions. I compared the ways that antimicrobials are entangled with life in rural Tororo with urban Kampala and peri-urban Wakiso. Part of the multi-sited analysis took place during the weekly meetings with the AMIS team where findings from the field were discussed. In addition, being part of the participant feedback discussions across the three study sites, enabled me to gain a better understanding of the findings. I was also part of some of the discussions of papers arising from the work done in the urban and peri-urban study sites. Common themes such as security identified from the fieldwork in these sites, manifested differently in Kampala and Wakiso – where the focus was on livelihoods and investments. This contrasted with Tororo, where I found concerns regarding security

of household property, including concern about their animals which resulted in people sharing living spaces with them, were linked to persistent ill health. In Chapter 8 of this thesis, I describe the phenomena of security in relation to antibiotic use locally, but also in comparison to debates around global health security. In addition, I observed differences in the pace of life which contributed to the differences in expectations from residents in terms of productivity and, consequently, a difference in how medicines were deployed. Indeed, I found more overlap in the ways antimicrobials were used within households in the urban and rural settings to cope with inadequate sanitation facilities and limited access to clean water.

4.3 Positionality

4.3.1 Anthropology at home

In this section, I explain where social sciences in general and anthropology sit as a discipline in Uganda. This is followed by a reflection on my fifteen-year journey working as a social scientist in biomedical research, to highlight the changes that I have observed in the way social science is perceived, and drawing out the strides that we have made towards increased appreciation of social science in Uganda.

Social science and anthropology as a discipline in Uganda

The field of social science and anthropology is steadily growing in Uganda. As a discipline of study at university level, anthropology is taught in the School of Social Sciences as a module within the Masters in Sociology programme at Makerere University. Gulu University in northern Uganda runs a master's programme in Medical Anthropology and International Health under the Faculty of Medicine. The programme is run in collaboration with the Medical University of Vienna with support from the Austrian Development Cooperation. However, four years since it started in 2013, the programme has faced challenges with funding and low enrolment of students.

Anthropology is not offered at undergraduate level in Ugandan universities. In Uganda, social sciences have for many years been considered a subsidiary discipline as compared to other disciplines in the arts and humanities. It had been labelled a 'flat course' with a general perception that it is taken up by students that fail to meet the minimum academic requirements for university courses in the humanities and arts that are ranked highly, such as law and mass communications. This perception is reflected in the career guidance process at A level, where students completing university entry forms are advised to include social science among the last choices to ensure that in the event that they don't excel in their final exams, they can still get admitted for a course at the university.

As a field of study, social sciences have not been appreciated by some political leaders in Uganda. President Museveni, once a student of the arts, has openly discouraged Ugandans from enrolling for humanities courses at university level, describing humanities as useless and saying their graduates are not employable in the labour market in Uganda. He has emphasised that universities funded by the government must focus on developing more science courses and drop many of the courses in the arts and humanities. The government does not offer scholarships to arts and humanities students anymore. President Museveni believes that training professionals in the agriculture, industries and Information Communication and Technology sectors will lead to an increased number of graduates that have the potential to contribute to national development, by addressing the challenges of housing, food, transport and communication (Daily Monitor, 2020).

Social sciences and anthropology in practice

The increase in the number of collaborative research projects in Uganda has provided an opportunity for the growth of the field of social science and anthropology. Researchers from institutions overseas who appreciate the value of the discipline have incorporated components of it in research studies conducted locally, and supported local teams to build capacity in social science and anthropological methods of

research. Over the past decade, anthropologists trained in Uganda and abroad have taken on jobs in academic institutions and with research institutions – such as my own, the Infectious Diseases Research Collaboration (IDRC) – in the areas of medical research, development and agriculture among others. From 2006 to date, I have had the opportunity to be part of eight research studies working with local and foreign researchers including anthropologists, epidemiologists, medical doctors, entomologists, and statisticians to evaluate interventions aimed at improving healthcare for malaria patients.

One of the dominant perceptions I have encountered is that of social scientists being perceived as best suited for talking to people, while our biomedical colleagues handle the 'real science' aspects of the study. However, over the past five years we have seen a shift, where the role of social scientists in Uganda and in my institution is increasingly being appreciated as critical in answering key research questions. In 2017, the AMIS project became the first standalone anthropological study to take place in IDRC. In the same year, I was the first social science student from IDRC to be offered a PhD scholarship under the malaria training grant funded by Fogarty International Centre of the National Institutes for Health. In the field of AMR and antibiotic use, the contribution of social science to understanding the everyday realities within which antibiotics are used in healthcare settings and in the community, has been recognised by key actors in AMR in Uganda.

In January 2019, I was appointed a member of the One-health Technical Working Committee on Antimicrobial Stewardship, Optimal Access and Use of Antimicrobials. This committee is led by the Ministry of Health and coordinates policies and interventions related to promoting appropriate use of medicines and health supplies in Uganda. In addition, social science aspects have been incorporated in the Uganda AMR National Action Plan 2018 as key areas of research to inform antimicrobial stewardship interventions. Being part of the antimicrobial stewardship technical working committee dominated by biomedical scientists, has allowed me to share findings emerging from our research, drawing attention

to the contribution that social sciences make to understanding complex problems such as antibiotics use. We have also seen an increase in appreciation of social science work when we have presented our findings and received feedback at the National AMR conferences held annually in Uganda. There is still more work to do in terms of shifting the mindset of key actors in AMR, from seeing social scientists as offering an understanding of behavioural aspects of antibiotic use that can be addressed through raising awareness and educating people. The thinking that people's practices are a reflection of their lack of knowledge is still common in public health and global health (Will, 2018). We have tried to address this mindset in the AMIS study by drawing attention to social, economic and political drivers of antibiotic use and emphasizing the need to invest in infrastructures – as I explain in Chapter 9 in the section on 'implications for AMR policy and practice'.

4.3.2 Anthropology as part of a collaborative project

In this thesis, I switch between writing in first person and using 'we'. This is because this research was part of collaborative work and in cases when I am referring to the team I use 'we'. Throughout my research, I reflected on my role, responsibilities and relationships as I carried out my fieldwork. This research was embedded in the AMIS Uganda project to which I am a co-investigator and the local Principal Investigator. I was responsible for leading all aspects of the project in Uganda, from protocol development to project management, implementation of fieldwork, analysis and writing of research articles. I supervised – including regular visits and review of emerging data – the fieldwork in the urban Kampala site and the peri-urban Wakiso site, making it possible for me to make cross-site comparisons with my work in Tororo. Having access to and being aware of the findings from the other study settings allowed me to reflect on the findings from Tororo, and to ask questions about this setting as compared to the other two study sites. With my experience of being involved in research in Tororo for the past decade through the PRIME and PROCESS studies, the cross-site comparisons enabled me to deal with the effects of being very familiar with this setting.

Additionally, my prominent role in the AMIS Uganda study enabled me to be part of national groups working on AMR in Uganda, including the National Technical Working Committee on Antimicrobial Stewardship, Optimal Access and Use. As part of this working group, I attended meetings that brought together Ugandan experts and researchers from the human, animal and environmental sector to discuss issues that were considered critical for AMR in Uganda. Listening to the discourses at the national level, shaped in certain ways what I became attuned to during fieldwork and how I wrote about it. I had access to a team of experts from different disciplines that were part of the team of mentors for the AMIS Hub and the advisory committee to the AMIS Uganda study. Listening to the inputs from these experts on the findings of the AMIS Uganda team shaped the direction that I took with my analysis.

My supervisory team, as well as the AMIS Uganda team, were made up solely of women. As an all-female study team, we were naturally drawn to women as our primary participants in the households where we carried out observations. We interacted more with women and the stories I tell in this thesis are mostly based on the experiences and stories of these women. As an all women team, we paid particular attention to issues of security of the team while in the field, and were careful about the way we dressed and the way we interacted with our participants that were male. Notably, the farmers that we observed were mostly male because most of the farms were managed by men. We found that they were as open to having the team spend time on the farm as the few female farmers we engaged were.

4.3.3 Navigating anthropology as a new field at home

The ethnographic research that we undertook as a team under the AMIS project, was different from the social science research that we had previously engaged in; but also broadly the kind of research that is commonly carried out in Uganda. We had had previous experience conducting participant observations in two projects that were school based and health facility based. Our experience leading ethnographic research in multiple sites that were not controlled settings, such as schools and health facilities, was

limited. We worried about gaining access to new study sites like the informal settlement and farms where we had never previously worked. We also had concerns about the willingness of our study participants to take part given the amount of contact that ethnography requires. Safety while in the households in Tororo and the informal settlement was a real concern for us.

Furthermore, ethnographic research was often not well understood by our biomedical colleagues, who wondered what we did when we spent time in households and farms all day and how our small sample sizes would yield any generalisable findings. Coming from a public health background, we were used to working with structure, plenty of prior planning and following the plan strictly. In the early stages of our fieldwork, we found ethnography to be very unstructured and too flexible. My colleagues and I initially tuned in more to healthcare practices and use of medicines. However, during our fieldwork we were amazed by how much we learnt from our study participants about various aspects of life such as farming, economics, family life, domestic violence, gender dynamics, investment, security, government and non-governmental programmes and education and how these intersected with health and medicine use. Having the privilege to attend national level meetings on AMR alongside my fieldwork, allowed me to understand how narrow our focus on peoples' medicine use practices alone was. Throughout my PhD, my goal was to provide a holistic picture of antibiotic use in everyday life, that reflected the multiple dimensions of the problem. I wanted to demonstrate that antibiotic use was shaped by everyday realities, such as limited access to water, lack of toilets, the pressure to make money, lack of food, climate instability, and difficulty in accessing qualified healthcare professionals. These concerns shaped the stories that I captured while in the field and the findings that I present in this thesis.

4.3.4 An insider and outsider at the same time

Over the past 15 years, I have been part of both anthropological and non-anthropological research studies conducted in central and Eastern Uganda, among people with whom I share an ethnic identity

and those from a different ethnic group. During these rich experiences, I have questioned what would be considered home for me as a Ugandan social scientist engaging in ethnography. Am I at home when in my country, among those with whom I share a language, among fellow social scientists and anthropologists or colleagues from my institution? Being from central Uganda, doing fieldwork in Eastern Uganda amongst people whose language I could not speak, sometimes made me feel like I wasn't at home despite still being located in Uganda. With no clear answer to the question on where home is for me, during my PhD fieldwork I have reflected on my position in relation to my study participants. I was preoccupied with building good relationships with my study participants, constantly being aware of how I might be perceived as someone from a different ethnic group, of a different economic and education status, and being cognisant of the power relations that my position comes with. Notably, during my fieldwork my relationships kept shifting in different settings. In the households where I conducted participant observations, I was received as a student that wanted to learn about everyday life in the local area. I mostly interacted with the women of different ages who felt comfortable talking to me as a friend, daughter, fellow woman, an elite, and an educated person knowledgeable on many things. In the public primary care facilities, I was received as a researcher because I had previously engaged in research in health facilities in the local area and was known to some of the health workers. This experience made me realise that as I observed and studied my research participants, they also did the same with me and this shaped what they allowed me to see, hear and learn from them. I took on different identities, being perceived as 'one of them' when they talked to me as a friend or fellow woman and one of the 'others' when they talked to me as a researcher or an elite. This speaks to the objectivity of a researcher doing fieldwork at home, where the field is assumed to be homogeneous. As a Ugandan social scientist doing fieldwork at home, I was limited to understanding my study participants from the viewpoints that they allowed me to, based on the different identities that I took on.

My limited ability to speak the predominant local language in the local area, is one of the main reasons I questioned whether I was doing fieldwork at home, and whether I was an insider or an outsider. My position of being at the same time an insider and outsider, allowed me to ask any kind of question about what I observed without feeling that I was being judged for not knowing things that I should know as a Ugandan. My pre-existing familiarity with the study site, gave me an advantage of having a strong relationship with the district health leadership and access to local contacts, that helped me build rapport with local residents and health care providers. In general, being a Ugandan doing fieldwork in Tororo, where I had already established contacts from previous studies, made it easier to access and build rapport with the local population. Doing fieldwork in Uganda, which is also my home, meant that my experience with the binary of 'field' and 'home', which are often imagined to be distinct was different because my research seemed to evolve to become a broader project about Uganda, as my research topic required me to expand my frame of focus beyond my study site.

4.3.5 Pressures and ethical dilemmas of doing ethnography at home

Doing anthropological work at home comes with a lot of pressure to properly represent what you learn, and to give back to study participants for the sacrifices that they make to be part of our research. I built close relationships with my study participants which made me very cautious to tell their stories in ways that accurately reflected their reality. I was very careful to ensure that that there was a balanced reciprocity of relationships. The need to give back to the people who had given me so much continues beyond the fieldwork period, and this is felt much more when doing ethnography at home where people continue to contact you and update you on changes in their lives. They became part of my life, both as a researcher and beyond. Even after the fieldwork period, I continue to carry a gift when I visit the local area and call in my study participants.

Doing anthropology at home, presented a dilemma when it came to some of the things that I observed and heard that were ethically wrong. Some of these included observing medicines sold in the market, which is illegal in Uganda and practices like mixing medicines and selling small portions of medicines in the clinics. Reporting such practices came with a risk of losing the trust of study participants, but on the other hand as local social scientist I was aware of what was legal and what was not. Sometimes I was torn between protecting my informant, who had been kind enough to let me observe them, and 'doing the right thing', which would be to let the concerned authorities know what was happening. This burden is felt much more when you are doing anthropology at home. I had to develop the ability to make judgements on what was ethical or not based on what was appropriate for the situation at hand, by weighing between the harm versus the benefit that whatever course of action I decided to take would have on my study participants.

4.3.6 Social science research on veterinary use of antibiotics

I set out to gain a holistic picture of antibiotic use by focusing on both humans and animals. However, observing antibiotic use among animal health workers in everyday life was a challenge, given the current set up of their work where their services are demand based, and so to observe encounters between animal health workers and animal owners required shadowing them and tagging along as and when they received a phone call to go and offer this service. There were no animal clinics in the rural area where this research took place. I ended up positioning myself in the weekly mobile markets where prophylactic treatment was given for animals sold, and where animal owners bought antibiotics to stock at home for care of their animals. I also spent time at a veterinary drug shop, which allowed me to see the antibiotics that people demanded and understand the dynamics around what antibiotics were stocked; but this did not fully represent encounters between animal owners and animal health workers. Thus, in this study, I was not able to fully understand the social and contextual factors that shape the prescribing practices of animal health workers.

4.3.7 The value of incorporating ethnography in social science studies

In my journey working as a social scientist in the field of biomedical research since 2006, I was introduced to ethnography eight years later when I joined the START-IPT study as part of the qualitative team evaluating the acceptability of a malaria chemotherapy study that was implemented in schools. In the START-IPT study, my colleagues and I were trained by a medical anthropologist from a collaborating institution in the UK, on how conduct participant observations and write good field notes. Prior to this, I had been doing social science research employing in-depth interviews and focus group discussions to understand social aspects of malaria related interventions. These methods were useful in gaining a deeper understanding of the success or shortcomings of interventions. Using these methods, my colleagues and I were able to understand the meanings that people attached to different aspects of health and how this influenced their social interactions and ultimately their health outcomes. We were able to gain a holistic understanding of peoples' knowledge and practices on a personal level and how these made sense in particular contexts.

However, despite using these methods, there are some aspects of peoples' practices that we were unable to fully understood. As an example, in chapter 3 I wrote about my work leading a team of social scientists at IDRC to carry out a process evaluation of a large health centre trial called the ACT PRIME study aimed to improve healthcare delivery in selected government health centres in Tororo. As part of the evaluation team, my colleagues and I spent time at health facilities talking to health workers and patients and sitting in on consultations. During that time, we observed that drug stock outs limited activities at the health facilities and antimicrobial prescribing seemed to occur – and be expected – in place of other forms of care. Introducing RDTs for malaria reduced the unnecessary use of antimalarials but increased the use of antibiotics. These observations suggested that medicines may play a larger role than simply a curative one in this area. Talking to health workers and sitting in on consultations enabled

us to observe that medicines seemed to have replaced other forms of care in this setting, but we were not able to gain a holistic understanding of the role that medicines played.

Engaging in ethnography research involving participant observations coupled with interviews and group discussions in the AMIS study and in my PhD research, had several benefits. Ethnographic research provides an opportunity for immersion making it ideal for understanding why and how medicines are used, and the roles that they play across a variety of social spheres (Bernard, 2011b; Whyte et al., 2002). For example, Sjaak van der Geest during fieldwork in Ghana was intrigued by the popularity and widespread use of a contraceptive called 'Alophen' among Ghanaian youth. Through ethnographic fieldwork, he learnt that Alophen played a dual role of preventing pregnancy and terminating pregnancy (Whyte et al., 2002). Using an iterative approach, where an interim analysis of findings was carried out every after three months of ethnographic fieldwork, allowed us to generate relevant questions for follow up through in-depth interviews and participant feedback meetings. As an example, during the participant feedback meetings with participants, discussions focused on key findings from the previous phase of fieldwork. This allowed for richer and more focused discussions with participants, enabling us to gain a better understanding of the study findings. Questions and probes that we included in the topic guides for in-depth interviews with residents and key stakeholders, were built around scenarios drawn from participant observations which enabled us to ask participants sensitive questions without them feeling offended or getting defensive. Throughout our research, our analyses built on the previous analyses conducted and informed the next phase of fieldwork. Ultimately, it is the attentiveness and detailed understanding of the lives and experiences of our study participants, gained through an ethnographic approach, that played an essential role in enabling us to achieve the list of publications presented in the section on 'reflections' in Chapter 9.

4.3.8 Fieldwork during the COVID-19 pandemic

My ethnographic fieldwork in health facilities was interrupted by the COVID-19 pandemic and restrictions on movement in March 2020. Fortunately, I was able to return to the field and complete my fieldwork six months later. However, I was unable to travel to attend conferences where I had hoped to share my findings and develop my analysis further. Some conferences were held virtually, which allowed me to attend remotely. I had planned to spend most of my time writing my thesis in London, where I would have access to libraries, but this was not possible with the restrictions that came with the COVID-19 pandemic. With limited flights to and from Uganda, I also faced challenges around delays in the delivery of the books that I purchased from the UK. This limited the number of books that I could read with in the timeframe available for writing my thesis.

4.4 Data

4.4.1 Data management

Records and storage

All data collected in the AMIS Uganda project within which this study was embedded, was stored on password protected local computers, backed up to a local server at IDRC and uploaded to the LSHTM server held locally at LSHTM. The software that facilitated this back up is FilR, which is a secure server hosted at the LSHTM, and storage of data on this server complies with UK Data Protection laws. The FilR software allows storage of audio, video and written files, and allows users to share data and restrict access to the content stored. All paper versions of the interviews (contact summaries, transcripts), fieldnotes and digital voice recorders were stored in a locked filing cabinet in the Kampala office.

Antibiotic surveys

Data from the antibiotic surveys was entered directly into a database upon data collection using tablet computers, with Open Data Kit (ODK) software. The data was then exported for analysis into statistical analysis software packages including Excel and Stata for analysis. A copy of the medicines interview database was stored in FilR and backed up on the IDRC server.

Participant observation fieldnotes

Field notes of participant observation were typed up in detail into Microsoft Word documents and labelled and stored in predefined folders in a password protected computer, that was backed up on FilR. I uploaded the detailed field notes into NVivo 11 file (QSR International, Cambridge, MA) which was visible to the AMIS research team only. All paper versions of the field notes were stored in a filing cabinet in Kampala.

Key informant interviews and participant feedback discussions

Audio recordings from key informant interviews and participant feedback discussions, upon completion of the interview or discussion, were removed from the digital recorder or phone and stored in a pre-determined folder in a password protected computer, backed up to the IDRC server. Audio recordings were listened to carefully and then transcribed word for word, including all pauses and expressions made. The transcription was made directly into English using meaning-based translation and saved in Microsoft Word documents. These files were imported into NVivo 11 (QSR International, Cambridge, MA) qualitative data management software for coding and analysis. I proofread the transcripts against the audio files. All transcripts had a standardized header including a description of participants, location of interview or discussion and date. Audio files and transcripts made from the audio files were stored in a predetermined folder on the IDRC server and in a FilR folder in a password protected computer. All

paper versions of key informant interviews, participant feedback discussions (contact summaries, interviewer's notes) and digital voice recorders were stored in a filing cabinet in the Kampala office.

Documentary analysis

Literature was stored in a password protected FilR folder. Media content was stored in an NVivo folder using the multimedia functionality and in a predetermined folder in FilR, while the NVivo file was stored in a password protected computer. Any of these materials that were already in the public domain were shared with permission under the data sharing arrangement.

4.4.2 Data analysis

I used an iterative approach to analyse the qualitative data from the ethnographic fieldwork, interviews and participant feedback discussions. While I began this research and carried out initial ethnographic fieldwork with a focus on how antibiotics were deployed as devices for supporting care, during my fieldwork my focus expanded to include the themes of chasing opportunities and entrepreneurialism, that recurred throughout my research and that antibiotics appeared to be interwoven with. I interpreted and coded my fieldnotes alongside my fieldwork. During coding, I made links with the documentary materials and sought additional literature on how others had examined the same topic. I coded the text from the documents and other materials included in the documentary analysis over the duration of the study, and developed emerging themes and sub themes. Coding and analysis were carried out using qualitative data analysis software, NVivo 11 (QSR International). Following the first three months of fieldwork, I carried out an interim analysis and summarised the initial findings of the experiences of study participants in relation to the use and roles of antibiotics, through producing a leaflet. Subsequent analysis summaries were produced following every three months of fieldwork. Each time, analysis built on the previous analyses conducted and informed my next phase of fieldwork. Interim findings were discussed at meetings with my supervisors.

To allow for cross site analysis in the AMIS Project, we developed common study themes. The common study themes were developed during the AMIS project meetings and discussions where findings from the ethnographic fieldwork in the three sites were discussed. Our coding across the study sites involved drawing findings from the field notes, the interviews and participant feedback discussions into the common broad themes. In addition, we coded the literature on the wider social, economic and political trends around the same themes, allowing us to make connections between issues at local, system, policy and international levels. We interpreted the fieldwork findings in the light of the documentary analysis findings, to situate them in the context of the political, economic, historical, national, and transnational issues.

The analysis of findings on antibiotics that were used for humans and animals, collected during the antibiotic surveys through the pile sorting exercise, involved summarising how users categorized the medicines. These piles were then compared with the WHO AWaRe classification which places antibiotics under the categories of access, watch or reserve for antibiotics used for human treatment. Antibiotics used in animals were compared with the WHO list of critically important antimicrobials for human medicine which classifies antimicrobials as: (1) critically important; (2) highly important; or (3) important, based on their indications for treatment of humans (World Health Organisation, 2018c). This classification guided the presentation of these findings, and informed conclusions on the current use of antibiotics for humans and animals at the household and farm level.

4.5 Ethical considerations

The AMIS Uganda study within which this research is embedded was approved by the School of Biomedical Sciences Research and Ethics Committee, Makerere University College of Health of Sciences (SBSREC REF no.562) and the National Council for Science and Technology (SS 4679) in Uganda. The study was also approved by the London School of Hygiene and Tropical Medicine Ethics Committee

(LSHTM Ethics Ref: 15244). The approaches undertaken in this research were in accordance with the ethical guideline for the Association for Social Anthropologists of the UK and the Commonwealth (2011). As a researcher, I followed the principles set out in this ethical guideline throughout the preparation for and during research, analysis and writing up processes. I took ethics as a relational process, which meant that I was open and sensitive to the diverse participants and circumstances I encountered during my research. The extended nature of engagement of my research, meant that I was able to develop an acute sensibility to potentially difficult or emotional topics and develop contextually and culturally appropriate responses – including rephrasing or dropping questions and disengagement where necessary. This echoes the centrality of care to both my research focus and the process of how I conducted the research itself.

4.5.1 Potential harms and benefits

This study was observational and therefore posed minimal harm to participants. However, the qualitative methods I employed involved interactions with participants that were both prolonged and affective (Bernard, 2011b; Russell, 2011). I therefore took ethics as a relational process, which meant that I had to be open and sensitive to the diverse participants and circumstances that I encountered during my research.

I ensured that participants understood the voluntary nature of their participation in the research and that no harm would come to them if they chose not to respond to particular questions, refused to participate or withdrew from the research at any point. Where they travelled for the participant feedback meetings, refunds for transport and refreshments were provided as was appropriate. More broadly, I ensured that participants understood that my research and the AMIS study aimed to contribute to improved policy and interventions to reduce reliance on antibiotics while minimizing unintended consequences, that would benefit people in Uganda.

4.5.2 Informed consent

At the time of enrolment, I provided written informed consent forms on study participation for each participant and performed the consent process with study participants. For the ethnographic fieldwork component of the research, I discussed with participants the timeframes during which participant-observation and interviews would be performed, and made it clear that this was subject to ongoing dialogue during the research process. I requested consent to perform the medicines interviews as part of the same consent process as for interviews and participant-observation. For healthcare providers, I requested consent to conduct participant observations as part of the same consent process as for interviews.

I asked permission for interviews to be recorded and transcribed where this was appropriate in the setting. If participants did not feel comfortable with the use of a digital encrypted recorder, detailed notes of the interview were instead taken, including verbatim quotes where possible and agreed by the participant. I ensured that participants understood that their identities would be protected through the use of identification numbers or pseudonyms in both transcriptions and in all subsequent references to interview proceedings, including written accounts. Participants were given the opportunity to ask questions and discuss details of the study with me, and were free to ask further questions at any time during or after completion of the study activities. During the consent process, I made it clear that participants had the right to withdraw or interrupt their participation in the research at any point and that data relating to them would then not be used.

Informed consent for all face-to-face interactions was conducted in the participant's preferred language and where necessary a translator was present. Consent forms, approved by all relevant ethical review boards, were available in Luganda, Japadhola and English. Where the participant was unable to read or write, I made sure a witness was present during the consent process and a witnessed fingerprint was

substituted for a signature. During the participant observations when I observed interactions with other people (such as in clinics, in the health facilities, in the market etc), I provided verbal consent to the other person (or people). Where any of these people became a focus for the research, I then went through an informed consent process with them. Moreover, when people expressed concern about being observed, I did not take notes during these interactions.

4.5.3 Privacy and confidentiality

Given the invasive nature of qualitative methods, particularly participant-observation, I put detailed measures in place to ensure the privacy of participants was respected and maintained. All interviews were conducted in a private space where conversations could not be overheard. Where participant-observation took place in public spaces, the limitations were made very clear to participants at the outset, in order that they could make informed choices as and when to share information. I ensured that participants were aware that only I and the AMIS research team would have access to the raw data, and any data shared beyond the group would be subject to approval from the research team on a case-by-case basis. I was careful to convey to participants that any photographs taken would be made anonymous by removing any potential identifiers, so that they would not be connected back to them. Similar measures were taken for photos of buildings and other infrastructure. Where photos included people, they were taken in a fashion to ensure they were not identifiable. Where photos included people's faces, care was taken to discuss and consider the contexts in which the photos would be used and published, to avoid any undue consequences. This process was described to participants at the point of consent.

In all publications and other research outputs from this study, all participants, healthcare facilities and local area markets, and shops, were assigned pseudonyms. In the case of individuals with more unique and potentially identifiable roles such as district officials, it was made clear during the consent process

that there may be limits to their anonymity in research outputs. I also offered them the option for me not to use direct quotes from interviews. With this information, they made an informed decision as to whether to participate and whether to allow me to use direct quotes from interviews or participant feedback meetings.

4.5.4 Compensation

It was important to recognize the time and effort given by my participants who welcomed me into their homes and places of work with no reservations and the community leaders, including local council members and village health team members, who spared time to assist me with selecting, locating and approaching households. The ethics committee in Uganda also requires that participants be compensated in monetary terms. On consultation with the regulatory office at IDRC where I am based in Uganda, I developed a scheme to provide 20,000 Ush, approximately $5 per day, to participants in Nagongera. Participants in the participant feedback meetings were compensated 20,000 Ush for every meeting that they attended. Otherwise, participants were not paid for taking part in my research. Research activities were conducted at convenient places within the local area, which eliminated the need for travel and minimized opportunity costs for the participants.

4.6 COVID-19 Protocols

Part of the health facility ethnography was conducted during the COVID-19 pandemic in October 2020. The Uganda National Council for Science and Technology (UNCST) requested the principal investigators of every ongoing research to develop COVID-19 risk management plans reflecting measures that would be undertaken by the study teams to ensure safety for themselves and research participants while in the field. The safety measures that I included in the risk management plan that I developed for this study included ensuring that I observed the COVID-19 national standard operating procedures including maintaining physical distance, washing hands and wearing a mask at all times. In addition, IDRC the

institution where I am based in Uganda had also developed COVID-19 safety guidelines that all staff were required to follow including safety procedures of washing hands, maintaining physical distance and wearing masks. IDRC provided contacts of health care providers in every district who could be contacted for treatment for COVID-19 for both staff and contacts and for medical guidance. I carried disinfectant, alcohol-based sanitiser and masks with me to the health centres. I offered a mask to the people I engaged with who did not have one including health facility staff and patients that came into the consultation room where I positioned myself for the observations.

Chapter 5 Use of antibiotics to treat humans and animals in Uganda

5.1 Chapter Introduction

This chapter addresses Objective 1, to describe how and which antibiotics are used for people and animals. It presents findings from a cross site analysis of quantitative data from antibiotic surveys carried out in the three AMIS study sites, that was published in the peer-reviewed journal *JAC Antimicrobial Resistance* (Nayiga et al., 2020). Current efforts to optimise antibiotic use outside of hospitals rely on key messages to increase awareness of antimicrobial resistance and discourage the misuse of antibiotics. However, lack of data to inform these messages, especially from low- and middle-income countries, limit their impact on antibiotic use. The aim of this paper is to provide important insights into the current status of antibiotic use in Uganda. The stark difference in patterns of antibiotic use in three different settings – rural, urban and peri-urban – suggests that interventions will need to be tailored to specific sites and populations.

5.2 Research Paper

The research paper cover sheet is presented below, followed by the paper itself.

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RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed <u>for each</u> research paper included within a thesis.

SECTION A – Student Details

Student ID Number	1702759/RPHP	**Title**	Ms
First Name(s)	Susan		
Surname/Family Name	Nayiga		
Thesis Title	Antibiotics in Society: a multi-sited ethnography in rural and urban Uganda		
Primary Supervisor	Prof. Clare Chandler		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

SECTION B – Paper already published

Where was the work published?	JAC-Antimicrobial Resistance		
When was the work published?	October 2020		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	Not applicable		
Have you retained the copyright for the work?*	Yes	Was the work subject to academic peer review?	Yes

*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.

SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	Choose an item.

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I contributed to the data collection and led the analysis and preparation of the paper.

SECTION E

Student Signature	[redacted]
Date	29th July 2021

Supervisor Signature	C.I.R.Chandler
Date	31.7.2021

Use of antibiotics to treat humans and animals in Uganda: a cross-sectional survey of households and farmers in rural, urban, and peri-urban settings

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Running Title: Use of antibiotics to treat humans and animals in Uganda

Synopsis

Background: Use of antibiotics to treat humans and animals is increasing globally, but evidence from low- and middle-income countries (LMICs) is limited. We conducted cross-sectional surveys in households and farms in Uganda to assess patterns of antibiotic use among humans and animals.

Methods: Between May and December 2018**,** 100 households in Nagongera (rural), 174 households in Namuwongo (urban), and 115 poultry and piggery farms in Wakiso (peri-urban), were conveniently selected and enrolled. Using the 'drug bag' method, participants identified antibiotics they used frequently, and the sources of these medicines. Prevalence outcomes were compared between different sites using prevalence ratios (PR) and chi-squared tests.

Results: Nearly all respondents in Nagongera and Namuwongo reported using antibiotics to treat household members, most within the past month (74.7% Nagongera versus 68.8% Namuwongo, p=0.33). Use of metronidazole was significantly more common in Namuwongo than in Nagongera (73.6% versus 40.0%, PR 0.54, 95% CI: 0.42-0.70, p<0.001), while the opposite was true for amoxicillin (33.3% versus 58.0%, PR 1.74, 95% CI: 1.33-2.28, p<0.001). Veterinary use of antibiotics within the past month was much higher in Wakiso than in Nagongera (71.3% versus 15.0%, p<0.001). In both sites, oxytetracycline hydrochloride was the most frequently used veterinary antibiotic, but it was used more commonly in Wakiso than in Nagongera (76.5% versus 31.0%, PR 0.41, 95% CI: 0.30-0.55, p<0.001).

Conclusions: Antibiotics are used differently across Uganda. Further research is needed to understand why antibiotics are relied upon in different ways in different contexts. Efforts to optimise antibiotic use should be tailored to specific settings.

Introduction

Increased use of antimicrobial medicines for treatment of humans and animals is understood to be driving the development of antimicrobial resistance (AMR) globally (World Health Organisation, 2018a,2018d; World Health Organization et al., 2015). As concerns about AMR grow, global health actors have emphasised the need to reduce unnecessary use of antimicrobials (Food and Agriculture Organisation of the United Nations, 2016; World Health Organisation, 2015; World Organisation for Animal Health, 2015). The World Health Organization's (WHO) Global Action Plan on AMR highlights the importance of optimal use of antimicrobial medicines in human and animal health, specifically aiming to reduce consumption of antimicrobial agents worldwide (World Health Organisation, 2015). However, while evidence suggests an increasing trend in global consumption of antimicrobials, particularly antibiotics, among both humans and animals (Klein et al., 2018; Van Boeckel et al., 2017a), country-level data on antibiotic use is patchy (Queenan et al., 2017). Current information on antibiotic consumption is drawn from imports and sales data at a national level. Low -and middle-income countries (LMICs) are reportedly major contributors to the global increase in antibiotic use (Klein et al., 2018; Van Boeckel et al., 2014), but evidence from LMICs is limited (Hamers and Rogier van Doorn, 2018). Data are available from only sixteen African countries (Klein et al., 2018; Van Boeckel et al., 2014), and patterns of antibiotic use in LMICs are not well understood (Hamers and Rogier van Doorn, 2018).

Evidence on hospital prescribing practices has informed stewardship programmes aiming to reduce antibiotic use in hospitals (Davey et al., 2017; Honda et al., 2017; Schuts et al., 2016; Van Dijck et al., 2018). However, while antibiotic use outside of hospitals is substantial (Center for Disease Dynamics Economics and Policy, 2015; Wise et al., 1998), relatively little is known about community-level use of antibiotics in LMICs, including the geographic distribution of antibiotic use amongst households and farms, and the frequency and types of antibiotics used. Without this detailed information, interventions to optimise antibiotic use will be limited to a generic design, which has hampered the effectiveness of

rational drug use programmes in the past (Haynes and McLeod, 2015; Holloway et al., 2016; Price et al., 2018). In Uganda, the prevalence of antibiotic use in the community has been reported to range from 39-44%, including 43% for use of antibiotics among children under five years of age with acute respiratory infections in the prior month in urban Kampala (Kibuule et al., 2016), 44% for treatment of cough with cotrimoxazole among children less than 5 years of age two weeks prior in rural Tororo (Alele et al., 2015), 39% for antibiotic use in the prior month among hospitalised patients in urban Kampala (Kiguba et al., 2016) and 39% for antibiotic use among households reporting acute illness two weeks prior to the survey (Vialle-Valentin et al., 2012). Frequent use of antibiotics in poultry farms was reported by 97% of farmers in a study conducted in peri-urban Wakiso (Bashahun and Odoch, 2015) and use of tetracycline for routine management of animal health was reported by 66% of farmers interviewed in rural Nakaseke (Mukasa et al., 2012). To better understand patterns of antibiotic use in Uganda, we conducted cross-sectional surveys in three geographic locations, focusing on both households and piggery and poultry farms where antibiotic use has been reported, but not yet well-described (Alele et al., 2015; Bashahun and Odoch, 2015; Kibuule et al., 2016).

Methods

Study sites

Cross-sectional surveys were conducted in three locations (Figure 1): (1) Nagongera sub-county in Tororo district in Eastern Uganda, a rural area where most residents engage in agriculture as their main economic activity (Uganda Office of the Prime Minister, 2016). In Nagongera, we collected information on antibiotic use for humans and any animals associated with the households; (2) Namuwongo in Kampala city, a large informal settlement where many people who work in the city centre and the surrounding affluent neighbourhoods reside (London School of Economics and Political Science Blog, 2015). In Namuwongo, where few animals are kept, we collected data on antibiotic use among humans

only; (3) Wakiso district, a peri-urban area approximately 20 kilometres northwest of Kampala. Wakiso is an agricultural district which has been ranked as a top producer of poultry and piggery in Uganda (Sabiiti and Katongole, 2016). In Wakiso, we collected data on antibiotic use from small and large-scale poultry and piggery farmers.

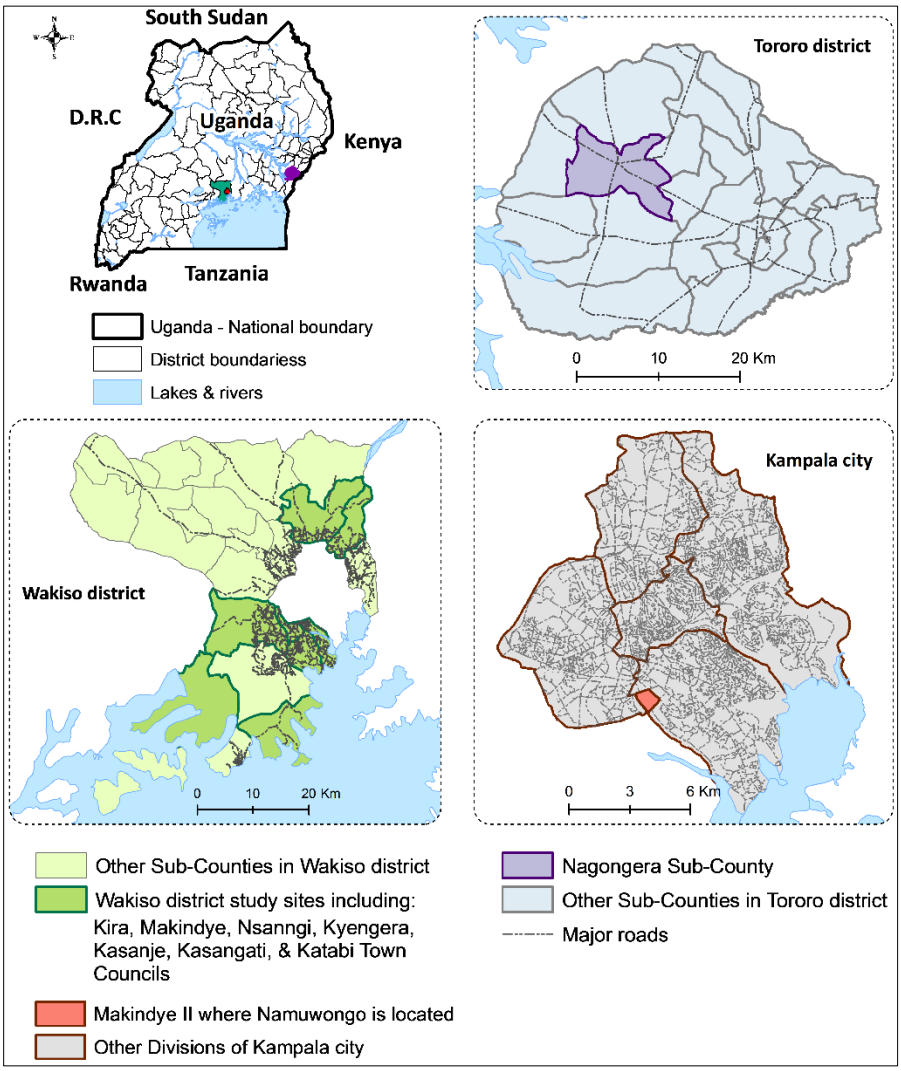

Figure 1. Map of study areas. The study was conducted in (1) Nagongera sub-county, Tororo district; (2) Namuwongo informal settlement, Kampala city; (3) Kira, Makindye, Nsangi, Kyengera, Kasanje, Kasangati, and Kabati town councils, Wakiso district.

Recruitment

Potential participants were identified with the help of field guides, including local council leaders (LCs) and village health team (VHT) members in Nagongera and Namuwongo, and animal health workers in Wakiso. In Nagongera and Namuwongo, households were included if: (1) at least one adult (≥ 18 years) was present, (2) household members were permanent residents (lived in the area for at least 6 months), and (3) the adult agreed to provide written informed consent. In Wakiso, farms were included if the farm owner: (1) was present or could be reached by phone, and (2) agreed to provide written informed consent. Households and farms were excluded if an adult resident or farm owner could not be located after at least two visits. Participants were selected using convenience sampling but we attempted to recruit a cross-sectional sample of the population in each study site.

Survey procedures

Prior to the surveys, the study team met with local health and veterinary officials, and village leaders, to discuss the survey plans. The survey was conducted using the 'drug bag' method (Dixon et al., 2019). First, we visited local drug shops, pharmacies, private clinics, and public health facilities. With the help of Ugandan pharmacists, we compiled a list of antibiotics available for human and animal use. Subsequently, we purchased packets, bottles, tablets, capsules, and vials of the antibiotics reported to be most commonly requested. These medicines were put into a 'drug bag'; one for human antibiotics and another for animal antibiotics. During the surveys, we presented the drug bag to participants and asked them to 'pile sort' the medicines into four different categories, including drugs they: (1) recognised, (2) had ever used, (3) used frequently, and (4) needed, but could not get. While the participants sorted the medicines, we used a pre-set questionnaire to gather information about their experiences using these medicines.

Data management and statistical analysis

Data were collected using hand-held tablets which were programmed using Open Data Kit (ODK) (accessible at www.opendatakit.org)**.** We classified antibiotic use into two categories: (1) Any antibiotic use (ever used): defined as taking any antibiotic, for any indication, with any dosage, with or without a prescription, as reported by participants; and (2) Frequent antibiotic use: self-reported by study participants during the pile sorting exercise, and defined during analysis as antibiotic use within the past month. Questionnaire data were transferred daily from the tablets to a password-protected laptop. At the end of the survey the complete databases were stored on a secure server at the Infectious Diseases Research Collaboration (IDRC) in Kampala. Data were analyzed using STATA 14 (StataCorp LLC, College Station, Texas, USA).

Antibiotics for human use were categorised using the WHO AWaRe classification (World Health Organisation, 2017), as (1) Access: first- and second-choice antibiotics for common infections that should be widely available, affordable and quality-assured; (2) Watch: first- and second-choice antibiotics recommended for a specific and limited number of indications, given their association with antimicrobial resistance; and (3) Reserve: antibiotics that should be treated as a 'last resort', limited to highly specific patients and settings, and used only when all alternatives have failed. The WHO AWaRe classification aims to inform effective antimicrobial stewardship and ensure access to necessary antibiotics and appropriate prescribing (World Health Organisation, 2017). Antibiotics used for animals were interpreted using the WHO list of critically important antimicrobials for human medicine (WHO CIA), which classified antimicrobials as (1) critically important, (2) highly important, or (3) important, based on their indications for treatment of humans. This list aims to ensure that antimicrobials, particularly those classified as critically important, are used with caution both in human and veterinary medicine (World Health Organisation, 2018c).

In the analysis, descriptive statistics were generated, and proportions were reported for each variable. Chi-squared tests were used to compare participant characteristics between the study sites. Prevalence ratios (PRs) were generated for comparisons of data on prevalence of any antibiotic use, frequent antibiotic use, different antibiotics used, and the source of antibiotics, between the study sites.
The PR in our study was the ratio of the outcome of interest (proportion of participants that reported any antibiotic use, frequent antibiotic use, use of different antibiotics, and source of antibiotics) divided by the proportion of participants surveyed, in a given geographic location.

Ethics clearance

We obtained ethics approval for the study from the School of Biomedical Sciences Research and Ethics Committee, Makerere University College of Health of Sciences (SBSREC REF no.562), the Uganda National Council for Science and Technology (SS 4679) and the London School of Hygiene and Tropical Medicine Ethics Committee (LSHTM Ethics Ref: 15244).

Results

Baseline characteristics

From November to December 2018, 100 participants were enrolled in Nagongera, and from May to June 2018, 174 and 115 participants were enrolled in Namuwongo and Wakiso, respectively (Figure 2).

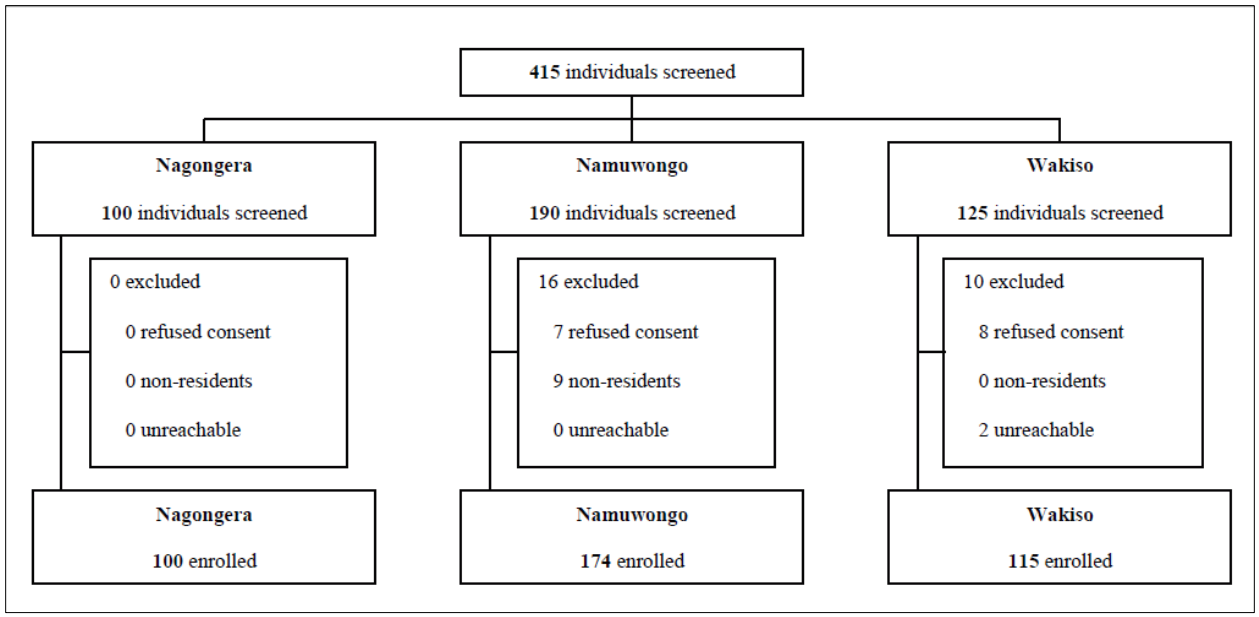

Figure 2. Trial profile. Outlining the process of recruitment, screening, and enrollment into the study. In total, 100 participants were enrolled in Nagongera, 174 in Namuwongo and 115 in Wakiso.

The characteristics of participants enrolled in the three sites varied (Table 1). Considering the population evaluated for antibiotic use in humans, more respondents were female in Namuwongo than in Nagongera (79.3% versus 56.0%, respectively). In Nagongera, 89.0% of respondents were subsistence farmers, while in Namuwongo, 85.1% were either merchants or laborers (involved in making, building or fixing things, or cooking and cleaning). Considering the population evaluated for antibiotic use in animals, respondents in Nagongera and Wakiso were similar in gender and age (Table 1), but education, occupation and farm characteristics varied. In Nagongera, 16.0% of respondents had received no education, and 49.0% only reached primary school, while in Wakiso, 78.8% of participants reached secondary school or higher. In Nagongera, no respondents owned their farm, while in Wakiso, 72.2% were farm owners. In Nagongera, all farms were classified as subsistence farms with little capacity to produce surplus for the market, while all farms in Wakiso were commercial, mostly small-scale farms.

Table 1. Participant characteristics

Human use	**Nagongera**	**Namuwongo**	**P**
Setting	Rural	Urban	
Sample size	100	174	
Gender of respondent (female)	56 (56.0%)	138 (79.3%)	<0.001
Occupation[a]			
Subsistence farmer	89 (89.0%)	7 (4.0%)	<0.001
Merchant	1 (1.0%)	103 (59.2%)	
Labourer	1 (1.0%)	45 (25.9%)	
Other	9 (9.0%)	19 (10.9%)	
Animal use	**Nagongera**	**Wakiso**	**P**
Setting	Rural	Peri-urban	
Sample size	100	115	
Gender of respondent (female)	56 (56.0%)	55 (47.8%)	0.23
Age (years)			
<40years	39 (39.0%)	41 (35.7%)	0.61
≥40 years	61 (61.0%)	74 (64.3%)	
Highest level of education[b]			
Never went to school	16 (16.0%)	1 (0.9%)	<0.001
Primary	49 (49.0%)	23 (20.4%)	
Secondary or higher	35 (35.0%)	89 (78.8%)	
Occupation[c]			
Subsistence farmer	89 (89.0%)	0	<0.001
Farm owner	0	83 (72.2%)	
Farm worker	0	32 (27.8%)	
Other	11 (11.0%)	0	
Farm categories[d]			
Poultry			
Subsistence	85 (85%)	0	<0.001
Small (<5000 birds)	0	61 (95.3%)	
Large (≥ 5000 birds)	0	3 (4.7%)	
Piggery			
Subsistence	38 (38%)	0	<0.001
Small (<30 pigs)	0	47 (72.3%)	
Large (≥ 30 pigs)	0	18 (27.7%)	

[a]Occupations: Merchants – engaged in selling food, drinks and other items; Labourer: making, building, fixing, cooking, cleaning; Other: students (n=2), witch doctor (n=1), drivers (n=2), bodadrivers (n=1), businessmen (n=1), rent collectors (n=1),teachers (n=4), security guards (n=8), factory workers (n=5), mason (n=1), unemployed (n=2)

[b]Education: In Wakiso, 2 respondents refused to answer and were excluded (N=113); Secondary or higher: secondary-level education, certificate, diploma, vocational training and university degree.

[c]Occupations: Farm worker: anyone employed at the piggery or poultry farm, including farm managers and other workers; Other: teachers (n=4), students (n=2), businessmen (n=1), mason (n=1), food seller (n=1), unemployed (n=2)

[d]Farm categories: In Wakiso, poultry farms N=64, piggery farms N=65;Farms defined using the Food and Agricultural Organisation 2014 criteria; Subsistence farms: those that produce for the farmer's own consumption and with little or no capacity to generate surplus production for the market; Small farms: those that are either market-oriented and commercial, generating surplus production for a market (local, national or international), or have the potential to become market-oriented; Large farms: those showing characteristics of industrial ventures.

Patterns and sources of antibiotics in humans

Nearly all respondents in Nagongera and Namuwongo reported using antibiotics to treat illness in their households (Table 2), most within the past month (74.7% in Nagongera versus 68.8% in Namuwongo). Far more participants in Nagongera reported obtaining medicines from public health facilities than in Namuwongo (84.2% versus 22.9%), but in both areas, most participants reported obtaining medicines from the private sector (87.4% in Nagongera versus 75.9% in Namuwongo).

Table 2. Antibiotic use and the source of medicines for treatment of humans

Human use	Nagongera (n=100)	Namuwongo (n=174)	PR (95% CI)	P
Ever use antibiotics[a]				
Yes	95 (95.0%)	170 (97.7%)	0.97 (0.92–1.02)	0.29
No	5 (5.0%)	4 (2.3%)		
Frequency of antibiotic use[b]				
≤ 1 month	71 (74.7%)	117 (68.8%)	1.09 (0.93–1.27)	0.33
>1 month	24 (25.3%)	53 (31.2%)	0.81 (0.54-1.22)	0.33
Source of medicines				
Public health facilities	80 (84.2%)	39 (22.9%)	3.67 (2.75–4.90)	<0.001
Research/NGOs	1 (1.1%)	8 (4.7%)	0.22 (0.03–1.76)	0.16
Other[c]	83 (87.4%)	129 (75.9%)	1.15 (1.03–1.29)	0.03

[a] Antibiotic use was defined as taking any antibiotic for any indication at whatever dosage as reported by participants
[b] In Nagongera, participants reported how often any antibiotic was used to treat any member of the household for any indication and in any dosage; In Namuwongo, participants reported the last time any antibiotic was used for any indication and in any dosage, with or without a prescription
[c] Other: private clinics, pharmacies and drug shops

In Namuwongo, the antibiotic bag contained 24 antibiotics; 21 of these were recognised by respondents, and 18 were used frequently (Figure 3). In Nagongera, the drug bag contained only 20 antibiotics; 16 of these were recognised by respondents, and 13 were used frequently. In both sites, the drug bag for humans did not include any antibiotics classified as 'reserve' drugs because these drugs were rarely requested.

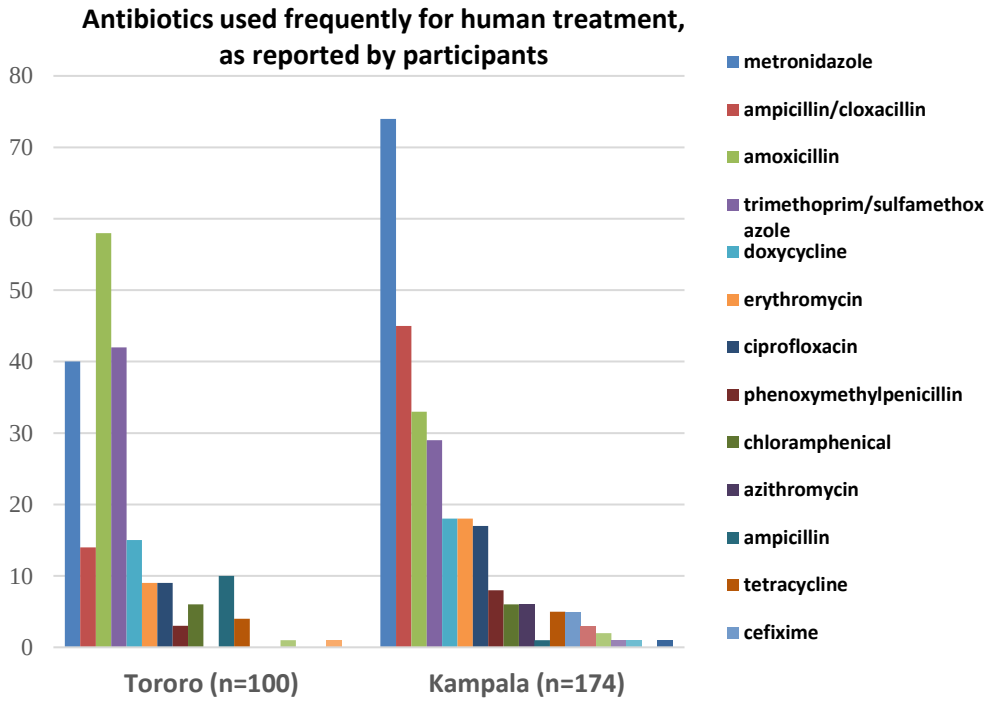

Figure 3. Antibiotics used frequently for human treatment, as reported by participants

The most frequently used antibiotic in Nagongera was amoxicillin, while in Namuwongo it was metronidazole (Table 3). Use of amoxicillin was significantly more common in Nagongera than in Namuwongo (58.0% versus 33.3%, PR 1.74, 95% CI: 1.33-2.28, P<0.001), while the opposite was true for metronidazole (40.0% versus 73.6%, PR 0.54, 95% CI: 0.42-0.70, P <0.001). Ampicillin/cloxacillin and trimethoprim/sulfamethoxazole were also frequently used; ampicillin/cloxacillin more commonly in Namuwongo (45.4% in Namuwongo versus 14.0% in Nagongera) and trimethoprim/sulfamethoxazole more commonly in Nagongera (42.0% in Nagongera versus 28.7% in Namuwongo). Ciprofloxacin and erythromycin, classified as drugs to 'watch' in WHO's AWaRe system, were used more often in

Namuwongo than in Nagongera (ciprofloxacin PR 0.54, 95% CI: 0.27-1.09, P=0.10 and erythromycin PR 0.49, 95% CI: 0.24-0.98, P=0.04), although this difference was significant only for erythromycin.

Table 3. Antibiotics used frequently for human treatment, as reported by participants

Antibiotic class Human use	Antibiotic	WHO classification (AWaRe)[a]	Nagongera	Namuwongo	PR (95% CI)	P
Penicillin	amoxicillin	Access	58 (58.0%)	58 (33.3%)	1.74 (1.33–2.28)	<0.001
	ampicillin	Access	10 (10.0%)	1 (0.6%)	17.4 (2.26–133.93)	<0.001
	phenoxymethylpenicillin	Access	3 (3.0%)	14 (8.1%)	0.37 (0.11–1.27)	0.12
	ampicillin/cloxacillin	Access	14 (14.0%)	79 (45.4%)	0.31 (0.18–0.51)	<0.001
Cephalosporin	cefalexin (cephalexin)	Access	1 (1.0%)	4 (2.3%)	0.44 (0.05–3.84)	0.66
Metronidazole	metronidazole	Access	40 (40.0%)	128 (73.6%)	0.54 (0.42–0.70)	<0.001
Sulfa	trimethoprim/ sulfamethoxazole	Access	42 (42.0%)	50 (28.7%)	1.46 (1.05–2.03)	0.03
Fluoroquinolone	ciprofloxacin	Watch	9 (9.0%)	29 (16.7%)	0.54 (0.27–1.09)	0.10
Chloramphenicol	chloramphenicol	Access	6 (6.0%)	11 (6.3%)	0.95 (0.36–2.49)	1.00
Macrolide	erythromycin	Watch	9 (9.0%)	32 (18.4%)	0.49 (0.24–0.98)	0.04
Tetracycline	tetracycline	Access	4 (4.0%)	9 (5.2%)	0.77 (0.24–2.45)	0.77
	doxycycline	Access	15 (15.0%)	31 (17.8%)	0.84 (0.48–1.48)	0.62

[a]The World Health Organization's AWaRe classification aims at informing effective antimicrobial stewardship and ensuring access to necessary antibiotics and appropriate prescribing; categories include 'access', 'watch', and 'reserve'. Access: first and second choice antibiotics for common infections that should be widely available, affordable and quality-assured; Watch: first and second choice antibiotics recommended for specific and limited number of indications because they have a higher potential for development of resistance.

Patterns and sources of antibiotics in animals

Veterinary use of antibiotics was reported in both Wakiso and Nagongera (Table 4) but was far more common in Wakiso (86.1% versus 33.0%, respectively). Of those participants who reported ever using antibiotics to treat animals, significantly more participants in Wakiso had used antibiotics over the past month (82.8% in Wakiso versus 45.5% in Nagongera, PR 0.55, 95% CI: 0.37-0.81, P<0.001). In both areas, medicines were obtained frequently from the private sector.

Table 4. Antibiotic use and the source of medicines for treatment of animals

Animal use	Nagongera (n=100)	Wakiso (n=115)	PR (95% CI)	P
Ever use antibiotics[a]				
Yes	33 (33.0%)	99 (86.1%)	0.33 (0.25–0.44)	<0.001
No	67 (67.0%)	1 (0.9%)		
Frequency of antibiotic use[b]				
≤ 1month	15 (45.5%)	82 (82.8%)	0.55 (0.37–0.81)	<0.001
>1 month	18 (54.5%)	17 (17.2%)	3.18 (1.86–5.41)	<0.001
Source of medicines				
Veterinary pharmacy/drug shop	30 (90.9%)	77 (77.8%)	1.17 (1.01–1.36)	0.13
Veterinary officer	0	23 (23.2%)	0	0.001
Market	3 (9.1%)	0		0.01

[a] Antibiotic use was defined by participants as using any antibiotic for treatment of animals for any indication at any dose; In Wakiso, 15 respondents didn't know if antibiotics had been used to treat their animals (N=100)

[b] In Nagongera, participants reported how often any antibiotic was used to treat animals kept by the household for any indication and in any dosage; In Wakiso, participants reported the last time any antibiotic was used on the farm for any indication and in any dosage

In Wakiso, the antibiotic bag contained 21 antibiotics; all of these were recognised by respondents, and 20 were used frequently (Figure 4). In Nagongera, the drug bag contained only 16 antibiotics; 10 of these were recognised by respondents, and 7 were used frequently. In both sites, all 15 of the antibiotics classified as 'critically important' that were included in the drug bags were recognised by participants in Wakiso, while only 7 were recognised in Nagongera.

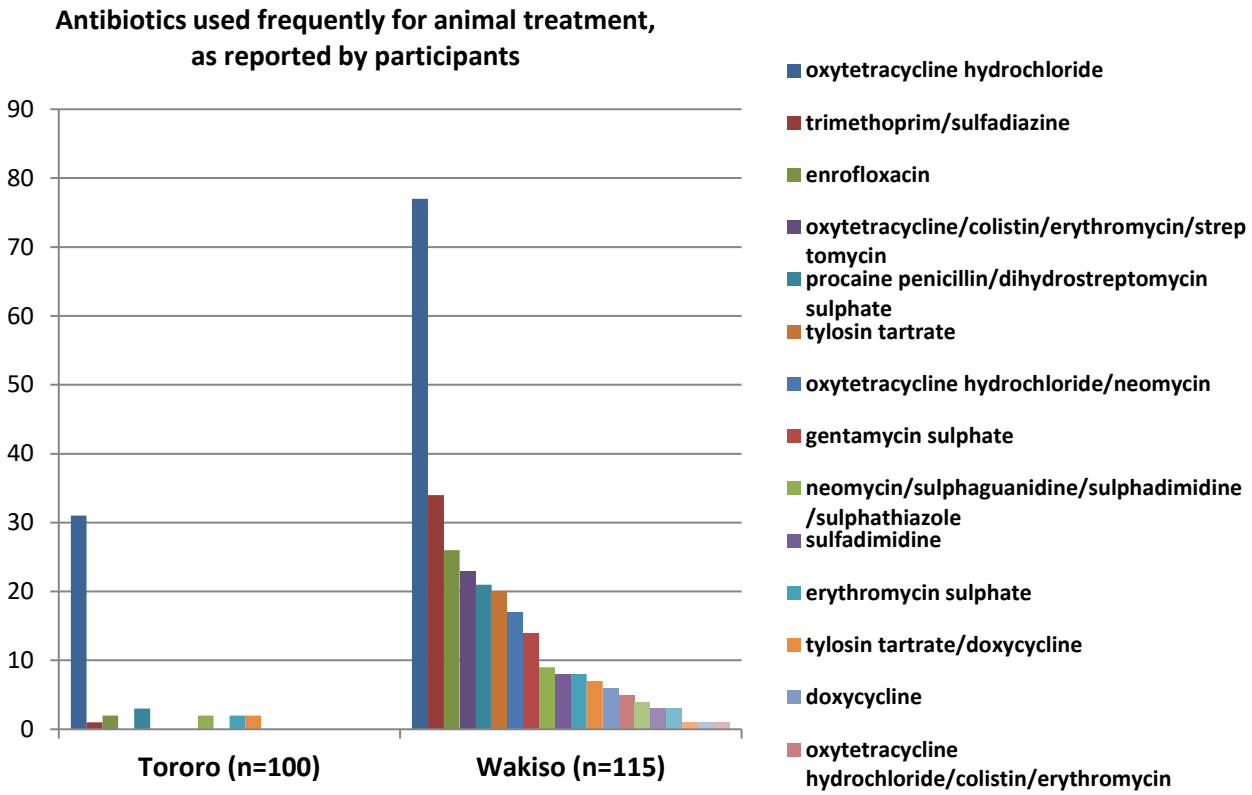

Figure 4. Antibiotics used frequently for animal treatment, as reported by participants.

In both sites, the most frequently used antibiotic was oxytetracycline hydrochloride (Table 5), which was used more often in Wakiso than in Nagongera (76.5% versus 31.0%, respectively, PR 0.41, 95% CI: 0.30-0.55, P<0.001). In Wakiso, three other commonly used antibiotics (dihydrostreptomycin sulphate, erythromycin sulphate and tylosin tartrate) are classified as 'critically important' in WHO's CIA system; all three were used more often in Wakiso than in Nagongera (Figure 4, Table 5), although this difference was not significant for erythromycin sulphate. Of note, use of colistin, another 'critically important' antimicrobial, was reported by some respondents in Wakiso, either alone or in combination with other antibiotics.

Table 5. Antibiotics used frequently for treatment of animals

Antibiotic class Animal use	Antibiotic	WHO classification (CIA)[a]	Nagongera	Wakiso	PR (95% CI)	P
Penicillin/ Aminoglycoside	procaine penicillin/	Highly important	3 (3.0%)	24 (20.9%)	0.14 (0.04–0.46)	<0.001
	dihydrostreptomycin sulphate	Critically important	3 (3.0%)	24 (20.9%)	0.14 (0.04–0.46)	<0.001
Sulfa	trimethoprim/sulfadiazine	Highly important	1 (1.0%)	39 (33.9%)	0.03 (0.004–0.21)	<0.001
Macrolide	erythromycin sulphate	Critically important	2 (2.0%)	9 (7.8%)	0.26 (0.06–1.16)	0.07
	tylosin tartrate	Critically important	0	23 (20.0%)	0	<0.001
Tetracycline	oxytetracycline hydrochloride	Highly important	31 (31.0%)	88 (76.5%)	0.41 (0.30–0.55)	<0.001

[a]The World Health Organization's CIA classification aims at ensuring that antimicrobials, particularly those classified as critically important, are used with caution both in human and veterinary medicine; categories include (1) critically important, (2) highly important, or (3) important, based on their indications for treatment of humans.

Discussion

Current efforts to optimise antibiotic use outside of hospitals rely on key messages to increase awareness of AMR and discourage the misuse of antibiotics. However, lack of data to inform these messages, and the generic nature of centralised global messaging, limit their impact on antibiotic use (Glover et al., 2019; Huttner et al., 2019). Our findings provide important insights into the current status of antibiotic use in Uganda. Here, the stark difference in patterns of antibiotic use in three different settings – rural, urban and peri-urban – suggests that interventions will need to be tailored to specific sites and populations.

Overall, the frequency of antibiotic use amongst residents and farmers was high, underscoring a trend signalled in estimates of global use of antibiotics for human treatment, derived from import/sales data (Klein et al., 2018; Van Boeckel et al., 2014), as well as the projected trajectory of antibiotic use in

animals based on increasing livestock farming (Van Boeckel et al., 2015). High levels of antibiotic use have been reported amongst residents in rural Nigeria where 82% of respondents had used an antibiotic in the past 6 months (Abdulraheem et al., 2016), and in an informal settlement in urban Kenya where 87% reported using antibiotics in the last 12 months (Omulo et al., 2017). However, other research studies, conducted in Uganda and elsewhere in Africa between 2007 and 2017, have reported lower prevalence of antibiotic use; in a household survey conducted in five African countries (The Gambia, Ghana, Nigeria, Uganda and Kenya) in 2007-2008, use of antibiotics to treat acute illness within the past two weeks ranged 17.6% to 42.3% in Kenya (Vialle-Valentin et al., 2012). Similar results have been reported from urban settings across Africa; antibiotic use in the prior month was 39% among hospitalised patients in Uganda (Kiguba et al., 2016), and 57% amongst residents in Nigeria (Auta et al., 2013), while 49% residents in Ethiopia reported antibiotic use within the past year (Erku et al., 2017). Our findings of frequent antibiotic use amongst piggery and poultry farmers in Wakiso, an area with increasing commercial and semi-industrialised farms, also mirror rates of antibiotic use reported elsewhere in Africa: 100% of respondents on commercial poultry farms in Tanzania (Mubito et al., 2014), and Ogun State, Nigeria (Oluwasile et al., 2014), reported frequently using antibiotics, while in Abia State, Nigeria, 65% of commercial poultry farms and 40% of piggery farms, used an antibiotic weekly and fortnightly, respectively (Amaechi, 2014). Improvements in technology, changes in the global economy, rapid population growth, and increased consumption of livestock products, have been reported as factors which have influenced changes globally in farming with many subsistence farms, with little capacity to produce surplus for sale on the market, transitioning to commercial and market-based farms, which are associated with routine use of antimicrobials (Food and Agricultural Organisation, 2009; Van Boeckel et al., 2015). The shift away from subsistence farming towards commercial and market-based farming could explain the rates of antibiotic use observed in commercial farms in our study sites, and in studies conducted elsewhere in Africa (Van Boeckel et al., 2015; Van Boeckel et al., 2017a).

The types of antibiotics used by residents and farmers varied widely between the three geographies. In Namuwongo, 74% of participants reported using metronidazole frequently, compared to only 40% of households in rural Nagongera. However, in both sites, use of metronidazole was much higher than reports from elsewhere in Africa (Erku et al., 2017; Vialle-Valentin et al., 2012). In the study conducted in five African countries, use of metronidazole in individuals with an acute illness who received antibiotics was 17.2% overall, ranging from 10-27%; in Uganda, only 11.3% received metronidazole (Vialle-Valentin et al., 2012). The potential impact of such high use of metronidazole, as seen in our study, on the development of antimicrobial resistance requires exploration. There are numerous potential mechanisms for metronidazole resistance to occur (Alauzet et al., 2019a; Alauzet et al., 2019b; Schaumann et al., 2005), but the degree to which the high rates of metronidazole use has (or will) impact microbial communities, and subsequent susceptibility to therapy, remains unknown. Overuse of metronidazole may also damage beneficial gut microbial populations, which may have a negative impact on human health and increase susceptibility to infections and disease (Blaser, 2011; Cotter, 2012). The high levels of metronidazole use also require exploration with qualitative research, to understand the reasons and history of the use of this antibiotic in our study area. Use of other antibiotics by our study participants was more comparable across settings, and similar to reports from elsewhere, with quite a narrow range of 'Access' category antibiotics available and used frequently, notably penicillins. Further work is required to establish whether ciprofloxacin and erythromycin, drugs to 'watch' in WHO's AWaRe system, were prescribed as these drugs were used less frequently in our study sites. The range of antibiotics commonly used to treat animals was wider in Wakiso than in Nagongera, primarily a subsistence farming area, but nonetheless most antibiotics were not 'critically important', except for dihydrostreptomycin sulphate, erythromycin sulphate and tylosin tartrate. Notably, a few participants in Wakiso reported using colistin frequently. The most commonly used antibiotic in both sites was oxytetracycline hydrochloride, consistent with findings reported from studies conducted between 1998

and 2018 on commercial farms from Tanzania (Mubito et al., 2014), Ghana (Boamah et al., 2016), and Nigeria (Adesokan et al., 2015), and a wider review of veterinary use of antimicrobials in LMICs (Cuong et al., 2018).

Antibiotics were mainly acquired through the private sector for both human and animal use in all three study areas. This is consistent with results of prior studies of antibiotic access for humans in Uganda (Ocan et al., 2014), Ethiopia (Erku et al., 2017), and Tanzania (Mboya et al., 2018), for commercial poultry production in Nigeria (Oluwasile et al., 2014), and Ghana (Boamah et al., 2016), and studies of antibiotic access for animals in Rwanda (Manishimwe et al., 2017). Understanding the forces that draw people to the private sector is important, including how the pharmaceutical industry operates and is regulated. The favourable tax environment in Uganda where no taxes are levied on imported pharmaceuticals both for humans and animals (Uganda Ministry of Health, 2011b), and a growing pharmaceutical market valued at US$ 276 million in 2010 (United Nations Industrial Development Organisation, 2010), and $414 million in 2017 (Pharmaceuticals export promotion council of India), enable the pharmaceutical industry to flourish while being dominated by imported pharmaceuticals. With the deterioration of the public health system for both humans and animals over many years (Birungi et al., 2001; Ilukor et al., 2012), it has been estimated that 60-70% of human healthcare services and all veterinary clinical services in Uganda are provided by the private sector (Birungi et al., 2001; Ilukor et al., 2012; Ssennyonjo et al., 2018). These factors enable the existence of a dominant private sector in Uganda today.

Our study had several important limitations. First, our findings are based on self-reported use of antibiotics, which may not reflect the full picture of antibiotic use for human and animal health. However, we do expect our findings to be a more accurate representation of self-reporting due to the use of physical samples with the drug bag method in both homes and farms in order to avoid linguistic

and classificatory errors in antibiotic knowledge (Dixon et al., 2019). Second, we relied on convenience sampling to recruit participants into the surveys. Thus, the findings from these surveys are not generalisable to the wider Ugandan population, but they do provide insights into antibiotic use experiences from three different contexts, underscoring the uniqueness of each setting. Third, we relied on a self-determined classification of 'frequently used' for antibiotics, which could vary between individuals. This was in recognition of inaccuracies in reporting health events for time periods over about 2 weeks (Das et al., 2011), and reflected our interest in whether these medicines were often used, rather than just in a recent time period. Finally, very few large-scale farms were included, which may create a gap for further research to fully understand antibiotic use experiences in such spaces.

The implications of these findings for policy lie in the need to recognise the increasing reliance on many of these medicines and the important role of the private sector in providing access to antibiotics. Interventions aimed at changing the knowledge and behaviour of health care professionals and the general public through education on the importance of using antimicrobials appropriately, and the dangers that may arise from the misuse of antimicrobials, have had limited impact in some areas (Haynes and McLeod, 2015). Lessons can be learned from the challenges faced in attempting to reduce antibiotic use through knowledge and awareness programmes alone (Haenssgen et al., 2018; Pearson and Chandler, 2019). Rather, an in-depth understanding of the relationships between people, animals and medicines could provide alternative paths to intervention. Further research is required to understand why we found such heterogeneity between local geographies in the frequency and types of antibiotics used, and why particular antibiotics were so commonly used. Such research should trace the histories and current everyday realities of particular antibiotics across different settings to help clarify why and how antibiotics are used in different settings. It is also essential to harmonise these results with medical microbiological data to understand the impacts that short- and longer-term trends of antibiotic use may have on microbial populations and drug resistant infections. Finally, our findings demonstrate

the ongoing importance of addressing the roles of antimicrobial markets beyond the formal health sector, when developing programmes to optimise antibiotic use.

Acknowledgements

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Transparency declarations

None to declare.

Author contributions

SN, CN and MK led the data collection in Nagongera, Namuwongo and Wakiso respectively with oversight from CIRC, SGS and LDW. SN did the statistical analysis and drafted the manuscript with support from SGS and CIRC. All authors reviewed the drafts and approved the final manuscript.

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5.3 Chapter Summary

This paper has demonstrated how antibiotics are used differently across Uganda, highlighting the need to move away from 'one-size-fits-all' interventions. The subsequent chapters seek to offer an in-depth understanding of why antibiotic use patterns are different across the local geographies by drawing on findings from in-depth ethnographic fieldwork, documentary analysis and participant feedback meetings. Chapter 6 focuses on the realities of living in rural households and roles that antibiotics play in contexts of every day precarity.

Chapter 6 Role of antibiotics at a domestic and societal level

6.1 Chapter Introduction

This chapter addresses Objective 2, to understand the problems to which antimicrobial use has become a solution at the domestic as well as societal level. This paper presents findings from ethnographic fieldwork carried out in rural households in Nagongera, Tororo, an area that has been socially and politically marginalized for decades. This paper has been accepted for publication by the peer-reviewed journal *Medical Anthropology.* The findings were presented at the Chronic Living conference organised by the University of Copenhagen, Denmark in March 2021. With rising concerns about the continued increase in antibiotic use especially in low-and middle-income countries (LMICs), the need for context-specific interventions to optimize antibiotic use has been emphasized by world health leaders such as the World Health Organisation (WHO). However, contextual data emerging from everyday life to inform these interventions, especially from LMIC countries, has so far been limited. The aim of this paper is to provide an understanding of the significance of antibiotics for people's lives and livelihoods. The link between the ways people are taking antibiotics and the pervasive discourse and imperative to 'take opportunities' suggests that reliance on antibiotics cannot be resolved if the risks encountered by people in everyday life are not addressed.

6.2 Research Paper

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First Name(s)	Susan		
Surname/Family Name	Nayiga		
Thesis Title	Antibiotics in Society: a multi-sited ethnography in rural and urban Uganda		
Primary Supervisor	Prof. Clare Chandler		

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Please list the paper's authors in the intended authorship order:	Susan Nayiga, Laurie Denyer Willis, Sarah G Staedke, and Clare IR Chandler
Stage of publication	Accepted for publication

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I led the data collection, analysis and preparation of the paper.

SECTION E

Student Signature	[redacted]
Date	29th July 2021

Supervisor Signature	C.I.R.Chandler
Date	31.7.2021

6.3 Chapter summary

This paper has described how antibiotics mitigate the many risks encountered in everyday life, and how these relate to wider political and economic imperatives. Chapter 7 extends the findings presented in this chapter by focusing on the context of prescribing and dispensing antibiotics in primary care public health facilities that serve the households in the local area.

Chapter 7 The context of prescribing and dispensing antibiotics

7.1 Chapter Introduction

This chapter addresses Objective 3, to understand what is at stake for human care providers when prescribing or dispensing antibiotics. It takes the form of a paper which presents findings from ethnographic research conducted with healthcare providers from two government Health Centre (HC) IIs in Nagongera, Tororo. This paper has been published in the peer-reviewed journal *Global Public Health.* A core response to the continued increase in antibiotic use, especially in low-and middle-income countries, has been to export models of stewardship around the world. However, few stewardship interventions in healthcare settings have been piloted in LMICs, with a critical gap in how these might operate in primary care. The aim of this paper is to provide an understanding of antibiotic prescribing practices in lower-level health care facilities in the presence of the clinical guidelines that are held as a cornerstone of antimicrobial stewardship programmes. In a context of scarcity where 'care' is characterized by delivery of medicines, clinical practice was shaped by availability of resources, and professional and patient expectations, as much as by the clinical guidelines. This suggests that successful antimicrobial stewardship programmes will require a better understanding of clinical practice and expectations of care in relation to and beyond the framework of guidelines.

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Primary Supervisor	Prof. Clare Chandler		

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Where was the work published?	Global Public Health		
When was the work published?	27th February 2022		
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Stage of publication	

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SECTION E

Student Signature	[redacted]
Date	29th July 2021

Supervisor Signature	C.I.R.Chandler
Date	31.7.2021

7.3 Chapter Summary

This paper has demonstrated that in a context of scarcity, antibiotics are vehicles of care enabling health workers to cope with gaps in laboratory capacity and health worker training, as well as managing possible infection. Here, clinical guidelines co-exist with clinical practice rather than dictate it. Chapter 8 brings together the findings presented in this chapter as well as chapter 5 and 6, by focusing on peoples' current efforts to gain security in a context of precarity which involves connections, movement and flows between places – including between the rural, urban and peri-urban areas.

Chapter 8. A comparison of the ways antibiotics are entangled with life in rural Tororo, urban Kampala and peri-urban Wakiso.

8.1 Chapter Introduction

This chapter addresses Objective 4, to compare the ways antibiotics are entangled with life in a rural Ugandan setting, with urban Kampala and peri-urban Wakiso. It is composed of a paper which presents a cross site analysis of data from ethnographic research carried out in the three AMIS study sites. This work is currently being prepared for submission to a peer-reviewed journal. Components of the paper related to antibiotic use in animals were presented at the 5th International Conference on Responsible Use of Antibiotics in Animals in June 2021. The aim of this paper is to draw attention to the multiple dimensions of insecurity that people encounter in their everyday lives, that drive reliance on antibiotics. These everyday insecurities receive less attention in the global discourse on AMR, where the focus is on securing humans, borders and medicines from future threats. By describing the insecurities that people face daily, this paper underscores the need to address these insecurities, if AMR and reliance on antibiotics is to be overcome.

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	Globalisation and Health
Please list the paper's authors in the intended authorship order:	Susan Nayiga, Christine Nabirye, Miriam Kayendeke, Laurie Denyer Willis, Sarah G Staedke and Clare IR Chandler
Stage of publication	Not yet submitted

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I contributed to the data collection and analysis and led the preparation of the paper.

SECTION E

Student Signature	[redacted]
Date	29th July 2021

Supervisor Signature	C.I.R.Chandler
Date	31.7.2021

8.3 Chapter summary

This paper has described the multiple insecurities that characterize peoples' everyday lives and the ways that antibiotics have become a form of security. Chapter 9 draws on the insights from Chapters 5 to 8 to highlight the implications of this thesis for health social sciences, AMR policy and practice and public health research.

Chapter 9. Discussion

9.1 Introduction

This thesis has focused on how antibiotics intersect with life, livelihoods and healthcare for humans and animals in Uganda. It has provided new insights into the roles of antibiotics in everyday life in a rural setting, drawing comparisons with urban and peri-urban settings. In this chapter, I review the key findings from each of my chapters before exploring the implications of my findings for health social sciences, AMR policy and practice, and public health research. I highlight the strengths and limitations of my research and close the chapter with reflections on where my PhD journey has taken me.

9.2 Summary of findings

In presenting the findings of my PhD work in this thesis, I began in **Chapter 5** by laying the foundation with an account of patterns of antibiotic use for human and animal treatment in Uganda focusing on households and farms in rural, urban and peri-urban settings. Based on data from antibiotic surveys, I described how the frequency of antibiotic use varies from place to place, as does the types of antibiotics being used in different areas – particularly between rural and urban areas. I highlighted the need for further research to understand why we see such heterogeneity between local geographies in the frequency and types of antibiotics used, and why particular antibiotics are so commonly used. I also highlighted that antibiotics are mainly acquired through the private sector for both human and animal use and the need to recognise the important role that the private sector plays today in providing access to antibiotics. I proposed that interventions to optimise antibiotic use would need to be tailored to specific sites and populations. This approach would mean that an intervention that may work in one setting or population may not necessarily work in another. Each setting or population would have to be

considered as unique and therefore requiring a specific intervention package to avoid unintended consequences.

Chapter 6 drew upon ethnographic fieldwork to describe how taking antibiotics in rural households relates to the social milieu created through policies that follow President Museveni's vision for a population who 'tap wealth', in a context of every day precarity and discourse of betterment in today's competitive modern Ugandan society. I described how antibiotic use was one of the ways that people tapped opportunities in a landscape where clinical research and NGOs presenting medicines among other opportunities, has for decades become a way for people to better themselves. I highlighted that antibiotics had become essential in rural households for coping with the lack of good quality health services, inadequate sanitation, lack of clean water, and uncertain economic opportunities. I proposed that there was need for a closer connection to be made between medical and economic anthropology to push forward understanding of health, medicines and wellbeing in Africa.

Chapter 7 drew upon ethnographic fieldwork to describe antibiotic prescription practices in lower-level government health centres at a time when health workers are under pressure to comply with clinical guidelines to implement narrower gateways to antibiotic prescription as a way to securing antibiotics. I described how clinical practice was shaped by availability of resources, and professional and patient expectations, as much as by the guidelines in a context of scarcity where 'care' is characterised by the delivery of medicines, and constituted beyond algorithmic outputs. I also highlighted how emphasising action to secure medicines seemed to conflict with the wider remit of health workers to provide care in context. In a context of scarcity, antibiotics are vehicles of care, enabling health workers to cope with gaps in laboratory capacity and health worker training, as well as managing possible infection. Therefore, beyond disseminating guidelines, antimicrobial stewardship programmes will also require

investment in general health infrastructure and human resources, and wider recognition and support for patient-centred rather than medicine-centred care.

In **Chapter 8**, I drew on a cross site analysis of ethnographic data gathered from the rural, urban and peri-urban sites of the AMIS Project, to render visible the insecurities that people live with every day including insecurity of livelihoods, food insecurity, and health insecurity. I reflected on the way security is thought about in the global AMR discourse where the focus is on emerging infectious diseases and preparedness of nations to act against outbreaks whose consequences may be catastrophic, and securing what is seen as currently available – borders, bodies, medicines – from a future threat. By contrast, everyday life in the rural, urban and peri-urban study sites focuses on managing insecurity, and this drives reliance on antibiotics and shapes the way medicines are used. I highlighted how antibiotics had become a way of countering the multiple insecurities and the precarious conditions that people live in. I proposed that addressing antibiotic use requires going beyond our current focus on securing nations, bodies and medicines for the future, and addressing the everyday insecurities that shape the way antibiotics are used. This calls for a shift in focus from individual antibiotic use practices to the structural dimensions of antibiotic use.

Taken together, these chapters illustrate that antibiotic use is at the centre of the way people sustain everyday life in modern Uganda. Antibiotic use is shaped by wider social, economic and political factors beyond individual actors, such as consumers and prescribers. Social factors shaping antibiotic use include the culture of opportunity where medicines are considered as a very particular kind of opportunity that people can take to better themselves. Economic factors include the need to keep alive and the way this is encountered through precarious living. Political factors include the way that infrastructure is systematically underinvested in in some places where people live with a paucity of good quality health services, clean water and sanitation facilities. In addition, antibiotic use is shaped by

ecological factors, such as climate uncertainty, that contributes to food scarcity and low household incomes in areas where people depend on agriculture for survival. At a time when stewardship programmes are emphasizing action to secure medicines, these findings highlight the current everyday realities within which antibiotics are used by consumers and prescribers within and beyond formal healthcare settings, clarifying why and how antibiotics are used. Therefore, an in-depth understanding of the relationships between people, animals and medicines is needed when considering alternative paths to intervention.

9.3 Implications for health social sciences

In this section, I explore the potential contributions of this thesis to the field of social sciences in understanding the social, political and economic work that antibiotics do in society.

9.3.1 Understanding the social, political and economic work that antibiotics do in society

This research took place in the same district in Uganda as the long-term ethnographic work of Susan Reynolds Whyte. Whyte's influential work, including on the Social Lives of Medicines (Whyte et al., 2002), has provided critical insights about the different ways in which these objects have taken on meaning and power in different scenarios well beyond formal healthcare settings. Her research poses the question of what arrangements and forms of life are brought into being through medicines, and I followed this theme in my exploration of the work that antibiotics do in society – in social, political and economic life. I aimed to understand what sustains, or is sustained *by*, antibiotics in my study context. My analysis was informed by the anthropological literature on precarity, which was very helpful in understanding Nagongera as a rural area that has been socially and politically marginalized for decades. I contribute to the anthropological literature on precarity, through carefully analysed empirical material that shows how antibiotics mitigate the many risks encountered in everyday life, and how these relate to wider political and economic imperatives. I began this research and carried out ethnographic

fieldwork with a focus on how antibiotics were deployed as devices for supporting care. But, during the course of my fieldwork, it became apparent that antibiotics served as a more expansive infrastructure within and beyond meeting immediate health needs. The themes of tapping opportunities and entrepreneurialism recurred throughout my research, and antibiotics appeared interwoven with these social and economic trends. My focus then expanded to foreground this apparent cultural imperative and interrogate its links with everyday antibiotic use.

The literature on the anthropology of entrepreneurship has not been fully linked to the anthropological literature on use of medicines, and the contexts within which medicines are deployed have not been explored through the lens of entrepreneurialism and the culture of opportunity. In this research, I desired to understand and document antibiotic use 'in context'. When we think of context in medical anthropology, we often focus on 'political, economic, historic' aspects. Throughout this research I have found this framing lacking for me, and have been compelled instead to trace the ways that an economic imperative – *to tap wealth* – is experienced in everyday life, transforming even the ways medicines are understood and deployed. In finding that I could not describe antibiotic use without first rendering visible how economic narratives and aspiration constitute a distinctive social milieu in Tororo, I observed a gap in our typical analyses within the sub-discipline of medical anthropology. Whilst health related analysis frequently cites resource constraints as an influencing factor, it is less common to see an integrated economic-medical anthropological analysis developed. I propose that further research is required to take seriously the ways that health, medicine and wellness are entangled with emerging economic forms, to contribute to the development of our understandings of health.

9.4 Implications for AMR policy and practice

In this section, I build on the recommendations for antimicrobial stewardship proposed in the preceding chapters by providing more detailed considerations. The use of social theory in this research has prompted me to question what may at first appear self-evident, which has enabled me to make recommendations that extend beyond changing the knowledge and behaviour of individuals through education – hitherto the focus of global health actors when it comes to addressing the overuse of antibiotics. While these recommendations are drawn from the study of everyday life in rural, urban and peri-urban settings in Uganda, they could be applied when considering antibiotic use among other populations living in precarity and in low-income settings.

9.4.1 Addressing antibiotic use drivers

Tailoring stewardship interventions to specific settings and populations

Interventions aiming to optimise antibiotic use could learn from the detailed information provided in this research, that highlights the need to move away from 'one-size-fits-all' interventions. As an example, among subsistence farmers in rural households in Tororo, the main challenge was limited access to veterinarians as well as medicines for animals mainly because of cost while among commercial farmers in peri-urban Wakiso the main challenge was numerous risks that they shoulder solely with no safety nets. While providing safety nets for commercial farmers, such as affordable insurance schemes, might reduce their likelihood of turning to antibiotics to secure their financial investment and livelihoods in peri-urban Wakiso, this may not necessarily work among subsistence farmers in rural Tororo. Instead, addressing the current set-up of the veterinary sector to enable veterinarians employed by the government to extend their work beyond the provision of advisory and preventive services such as immunisation, to return to offering treatment services at a subsidised cost, may reduce residents' experimental self-treatment of livestock.

During the course of the AMIS project, our study participants expressed interest in getting information on what conditions antibiotics should be used for, which antibiotics to use, and the dosing both for human and animal treatment. However, attempts to follow up with professionals in human and animal sectors on the possibility of sharing this information was met with resistance, as they believed this information should be restricted to fully trained professionals such as veterinarians and medical practitioners. This constitutes a barrier because, as our findings reveal, antibiotics themselves move outside of the professional boundaries. There is need to consider what information is feasible and acceptable for sharing with end users, for example in antibiotic package inserts about how and when to use these medicines. Grace (2008) and colleagues have shown the benefit of providing cattle farmers with information on the diagnosis and treatment of bovine trypanosomiasis (Grace et al., 2008). In a cluster-randomized trial that was conducted in south Mali in 2004, cattle farmers were given an information leaflet coupled with a practical session on treatment of presumed-sick cattle with trypanocides. Grace and colleagues reported higher improvements in knowledge and effectiveness of farmer treatment of trypanosomiasis and improved clinical outcomes in the test group. As a starting point, key stakeholders could be engaged through workshops to understand what they would consider acceptable and feasible information to share outside of the veterinary and medical encounters. Materials such as pictorial messages with simple language descriptions could be developed in the form of package inserts or posters that can easily be used by end users – as we have seen in the past in the case of coartem produced by Norvatis for the treatment of malaria.

Investing in infrastructure

In **Chapters 6 and 7**, I drew attention to the roles that antibiotics play in everyday life in rural households and in healthcare settings. Antibiotics played a key role in mitigating the many risks encountered in everyday life – such as inadequate sanitation facilities, limited access to clean water and good quality healthcare – enabling people to be able to tap opportunities. Addressing these social,

political and economic structures has the potential to produce solutions that can achieve equitable and sustained impact. For example, improving community infrastructure, including water and sanitation facilities, to improve waste disposal and hygiene, would likely reduce illness and infection and thus reduce reliance on antibiotics in the rural and peri urban settings of the study.

The findings from this research will be useful to policy-makers tasked to make decisions about addressing antibiotic resistance. With increasing concerns about protecting antibiotics to ensure that they remain effective, policy-makers have focused on changing the behaviour of individuals including patients, prescribers and farmers, in order to minimise the development and spread of AMR. My findings provide evidence of why and how people use antibiotics for humans and animals, highlighting different ways for people to consider antibiotic use and presenting insights on alternative paths to intervention. At the local level, my research provides a locally relevant perspective on the role of antibiotics for Ugandan society more generally.

Under the AMIS project, we have promoted the concept that antibiotics are 'infrastructure', meaning that they are a part of the fabric of our health systems but also our societies. This framing has been taken up widely, by policy makers, funders and other researchers globally. Locally, the concept of antibiotics as infrastructure has been interpreted in different ways. In one of our dissemination meetings, an official from the One Health Platform-Antimicrobial Access, Stewardship and Optimal Use technical working committee, highlighted efforts by the Ministry of Health and other players in the area of infection prevention and control, as strides in improving infrastructure. On the other hand, my findings have also drawn attention to the ways that antibiotics become a 'quick fix' to make up for a shortfall in other things, such as the provision of good hygiene and good care, and this means that if we want to reduce our use of antibiotics, we need to focus on improving hygiene and care (Denyer Willis and Chandler, 2019). This framing has also been taken up by others in research, policy and practice, and

better understood as compared to the concept of infrastructure. For these findings to be better taken on board by key stakeholders, we need to find ways to talk about antibiotics as part of the fabric of our society that can be understood by policy-makers. One approach that could be undertaken, could be using case studies as examples that vividly explain the linkages between the multiple factors that shape the way antibiotics are used.

Securing people rather than medicines

In **Chapter 8**, I described the ways in which antibiotics provided some form of security in the insecure environments that people lived in. I proposed that antimicrobial stewardship interventions seeking to optimise antimicrobial use needed to incorporate efforts to provide security for people on an everyday level if medicines are to be secured. One way of doing this, would be by addressing economic insecurity across all the study settings. Doing so could help achieve health security and other forms of security, preventing people from turning to antibiotics to counter the everyday insecurities that affect them in different ways. As a starting point, there is need for a shift in how we talk about security in the AMR discourse. As I highlighted in Chapter 8, the way that anthropologists and other scholars have interrogated Global Health security is centred on borders, violence and resistant bugs. The Global Health Security agenda is framed in such a way that it implies that things are already available, and we want to secure them for the future. In contrast, my findings draw attention to the existence of multiple dimensions of insecurity in peoples' daily lives, underscoring the need for a global health insecurity agenda. In my study settings, it is about dealing with insecurity and antibiotics play a key role in countering insecurity. Until we deal with the reality of insecurity in people's everyday lives, we are not going to be able to resolve AMR and reliance on antibiotics. This calls for widening of the focus of the global health security agenda to include the way that people experience health insecurity emerging from the wider insecurities that afflict their lives, and which do not make it onto that Global Health Security agenda.

The problem of insecurities that people experience daily is observed by national and global actors and institutions but taking action to counter these is often foreclosed. In cases where responses are taken, however, they tend to be fragmented or a temporary fix by patching things up. This is observed with the Operation Wealth Creation Programme in Uganda that has a goal of getting peasants into the money economy by encouraging them to take up opportunities such as farming without addressing the wider conditions of the uncertain economic environment in which they operate. The challenges of the top to bottom approach taken by the Operation Wealth Creation programme, were highlighted in a report from an assessment that was carried out by the parliamentary sectoral committee on Agriculture, Animal Industry and Fisheries in 2017 (Parliament of Uganda, 2017).

The other issue is the limitations that come with the technical solutions that are embedded in the North-South relations that dictate AMR policy, deliberately aiming to depoliticise solutions and avoid state infrastructures (Cañada, 2021; Mateos and Suárez-Díaz, 2020). As an example, we can consider the water, sanitation and hygiene (WASH) programme, where despite models suggesting that improvement in WASH infrastructure has the potential for large reductions in antibiotic use (Araya et al., 2016), the focus has been put on correcting behaviour through interventions on handwashing and improving water quality through water treatment (Pickering et al., 2019). Evaluation of the behavioural models indicated that after the period of intense intervention activities, hand washing behaviours were not sustained sufficiently to maintain an impact on child diarrhoea. There was poor uptake of the water treatment programme, significant decline in use when programme activities became less intense, and no effect on diarrhoea. There is need to put emphasis on investment in water and sanitation infrastructure in order to see a decline in reliance on antibiotics as quick fixes (Denyer Willis and Chandler, 2019). In addition, some scholars have noted the down side of some behaviour change tools, such as the use of stigma which may be effective in changing hard-to-shift behaviours but may also have the unintended consequences of causing damage to those who are most vulnerable and reinforcing health disparities

(Brewis and Wutich, 2019). They emphasise the need for a shift from individual responsibility that comes with apportioning blame to individuals, but recognise that this shift may be difficult to attain as beliefs of individual responsibility are deeply embedded in the values of neoliberalism, which have been adapted in public policy and health practice but also in society in general (ibid).

As part of the AMIS study dissemination activities, we had the opportunity to share our findings with key stakeholders including members of the One-health technical working committee on Antimicrobial Stewardship, Optimal Access and Use of Antimicrobials, that is mandated to coordinate antimicrobial stewardship activities in Uganda. We highlighted the need to address economic insecurity and also invest in community infrastructure to reduce infection and the need for people to rely on antibiotics. This recommendation was found to be broad, and the AMIS team was tasked with breaking it down into immediate, short-term and long-term recommendations. One of the reasons that this recommendation has been challenging for stakeholders to take up, is that it cuts across many sectors – such as health, water and environment, agriculture, finance, and economic development – and would require coordination and inputs from each sector. It is important to note that some sectors, such as finance and economic development, have no representation on the One Health Platform that oversees all issues related to AMR in Uganda. The complexities of engaging different sectors that have traditionally worked independently and have differences in available resources and facilities becomes a challenge that has rendered the One Health approach difficult to implement (Cañada, 2021). The multi-dimensional and complex nature of AMR and antibiotic use is yet to be fully appreciated by all stakeholders. This adds a layer of complexity in taking up some of my recommendations.

9.4.2 Expanding the One health approach to AMR

My findings focus on humans and animals, consistent with the One Health approach that has been preferred as an integrated and holistic approach for achieving objectives related to tackling AMR. In

Chapter 2, I highlighted one of the short comings of the One Health approach: the prioritising of scientific evidence produced by biomedical professionals, over other forms of knowledge that are equally important. This research demonstrates the value of an ethnographic approach to studying the ways antibiotics are incorporated into the lives of both humans and animals. My findings are an example of careful consideration of the complex social, cultural and economic relations that people have with animals. In **Chapter 8,** I described climate instability as one of the insecurities that people encountered, contributing to low yields from agriculture, food insecurity and low household incomes and directly impacting healthcare and the way medicines were used in the local area. Notably, climate instability falls under the environment pillar of the One Health approach to AMR. However, the environment pillar of One Health often receives less attention as compared to the human and animal pillars (Humboldt-Dachroeden and Mantovani, 2021). There is need to consider AMR as an anthropogenic problem that might better be addressed within a planetary health framework, that focuses on understanding and addressing challenges emerging from human caused disruptions of the earth's natural systems. Most importantly, we need to recognise the limitations of restricting ourselves to frameworks and consider other important factors that become obscured when our focus is on frameworks. Instead, we should continue to 'follow' our research objects or subjects, in this case antibiotics as advocated by Marcus (1995), so that we can be less restrained in what we see and in a better position to understand complicated research subjects and objects that move across multiple sites (Marcus, 1995).

9.4.3 Improving regulation of antibiotics outside of the public sector

In **Chapter 5**, I reported that antibiotics were mainly acquired through the private sector for both human and animal use in all three study areas. In **Chapter 6**, I described how residents relied on local drug shops and private clinics, where medicines were available at the lowest cost possible. In **Chapter 8**, I talked about challenges that farmers faced in discerning genuine animal health workers from the pool of private veterinarians, and genuine farm products including medicines on the market in a context where

all veterinary clinical services are provided by the private sector (Ilukor et al., 2012). These findings render visible the important role of the private sector in providing access to antibiotics in Uganda. Policy makers need to recognize the role of the private sector and the importance of addressing the roles of antimicrobial markets within and beyond the formal health sector, when developing programmes to optimise antibiotic use.

In a country like Uganda with a predominant private health sector, improving how regulation of the private sector is implemented would be helpful in addressing who handles antibiotics and what antibiotics are sold. Most importantly, the sale of antibiotics on the Watch and Reserve lists of the World Health Organisation would be controlled. There have been efforts by the NDA to regulate pharmaceuticals in the private sector. These have included operations that involve closing drug outlets that are run by unqualified personnel and drug outlets found trading in expired drugs or re labelling drug packages. The NDA has also conducted operations to curb the selling and hawking of human and veterinary drugs in shift markets in Uganda. The punitive measures usually taken include arresting the culprits and having their medicines impounded. Despite these efforts, antibiotics continue to be handled by health professionals and end users, that are not legally allowed to do so and to be sold in drug shops and markets.

The Uganda National Action Plan on AMR 2018 specifies measures that will be undertaken to regulate the use of antibiotics outside the public sector. The plan proposes to start by carrying out a situational analysis of the existing regulations and their implementation and enforcement. To strengthen regulation of antimicrobials, the NAP proposes to increase support to the NDA and sensitise private providers of antibiotics of NDA regulations to increase compliance. In addition, enforcement of compliance to over-the-counter dispensing guidelines and sensitization of the public on the NDA regulations are proposed to increase compliance. Much as these plans are useful for regulation, there is need to understand the

different stakeholders and networks involved in the private sector and how they influence the medicine markets. Key stakeholders and networks need to be brought into the conversation when thinking of improving the regulation of antibiotics. Some researchers doing work on regulating medicine markets in Uganda have highlighted the various actors, organisations and networks that influence the medicine market, such as the Pharmaceutical Society of Uganda, the Pharmacy Board and the National Drug Advocacy Initiative (Hutchinson et al., 2020). They have proposed the establishment of dialogue between the NDA and these different actors to come up with collective solutions that might improve regulation in the market. They advocate for bottom-up interventions to regulate the medicines market more effectively, such as forming new partnerships and engaging key actors in the design of new regulation interventions.

Miller and Goodman (2016) have highlighted the role of regulation in shaping pharmacy provider practices in low and middle income Asian settings (Miller and Goodman, 2016). In their systematic review, they show that in an intervention conducted in Lao PDR involving inspection visits, punishments for violation of sanctions, supply of updated regulatory documents and reinforcement of the rules led to improved practices, such as less mixing of different drugs in the same package and order in the pharmacy. In Bangkok, Thailand, the regulatory component of the intervention led to a reduction of dispensing of prescription only steroids. However, enforcing regulation is costly and logistically challenging, which calls for leveraging on existing structures such as those set up by the organisational model of chain pharmacies to deal with the fragmented nature of pharmacy retail and improve regulation (Miller et al., 2018). They emphasise the need to address corruption in the health sector if regulation is to be improved (ibid). With dynamic medicine markets and emerging trends in LMICs such as e-Pharmacy, scholars have highlighted the need to ride on the opportunities for traceability and transparency provided by e-pharmacy to improve regulation (Miller et al., 2021). This would call for investment in expertise to manage the system and adaptation of regulatory processes.

9.4.4 Repositioning systems as stewards of antibiotics

In **Chapter 7**, I highlighted that clinical practice in primary care health facilities was shaped by availability of resources, and professional and patient expectations, as much as by the clinical guidelines. In addition, in **Chapter 7**, I wrote about the ways that health workers suspected resistance when a patient seemed to have failed on an antibiotic, informing their decision to prescribe what they considered to be a stronger antibiotic. The continued focus on resistance by stewardship programmes may have an unintended consequence of reinforcing this practice if not addressed (Pearson and Chandler, 2019). As such, this disconnect in understanding needs to be carefully considered when designing antimicrobial stewardship interventions, such as health worker awareness campaigns, to avoid negative unintended consequences. In addition, other scenarios that antibiotics have become a solution to addressing such as the management of infections with bacteria that are not covered by the originally prescribed antibiotic and management of non-bacterial infections as well as non-infectious causes of infection, would have to be addressed as part of stewardship intervention packages.

In Uganda, the main stewardship intervention so far in healthcare settings has been updating and disseminating of clinical guidelines. Clinical guidelines have been adopted throughout the health system aiming to optimise antibiotic use. With limited resources, high level health facilities such as hospitals have been prioritized for dissemination of the revised guidelines. Indeed, lower-level health facilities such as HC IIs in Tororo had not received the updated 2016 clinical guidelines when I did my fieldwork in 2020. It is still unclear how a combination of various stewardship interventions beyond clinical guidelines, would be received and implemented in Ugandan health facilities where the existing structures of healthcare continue to rotate around the giving of medicines. Removing antibiotics from health care encounters is likely to be a challenge.

Being a member of the Uganda One-health technical working committee on Antimicrobial Stewardship, Optimal Access and Use of Antimicrobials gave me an opportunity to listen to ongoing work and plans for antimicrobial stewardship focusing on healthcare settings. One research group that often gave progress reports on antimicrobial stewardship work in public health centres, was the Infectious Diseases Institute supported by the Global Health Security Partnership Engagement. Their scope of activities involved supporting the National Medicine and Therapeutic Committee and activating as well as training medicine and therapeutic committees, infection prevention and control committees and antimicrobial stewardship committees in six regional referral hospitals in Uganda, to promote rational use of antibiotics. There was an emphasis on disseminating the updated 2016 clinical guidelines which were reported to be available in all 6 regional hospitals following the intervention of the project. Other activities carried out by this project included strengthening laboratory capacity in the six regional referral hospitals, training prescribers on best practices, and sharing data on antimicrobial resistance and antimicrobial use and consumption. These activities taken together were expected to lead to improved antibiotic prescription practices and optimal use of antibiotics. In the National antimicrobial stewardship meetings, some stakeholders shared findings focusing on consumption of antibiotics in public health facilities revealing noncompliance with Ugandan clinical guidelines and recommending that there was need to strengthen national antimicrobial stewardship programs (Nambasa et al., 2020; Namugambe et al., 2021). With a focus on training and educating health workers on antibiotic use and infection prevention and control, what seemed to be missing from the conversations was a consideration of and plans to address gaps in the general health infrastructure such a limited human resource, equipment and supplies that impact on healthcare provider prescription practices.

There is need for a shift in thinking among key stakeholders to go beyond correcting prescribing behaviour if antibiotic use is to be optimised. One step in that direction could be for antimicrobial stewardship interventions to consider *systems* as well as *individuals* to be stewards of antibiotics.

Beyond disseminating guidelines, antimicrobial stewardship programmes should invest in the general health infrastructure such as equipment, medicines and supplies; as well as training of healthcare practitioners to improve health workers' ability to deliver quality care beyond the provision of medicines. Some scholars have drawn attention to the need for antimicrobial stewardship programmes to incorporate efforts to address context specific structural conditions to which antibiotic use has become a solution. Tarrant, in her study of factors that influence the overuse of broad spectrum antibiotics in high and low income, public and private healthcare settings, highlights system level factors that conflict with stewardship goals, such as inadequate material resources in hospitals (Tarrant et al., 2021). She recommends that stewardship programmes include a focus on identifying solutions to structural issues, such as investment in diagnostic facilities and healthcare facilities in general. Recognising that addressing structural issues requires extensive investment, she suggests some low-cost solutions, such as committing the limited available microbiology resources to patient groups where they have the highest impact. Focusing on structural factors shaping antibiotic use in healthcare settings, allows us to ask different questions such as 'How can we design infection control interventions that are feasible in suboptimal hospital environments?'(Tarrant et al., 2021). The need for a paradigm shift to incorporate the multiple dimensions, ranging from personal, interpersonal and institutional factors, that shape the way antibiotics are used, is essential if antimicrobial stewardship programmes are to be successful (Broom et al., 2019).

9.4.5 Sharing lessons on antibiotic use emerging from different fields of study

As reported in **Chapter 6**, residents had resorted to using antibiotics in a piecemeal manner to cope with persistent illnesses. However, the burden of antibiotic resistance already being faced by our study population in the rural Tororo and urban Kampala, is not clear. During the course of this project, this was a question that was raised by some stakeholders that I engaged with on platforms where I shared my research findings from rural households, as well as those from the urban study site in the AMIS

study. The findings from the antibiotic surveys presented in **Chapter 5** showing frequent use of antibiotics across the rural, urban and peri-urban study sites, suggest that antibiotic resistance is likely to be a problem now and in the future. For many people if there is resistance to first line treatments as has been reported in some settings in Uganda (Kabugo et al., 2017; Katongole et al., 2019; Katongole et al., 2020), then access to the next line of treatment may be challenging making AMR a critical problem.

Very few studies have combined an ethnographic approach to understanding the everyday realities of particular antibiotics, including why and how antibiotics are used in different settings, with the collection of microbiology data. One ongoing study in Uganda, Kenya and Tanzania has taken on a multidisciplinary approach to investigate the social, biological and community level drivers of AMR (Asiimwe et al., 2021). This study involves the use of qualitative methods to understand antibiotic provision practices and attitudes, knowledge and experiences of patients diagnosed with urinary tract infections, carrying out cultures and antibiotic sensitivity testing of urine samples collected from clinically diagnosed patients with urinary tract infections, and collecting samples from the environment for patients that are urinary tract infection positive. The findings from this multidisciplinary work on drivers of antimicrobial resistance are yet to be published. Most importantly, the findings presented in this thesis vividly explaining the ways in which people rely on antibiotics, underscores the importance of understanding the potential impacts of AMR, such as driving further use of antibiotics as well as long term ill health if the antibiotics are not working. Being able to look at the ethnographic data alongside medical microbiological data would be helpful for understanding the impacts that short- and longer-term trends of antibiotic use may have on microbial populations and drug resistant infections.

9.5 Implications for public health research

In this section I bring together the areas for further research emerging from my findings in the following areas: strengthening evidence on antibiotic use outside formal healthcare settings and the need for evidence and evaluations of antimicrobial stewardship programmes.

9.5.1 Strengthening evidence on antibiotic use outside formal healthcare settings

Current information on antibiotic consumption is drawn from aggregated data sources such as imports or wholesaler data, health insurance data, or hospital pharmacy dispensing or procurement data at the healthcare facility level (World Health Organisation, 2021). This data is considered a proxy estimate of antimicrobial use, but it does not reflect use of these medicines by the patients who receive it and why they use it. While antibiotic use outside of hospitals is substantial, relatively little is known about community-level use of antibiotics in LMICs. The studies that have looked at antibiotic use in the community have focused on specific populations and time periods such as children under five years of age, recently hospitalised patients or households reporting acute illness in the recent past, and particular conditions such as respiratory infections (Kibuule et al., 2016; Vialle-Valentin et al., 2012). These studies have also focused on knowledge, attitudes and practices regarding antibiotic use. It is important to understand antibiotic use practices beyond specific conditions, populations, defined periods of time and knowledge. There is still need for detailed information, including the geographic distribution of antibiotic use amongst households and farms, and the frequency and types of antibiotics. This information is crucial for informing the design of interventions to optimise antibiotics that are locally relevant and tailored to specific populations and settings. In addition, detailed information on the geographic distribution of antibiotic use as well as frequency and types of antibiotics use, could inform relevant questions that would need further exploration by other disciplines such as social sciences, microbiology, history and geography among others.

In **Chapter 6,** the evidence presented on use of medicines reflects how challenging it is to uncover the ways in which antibiotics are actually used in practice, even with extended observational fieldwork. People talked about taking medicines and showed me the medicines that they used, but I rarely saw residents actually taking medicines. Similarly, for animal treatment I did not witness the use of antibiotics in households first-hand during my fieldwork. However, residents described their practices when it came to management of illnesses in animals. This gap is also reflected in the literature on medicine use in real life settings, especially in LMICs which is limited, with very few African anthropologists studying this topic. Improving the evidence base on use of antibiotics in everyday life would add to the detailed evidence required to design locally relevant stewardship programmes.

In addition, understanding alternatives to antibiotic use for humans and animals was an area that was not explored in this thesis. Much as complementary and alternative medicine including a range of products such as natural compounds, dietary supplements and probiotics is increasingly being recognised globally as an effective approach for managing infections (Baker et al., 2018; Khameneh et al., 2019), it was rarely discussed in the Uganda national antimicrobial stewardship meetings. During the Uganda national AMR conferences that were organised annually, a few researchers doing work in the veterinary sector made presentations about phages that could be harnessed as alternative therapy to antibiotic resistant pathogens (Ssekatawa et al., 2021). However, a concern that was raised by one of the key actors in veterinary medicine in Uganda was that phages could have the detrimental effects of clearing all microbes, including the good ones.

In Uganda, the use of herbal remedies has not be widely promoted in part because there have been limited studies that have been carried out on them, raising concerns of potential public health risks (Ssempijja et al., 2020). However, the use of herbal remedies would be a particular area of interest for researchers given the wide circulation of information emphasizing the benefits of herbs in giving relief

for patients with COVID-19 in Uganda. In June 2021, the Uganda National Drug Authority approved a locally made herbal treatment for COVID-19 called Covidex following a scientific evaluation of its safety and efficacy (Athumani, 2021). The approval of Covidex was received with mixed feelings by the World Health Organisation who raised concerns that they had not approved the drug. However, locally it has been perceived as a local solution to a global challenge of COVID-19 amidst limited access to vaccines and medicines approved for emergency use.

9.5.2 The need for evidence and evaluations of antimicrobial stewardship programmes

Much of the existing literature on stewardship programmes, as described in **Chapter 7**, is drawn from hospital settings, mostly in high income countries focusing on specific formal healthcare providers such as doctors in well organised human health systems (Davey et al., 2017; Wilkinson et al., 2018). Evidence on stewardship is generated through research studies including randomised controlled trials and non-randomised studies, controlled before and after studies, interrupted time series studies, cohort studies, and qualitative studies. These studies measure behavioural and clinical outcomes, analyse variation in effects and identify unintended consequences. Few stewardship programmes have been piloted in low and middle income countries (Akpan et al., 2020; D'Arcy et al., 2021), where there is a variety of health system arrangements including public, private, traditional, biomedical, formal and informal providers (Wilkinson et al., 2018).

Wilkinson (2018) carried out a systematic review of 102 studies involving interventions to reduce antibiotic prescribing in LMICs. This review included primary care settings, hospitals and pharmacies. The interventions that were considered were categorised under norms and standards, knowledge interventions, decision support, supply chain, economic, and organisational/management. She highlighted that interventions in hospitals were the most commonly evaluated which could be explained by the fact that audit/feedback and stewardship programmes are most often implemented in hospitals

as compared to other healthcare settings. The evidence base she drew on was uneven, with only educational interventions and the essential medicine policy evaluated in all settings. Most of the evidence was from hospital and urban settings. There was much less evidence from formal and informal private providers and no evidence involving drug retailers or pharmaceutical companies. She concludes that the evidence base is limited with the strongest evidence coming from knowledge interventions. No study, however had looked at veterinary prescribing of antibiotics. Consistent with what I report in **Chapter 7**, Wilkinson (2018) points out the factors shaping healthcare provider prescribing as including the quality of the health system, education, patient demands and cultures of care among others. There is need for evidence drawn from different kinds of healthcare settings that go beyond hospitals and involving different kinds of healthcare providers. To go beyond educational and knowledge interventions, an ethnographic approach would be appropriate for exploring the lived realities of health care provision in different healthcare settings to provide locally relevant evidence to inform antimicrobial stewardship programmes.

9.6 Strengths and limitations

The insights from this thesis illustrate the benefits of undertaking an ethnographic approach for understanding complex problems, such as antibiotic use in everyday life. Spending an extended period of time in my study setting made it possible to observe first-hand everyday life in rural households and the ways in which antibiotics are entangled with different aspects of life, and not rely only on self-reported experiences. This thesis builds on insights from research that has been conducted in the same setting in Eastern Uganda focusing on medicines as social objects (Whyte et al., 2002). Previous research has not examined how medicines are used to make certain kinds of social, political and economic life possible. Throughout this study, I was committed to unveiling the ways in which antibiotics are deployed to do social and economic work, as well as simple curative work. This research has demonstrated the

feasibility of becoming embedded in rural households, to gain a holistic understanding of the realities of life, contributing to the limited evidence available on antimicrobial use in rural settings.

The value of participatory research and comparative analysis in facilitating richer discussions with participants and enabling a better understanding of the study findings, cannot be emphasised enough. Being very familiar with my study setting, attending participant feedback dialogues where key study findings were discussed with study participants in the urban and peri-urban study sites, allowed me to reflect on findings from Tororo and ask questions about my study setting in comparison to the other study sites. In addition, the participant feedback meetings offered a platform to cross-check that I had adequately captured and reflected study participant experiences within my analysis, which was crucial for a complex topic such as medicine use in a setting where I rarely saw residents take medicines even when observing them for hours at home during my ethnographic fieldwork.

The antibiotic surveys conducted in this study were an effective way to initiate conversations about medicines through a series of interviews, make contacts for more in-depth ethnographic fieldwork, and gain insight on topics to pursue using other research methods. In a setting where people rarely distinguished antibiotics from other medicines, the use of physical samples with the drug bag method in homes and farms, was instrumental in avoiding errors in classification of antibiotics. In addition, seeing and touching the physical samples facilitated in-depth conversations and stories on medicines use. This stage of fieldwork laid a strong foundation for more in-depth ethnographic fieldwork in the local area.

The ethnographic study involved spending 12 weeks in the field during each phase of fieldwork. During my household ethnography, I was only able to spend time in three households and the health facility ethnography also involved spending most of my time in two government health facilities. While it is common in anthropological work to engage with small samples and an in-depth understanding is preferred over generalisability of findings, it has to be acknowledged that the conclusions that can be

drawn from this sample are limited. As an example, the two lower-level government health facilities where I carried out participant observations may not be typical of other government health facilities and private healthcare settings, where much of the antimicrobial dispensing happens. In addition, the three households that I observed were selected conveniently based on expressed interest of residents to engage in longer term research following their participation in the medicines survey. However, with the amount of time that I spent in the field, I was able to provide a detailed account and engage in in-depth analysis focusing on these specific sites that adds to the limited evidence available on antibiotic use in rural settings, most of which has been based on non-anthropological approaches. The COVID-19 pandemic meant that I had to gather some of the data remotely; for instance, interviews with health workers were conducted through phone calls.

My fieldwork involved participant observations in healthcare settings to understand the context of prescribing and dispensing antibiotics for humans and animals. While my non-medical background enabled me to capture fresh insights without judging whether antibiotics were being used appropriately or not, sometimes this was a limitation hindering further exploration of pertinent issues from a clinical perspective. Therefore, in presenting the findings from healthcare settings, I have focused on describing everyday life in these spaces and the challenges of providing healthcare in a resource limited setting. In this way, I offer new insights that might otherwise have been missed, to better understand the factors that shape clinical practice in these settings.

9.7 Reflections: Ending the PhD journey

As my PhD journey comes to an end, I reflect on what has been an exciting few years. It has been a journey that I would describe as filled with breaking boundaries – in terms of the people I engaged with and places that I visited on the journey of learning more on antibiotic use. My position as a co-investigator on the AMIS programme and PI on the AMIS Uganda study gave me access to data from the

urban and peri-urban sites, it allowed me to be part of the national technical working committee handling issues on AMR and gave me access to a team of experts from different disciplines that are part of the team of mentors for the AMIS Hub and the advisory committee to the AMIS Uganda study. I have engaged with people that I would never have crossed paths with if it was not for our shared interests in AMR and antimicrobial use such as people from the fields of agriculture, veterinary medicine and medical microbiology. Doing research in the field of antimicrobial use calls for careful attentiveness, flexibility and innovativeness. It called for a great deal of people skills and being open to learning new things that go beyond the field of social science. It was a life journey like I have never experienced in Uganda. A journey that in many ways was made easier by my familiarity with the study site, which meant I already had a strong relationship with the district health leadership and access to local contacts that helped me build rapport with local residents. Being based in Uganda and doing fieldwork at home made my research a broader project about Uganda, and in a sense I was always in the field even when I was not in Nagongera.

Studying antibiotic use from rural households was an eye opener. It came with insights on gender and cultural dynamics, political and social marginalisation, models of development and how they play out for the ordinary Ugandan, and efforts for survival and betterment among others. I have found that positioning myself in rural households worked really well when it came to using a holistic approach to understand how antimicrobials intersect with life, livelihoods and healthcare for humans and animals in Uganda as well as appreciating the wider social, economic and political factors that shape the ways antimicrobials are deployed in Ugandan society today. I hope that this thesis has contributed to a growing literature that connects everyday pharmaceutical practices with national and global systems.

Being part of the AMIS programme provided an opportunity for me to co-publish with colleagues during the PhD on topics related to antibiotics. I present the papers that I contributed to during the PhD in the table below.

List of papers I contributed to during the PhD

Paper	Journal	Status
The 'Drug Bag' Method: Lessons from Anthropological Studies of Antibiotic Use in Africa and South-East Asia. *Global Health Action* 12(1): 1639388. (2019) Justin Dixon, Eleanor MacPherson, Salome Manyau, **Susan Nayiga**, Yuzana Khine Zaw, Miriam Kayendeke, Christine Nabirye, Laurie Denyer Willis, Coll de Lima Hutchison and Clare IR Chandler.	Global Health Action	Published
Use of antibiotics to treat humans and animals in Uganda: a cross-sectional survey of households and farmers in rural, urban and peri-urban settings. *JAC-Antimicrobial Resistance*. 2(4):5925476. (2020) Susan Nayiga, Miriam Kayendeke, Christine Nabirye, Laurie Denyer-Willis, Clare IR Chandler, Sarah G Staedke.	JAC-Antimicrobial Resistance.	Published
Taking opportunities, taking medicines: antibiotic use in rural Eastern Uganda **Susan Nayiga**, Laurie Denyer Willis, Sarah G Staedke, and Clare IR Chandler.	Medical Anthropology	Accepted for publication
Antibiotic 'Entanglements': Health, labour and everyday life in an urban informal settlement in Kampala, Uganda. *Critical Public Health* Christine Nabirye, Laurie Denyer-Willis, **Susan Nayiga**, Miriam Kayendeke, Sarah Staedke and Clare IR Chandler.	Critical Public Health	Published
Reconciling imperatives: Clinical guidelines, antibiotic prescribing and the enactment of good care in lower-level health facilities in Tororo, Uganda **Susan Nayiga**, Laurie Denyer Willis, Sarah Staedke, and Clare IR Chandler.	Global Public Health	Published
Pharmaceuticalised livelihoods: Antibiotics and the Rise of Quick Farming in peri-urban Uganda Miriam Kayendeke, Laurie Denyer-Willis, **Susan Nayiga**, Christine Nabirye, Nicolas Fortané, Sarah Staedke and Clare IR Chandler.	Journal of Biosocial Sciences	Not yet submitted
Antibiotic Stories: A Mixed-Methods, Multi-Country Analysis of Household Antibiotic Use in Eastern Africa. BMJ Global Health 6(11) e006920. (2021) Justin Dixon, Eleanor MacPherson, **Susan Nayiga**, Salome Manyau, Christine Nabirye, Miriam Kayendeke, Esnart Sanudi, Alex Nkoambe, Portia Mareke, Kenny Sithole, Coll de Lima Hutchinson, John Bradley, Shunmay Yeung, Rashida Abbas Ferrand, Sham Lal, Chrissy Roberts, Edward Green, Laurie Denyer-Willis, Sarah Staedke and Clare IR Chandler.	BMJ Global Health	Published
Antibiotic arrivals in Africa: case study of yaws and syphilis in Uganda, Malawi and Zimbabwe Paula Palanco Lopez, Salome Manyau, Justin Dixon, Eleanor MacPherson,	Medical Anthropology Theory	Accepted for publication

Susan Nayiga, John Manton, Claas Kirchhelle and Clare IR Chandler.		
Securing everyday life: Antibiotics countering risks in rural, urban and peri-urban settings in Uganda **Susan Nayiga**, Christine Nabirye, Miriam Kayendeke, Laurie Denyer Willis, Sarah Staedke and Clare IR Chandler.	Globalisation and Health	Not yet submitted

Finally, I acknowledge the opportunity that I had to be able to complete my fieldwork during the COVID-19 pandemic. Unfortunately, with the ongoing pandemic and restrictions on movement and gatherings, it has been impossible to hold face to face meetings with my study participants and key stakeholders to share findings from the research. Together with colleagues working on the AMIS study, we have disseminated our study findings to district officials, national and international stakeholders through virtual meetings. We have also been able to deliver summaries leaflets and reports of our findings as well as a thank you gift to all our study participants. Conversations with study participants have revealed the ongoing challenges with food scarcity and paucity of healthcare, with and no hope of things improving. I wonder about the impact that the COVID-19 pandemic has had on use of pharmaceuticals in everyday life, during a time when the Ugandan health system is overwhelmed, and people are encouraged to manage mild cases of the disease from home. It has been interesting to hear stories of different concoctions of herbal remedies that the people I engage with, including my study participants, have come up with and recommend for the prevention and treatment of the COVID-19. The use of pharmaceuticals in everyday life will certainly not remain the same after the COVID-19 pandemic.

Over the next few months, I plan to continue disseminating findings from my PhD and the AMIS study in general to key actors in AMR, including among others, the Ministry of Health national technical working committee who have expressed interest in hearing the immediate, short term and long-term recommendations emerging from our research. I have also submitted my findings for presentation in upcoming conferences like the American Society of Tropical Medicine and Hygiene and the Royal Society

of Tropical Medicine and Hygiene. I will be leading a collaborative research project involving workshops with policy makers and drug regulators in Uganda, Tanzania, and Malawi to understand what would be considered acceptable and feasible information on antibiotics to share with end-users. This offers an opportunity to respond to the gap in information among end-users in my study, who expressed interest in getting information about what conditions antibiotics should be used for, which antibiotics, and the dosing. I also plan to build on the ideas emerging from my PhD with a postdoctoral scholarship, looking at existing programmes to revitalise cities that might also benefit AMR and consider how we can measure impact on antibiotic use and AMR, and make the case for infrastructural investment.

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Appendices

Appendix 1. Medicines survey questionnaire

VARIABLE	FREQUENCY/PERCENTAGE
1. Interviewer name:	
2. Date of interview:	
3. Household Number:	
4. Parish Katajula Namwaya Maundo	
5. Village *(To be typed in)*	
6. Are you able to locate adult in the household? Yes/No	If no, end here
7. Has the adult consented to the survey? Yes/No	If no, end here
8. GPS coordinates of household	
9. Duration they have lived in the area Months_____ (if less than a year) Years _____(if more than a year)	
RESPONDENT CHARACTERISTICS	
10. Role of respondent in the household Head of household Primary caregiver Child Relative Friend Other (Specify)	
11. Gender of respondent Male Female	

12. Age of respondent (In absolute numbers)	
13. Highest level of education of respondent 1 Never went to school 2 Primary education 3 O level 4. A level 5. Diploma 6. Vocational training 7. University degree 8. Other (Specify) 9. Refused to answer	
14. Primary occupation of respondent 1 -Unemployed 2- Farmer 3 -Bodaboda rider 4 -Market vendor 5- Tailor 6 -Builder/Mason 7-Carpenter 10. Refused to answer 11. Other (specify)	
15. Ethnicity of respondent Adhola Teso Baganda Gisu Gwere Samia Nyole Other (Specify)	
ILLNESSES AND MEDICINES	
16. Illnesses frequently experienced in the household (Tick all that apply) Malaria Cough/Cold/flu Diarrhoea Abdominal pain Ulcers Headache High blood pressure Sickle cells Skin rashes/Eczema Typhoid	

Other (Specify)	
17. Medicines used to treat the frequently experienced illnesses in the household o Medicines for Malaria o Medicines for Cough/Cold/flu o Medicines for Diarrhoea o Medicines for abdominal pain o Medicines for Ulcers o Medicines for Headache o Medicines for Skin rashes/Eczema o Medicines for Typhoid o Other(Specify)	
18. Medicines stored in the household (Tick all that apply) **None** Medicines for Diabetes (Capture the name of the medicine) Medicines for Diarrhoea (Capture the name of the medicine) Medicines for Hypertension (Capture the name of the medicine) Medicines for Pain (Specify the pain) (Capture the name of the medicine) Headache Stomach pain Joint pain General body pain Muscle pain Medicines for abdominal problems. (Capture the name of the medicine) Medicines for Cough/'Flu'/Pneumonia. (Capture the name of the medicine) Medicines for HIV/ISS/AIDS. (Capture the name of the medicine) Medicines for Asthma. (Capture the name of the medicine) Medicines for Skin rashes/Eczema. (Capture the name of the medicine) Medicines for Malaria. (Capture the name of the medicine) Medicines for ulcers. (Capture the name of the medicine) Medicines for typhoid. (Capture the name of the medicine) Other(specify medicine and capture the name of the medicine)	(***Provision for taking the photo of the medicine stored***)
19. Sources of medicines commonly used in the household (Tick all that apply) Drug shop Pharmacy Public Health Facility Private clinic Private hospital Research clinic/NGO Traditional healer Family/friends Don't know Other (specify)	

ANTIBIOTICS USED IN THE HOUSEHOLD	
20. Antibiotics recognised (Tick all that apply) None Amoxicillin Ampicillin Ampicillin + Cloxacillin Azithromycin Benzathine benzylpenicillin Benzylpenicillin Cefalexin/Cephalexin Ceftriaxone Chloramphenical Ciprofloxacin Cloxacillin Cotrimoxazole (Sulfamethoxazole + trimethoprim) Doxycycline Erythromycin Gentamicin Metronidazole Perfloxacin Nalidixic Phenoxymethylpenicillin Tetracycline	
21. Antibiotics frequently used in the household (Tick all that apply) None Amoxicillin Ampicillin Ampicillin + Cloxacillin Azithromycin Benzathine benzylpenicillin Benzylpenicillin Cefalexin/Cephalexin Ceftriaxone Chloramphenical Ciprofloxacin Cloxacillin Cotrimoxazole (Sulfamethoxazole + trimethoprim) Doxycycline Erythromycin Gentamicin Metronidazole Perfloxacin Nalidixic Phenoxymethylpenicillin Tetracycline	

22. Condition treated with the frequently used antibiotic in the household (*Capture the condition that they treated against the medicine*) Amoxicillin Ampicillin Ampicillin + Cloxacillin Azithromycin Benzathine benzylpenicillin Benzylpenicillin Cefalexin/Cephalexin Ceftriaxone Chloramphenical Ciprofloxacin Cloxacillin Cotrimoxazole (Sulfamethoxazole + trimethoprim) Doxycycline Erythromycin Gentamicin Metronidazole Perfloxacin Nalidixic Phenoxymethylpenicillin Tetracycline	(***This should be linked to the above question***)
23. How often are the frequently used antibiotics used in the household? Every day Every week Every two weeks Every month 1-6 months 6-12 months Other (Specify)	
24. Please tell me about your most recent experience using one of the antibiotics you frequently use to manage illnesses in your household? - What happened that led you to use this medicine? - How did you get to know about this medicine? - Where did you get it from? - What did it cost you – in terms of money, time, etc? - What is it like to take the medicine? - How often is this medicine needed in this household? - What would you do next time?	(**Provision for recording**)
25. Antibiotics they need but cannot get None Amoxicillin Ampicillin	

Ampicillin + Cloxacillin Azithromycin Benzathine benzylpenicillin Benzylpenicillin Cefalexin/Cephalexin Ceftriaxone Chloramphenical Ciprofloxacin Cloxacillin Cotrimoxazole (Sulfamethoxazole + trimethoprim) Doxycycline Erythromycin Gentamicin Metronidazole Perfloxacin Nalidixic Phenoxymethylpenicillin Tetracycline	
26. Reason why they cannot get the antibiotic they need It is not available in the government health facility It is not available in the drug shop/pharmacy It is too expensive Other (Specify)	
FARMING CHARACTERISTICS	
27. Farming practised in the household (Farming includes livestock, poultry and agriculture) Yes No (***If no, end interview here***)	
28. Type of farming practised in household (Tick all that apply) Crop farming Livestock farming Poultry Other	
29. Scale of farming practised in the household (Tick all that apply) Subsistence Commercial Other	
30. Crops grown in the household (Tick all that apply) None Maize Beans Rice Matooke	

Sweet potatoes Cassava Millet Sorghum Groundnuts Other (Specify)	
31. Livestock kept in the household (Tick all that apply) None Pigs Cattle Goats Sheep Rabbits Other (Specify)	
32. Poultry kept in the household (Tick all that apply) None Chicken Turkey Ducks Pigeons Other(Specify)	
33. Duration the household has practiced farming Months_____ (if less than a year) Years _____(if more than a year)	
34. Who in the household is primarily responsible for farming activities in the household? Head of household Primary caregiver Child Relative Friend Other (Specify)	
ILLNESS AND MEDICINES USED IN FARMING	
35. **Commonly experienced illnesses in livestock farming** (***Tick all that apply)*** • Nagana • Worms • Foot and mouth disease • Mastitis • Sudden death • Skin disease/wounds • Diarrhoea • Typhoid • External parasites • Cough/Flu	

• Other (Specify)	
36. **Commonly experienced illnesses in poultry** (***Tick all that apply)*** • Diarrhoea • Worms • Typhoid • New castle disease • Coccidiosis • Chicken pox • Flu/cough • Sudden death • Skin disease/wounds • General weakness • External parasites • Other (Specify)	
37. **Commonly experienced diseases in agriculture** (***Tick all that apply)*** • Maize weevil • Maize worms • Cassava mosaic • Cassava worms • Sweet potato worms • Rice worms • Banana weevil • Other (Specify)	
38. Medicines used to manage the commonly experienced diseases in livestock farming in the household • Medicines for Nagana • Medicines for Worms • Medicines for Foot and mouth disease • Medicines for Mastitis • Medicines for Sudden death • Medicines for typhoid • Medicines for Skin disease/wounds • Medicines for Diarrhoea/bloody stool • Medicines for External parasites • Medicines for Cough/flu • Other (Specify)	
39. Medicines used to manage the commonly experienced diseases in poultry in the household • Medicines for Diarrhoea • Medicines for Worms • Medicines for general weakness • Medicines for typhoid	

• Medicines for New castle disease • Medicines for Coccidiosis • Medicines for chicken pox • Medicines for general weakness • Medicines for Flu/cough • Medicines for Sudden death • Medicines for Skin disease/wounds • Medicines for External parasites • Medicines for Other (Specify)	
40. Medicines used to manage the commonly experienced diseases in agriculture in the household • Medicines for Maize weevil • Medicines for Maize worms • Medicines for Cassava mosaic • Medicines for cassava worms • Medicines for sweet potato worms • Medicines for Rice worms • Medicines for Banana weevil • Medicines for Other (Specify)	
41. **Management of diseases in farming** (***Tick all that apply)*** Consulting someone with experience Consulting a professional (Veterinarian or Agricultural officer) Visiting the Vet Drug shop vendor/Agro vet shop Other (specify)	
42. **Source of medicines used to manage illnesses in farming** (***Tick all that apply)*** Veterinary Drug shop Veterinary Pharmacy Agro veterinary Shop Human medicines Pharmacy Other farmers Veterinary officer Agricultural officer Imported Research clinic/NGO Other (specify)	
43. **Medicines kept at home for livestock and poultry** (***Tick all that apply)*** • Medicines for Nagana • Medicines for general weakness • Medicines for typhoid • Medicines for Worms • Medicines for Foot and mouth disease • Medicines for Mastitis	***(Provision for taking photo)***

• Medicines for Skin disease/wounds • Medicines for Diarrhoea/bloody stool • Medicines for External parasites • Medicines for Cough/flu • Medicines for New castle disease • Medicines for Coccidiosis • Medicines for chicken pox • Medicines for constipation • Medicines for pain • Medicines for fever • Supplements (e.g vitamins) • Vaccines • Other (Specify)	
44. Medicines kept at home for crops (***Tick all that apply)*** • Medicines for Maize weevil • Medicines for Maize worms • Medicines for Cassava mosaic • Medicines for cassava worms • Medicines for sweet potato worms • Medicines for Rice worms • Medicines for Banana weevil • Medicines for Other (Specify)	***(Provision for taking photo)***
45. Recognised antibiotics used in farming in the household (***Tick all that apply)*** **None (Skip to Qn 48)** Oxytetracycline hydrochloride Procaine Penicillin + Dihydrostreptomycin Sulphate Trimethoprim + Sulfadiazine Sulphadimidine Neomycin +Sulphaguanidine+Sulphadimidine-+Sulphathiazole Trimethoprim + Sulfadiazine Oxytetracycline hydrochloride Trimethoprim + Sulfadiazine Tylosin Tartrate Oxytetracycyline + Erythromycin+Colistin Sulphaquinoxaline Sulfadimidine Sodium + Diaveridine Colistin sulphate Doxycycline +Tylosin Enrofloxacin 10% Erythromycin Thiocyanate Gentamycin Sulphate Oxytetracycyline + Erythromycin+Colistin+ Streptomycin Neomycin sulphate	

Oxytetracycline+Neomycin sulphate Trimethoprim + Sulfadiazine Ampicillin Trimethoprim + Sulfamethoxazole Chloramphenicol	
46. Antibiotics frequently used in farming for the household (***Tick all that apply)*** Oxytetracycline hydrochloride Procaine Penicillin + Dihydrostreptomycin Sulphate Trimethoprim + Sulfadiazine Sulphadimidine Neomycin +Sulphaguanidine+Sulphadimidine-+Sulphathiazole Trimethoprim + Sulfadiazine Oxytetracycline hydrochloride Trimethoprim + Sulfadiazine Tylosin Tartrate Oxytetracycyline + Erythromycin+Colistin Sulphaquinoxaline Sulfadimidine Sodium + Diaveridine Colistin sulphate Doxycycline +Tylosin Enrofloxacin 10% Erythromycin Thiocyanate Gentamycin Sulphate Oxytetracycyline + Erythromycin+Colistin+ Streptomycin Neomycin sulphate Oxytetracycline+Neomycin sulphate Trimethoprim + Sulfadiazine Ampicillin Trimethoprim + Sulfamethoxazole Chloramphenicol	
47. Condition treated with the frequently used antibiotic in farming in the household (*Capture the condition that they treated against the medicine*) Oxytetracycline hydrochloride Procaine Penicillin + Dihydrostreptomycin Sulphate Trimethoprim + Sulfadiazine Sulphadimidine Neomycin +Sulphaguanidine+Sulphadimidine-+Sulphathiazole Trimethoprim + Sulfadiazine Oxytetracycline hydrochloride Trimethoprim + Sulfadiazine Tylosin Tartrate Oxytetracycyline + Erythromycin+Colistin Sulphaquinoxaline Sulfadimidine Sodium + Diaveridine	***(This should be linked to the above question)***

Colistin sulphate Doxycycline +Tylosin Enrofloxacin 10% Erythromycin Thiocyanate Gentamycin Sulphate Oxytetracycyline + Erythromycin+Colistin+ Streptomycin Neomycin sulphate Oxytetracycline+Neomycin sulphate Trimethoprim + Sulfadiazine Ampicillin Trimethoprim + Sulfamethoxazole Chloramphenicol	
48. How often are the frequently used antibiotics used in farming the household used? Every day Every week Every two weeks Every month 1-6 months 6-12 months Other (Specify)	
49. Please tell me about your most recent experience using antibiotics to manage illnesses in farming in your household? • What happened that led you to use this medicine? • How did you get to know about this medicine? • Where did you get it from? • What is it like to use the medicine in farming? • What did it cost you – in terms of money, time, etc? • What would you do next time? • What would it be like practising farming without antibiotics?	(***Provision for recording***)
50. Antibiotics they need but cannot get for farming and agriculture Oxytetracycline hydrochloride Procaine Penicillin + Dihydrostreptomycin Sulphate Trimethoprim + Sulfadiazine Sulphadimidine Neomycin +Sulphaguanidine+Sulphadimidine-+Sulphathiazole Trimethoprim + Sulfadiazine Oxytetracycline hydrochloride Trimethoprim + Sulfadiazine Tylosin Tartrate Oxytetracycyline + Erythromycin+Colistin Sulphaquinoxaline	

Sulfadimidine Sodium + Diaveridine Colistin sulphate Doxycycline +Tylosin Enrofloxacin 10% Erythromycin Thiocyanate Gentamycin Sulphate Oxytetracycyline + Erythromycin+Colistin+ Streptomycin Neomycin sulphate Oxytetracycline+Neomycin sulphate Trimethoprim + Sulfadiazine Ampicillin Trimethoprim + Sulfamethoxazole Chloramphenicol	
51. Reason why they cannot get the antibiotic they need with answer options. • It is not available in the vet drug shop • It is too expensive • Other (Specify)	

Appendix 2. In-depth interview topic guide - HC II A

IDI DATA COLLECTION TOOL HEALTH WORKERS (HC II A)		
Health centre code [_____|_____]	**Study ID** [_____|_____]	**Date** [_____|_____] / [_____|_____] / [_____|_____] day month year

Position:

1 = In-charge	5 = Clinical officer	9 = Public health nurse	13 = Health assistant
2 = Senior medical officer	6 = Nursing officer	10 = Nursing aide/assistant	14 = Health educator
3 = Medical officer	7 = Enrolled nurse	11 = Laboratory technician	15 - Volunteer
4 = Senior clinical officer	8 = Midwife	12 = Laboratory assistant	15 = Other_____

[_____|_____]

DEMOGRAPHIC INFORMATION			
1. Age	Years [_____|_____]	**5. Highest level of education or qualification achieved**	
2. Gender	1 = Male 2 = Female [_____]	1 = Primary (P1 — P7) 2 = Secondary (S1 — S6) 3 = Certificate 77 = Other_____	4 = Diploma 5 = Bachelor's degree 6= Master's degree 99 = Refused to answer [_____|_____]
3. Originally from this area?	1 = Yes 2 = No [_____]		
4. Number of years worked in this job	[_____|_____]	**6. Year graduated**	[_____|_____|_____|_____]

PART 2: IN-DEPTH INTERVIEW – HEALTH WORKERS (HC II A) (1)	
Domains, topic questions, and probes: Use the table below to help you administer the questions during the interview.	
Domain	Topic and Probes
1. Your role at	a) Can you tell me the story of how you came to work at this health facility? (*Probe for when they joined the health facility, where they came from and how long they have*

work	*worked there)*
	b) What is the most important thing to you personally about doing this job?
	c) What does your usual day consist of at the health centre?
2. Common illnesses presenting at the health facility	a) Drawing from your experience working at this health facility, what are the common illnesses that people present with at your health centre?
	b) Why are these illnesses are common in this area? Have they always been common in this area? (*Probe about the drastic drop in malaria cases in the recent past and how this has impacted on his work at the health centre)*
3. Experience managing patients for the illnesses they present with at the health centre	*During the time I spent conducting observations at this health facility, I noticed that patients often presented with multiple conditions some of which they had been grappling with for a long time. You sometimes checked their books and said for instance 'this person reported here with the same problems last month'. Can you tell me more about this? What is going on here?* a) Can you tell me about your experience managing patients that present at the health centre? (Probe for w*hat works well in their job managing patients that present with different health problems?)* b) Tell me about the challenges that you face in managing the patients that present at

	your health centre. *c)* How do you overcome the challenges you face in managing patients that present at your health centre? d) During my observations, I noticed that some of the patients were known to you and you were able to make connections between the health problems they were reporting with and the problems you had managed in the recent past? How does your relationship with your patients impact on your work managing them at the health facility?
Medicines and supplies at the health centre	*a)* Can you describe the way that medicines are stocked at this health centre these days? (*Probe for what is working well and what the challenges are)* b) What happens when you run out of medicines and supplies at the health centre?
Medicine use in the community	*When I carried out observations at this health facility, you had just received supplies of medicines from NMS. I remember you trying to carefully scrutinise the patients to ensure they were not just coming to collect medicine because they had heard that medicine was available. In some cases you gave them something and told them to return if the condition persisted.* a) Tell me more about this. What are medicines used for in this community? What medicines do people stock in their homes? Why is there need for people to stock medicines at home? b) Can you tell me about anything that has happened in this area in the past or that is currently happening that you think has affected the way people use medicines in this community? c) Can you tell me about any programmes or initiatives that you have heard about in this community regarding use of medicines and the quality of health care and medicines provided at different sources of health care in this area?

9. Closing	Is there anything else you think is important about managing patients at this health centre or use of medicines at the health facility or in the community that we have not talked about?
✓ Summarise ✓ Thank participant	

Appendix 3. In-depth interview topic guide - HC II B

IDI DATA COLLECTION TOOL HEALTH WORKERS (HC II B)		
Health centre code [_____|_____]	**Study ID** [_____|_____]	**Date** [_____|_____] / [_____|_____] / [_____|_____] day month year

Position:

1 = In-charge	5 = Clinical officer 6 = Nursing officer	9 = Public health nurse	13 = Health assistant
2 = Senior medical officer	7 = Enrolled nurse	10 = Nursing aide/assistant	14 = Health educator
3 = Medical officer	8 = Midwife	11 = Laboratory technician	15 - Volunteer
4 = Senior clinical officer		12 = Laboratory assistant	15 = Other_____

DEMOGRAPHIC INFORMATION			
1. Age	Years [_____|_____]	**5. Highest level of education or qualification achieved**	
2. Gender	1 = Male 2 = Female [_____]	1 = Primary (P1 — P7) 2 = Secondary (S1 — S6) 3 = Certificate 77 = Other_____	4 = Diploma 5 = Bachelor's degree 6= Master's degree 99 = Refused to answer [_____|_____]
3. Originally from this area?	1 = Yes 2 = No [_____]		
4. Number of years worked in this job	[_____|_____]	**6. Year graduated**	[_____|_____|_____|_____]

PART 2: IN-DEPTH INTERVIEW – HEALTH WORKERS (HC II B) (1)	
Domains, topic questions, and probes: Use the table below to help you administer the questions during the interview.	
Domain	Topic and Probes
1. Your role at work	a) Can you tell me the story of how you came to work at this health facility? (*Probe for when they joined the health facility, where they came from and how long they have worked there)*

	b) What is the most important thing to you personally about doing this job?
	c) What does your usual day consist of at the health centre?
2. Common illnesses presenting at the health facility	a) Drawing from your experience working at this health facility, what are the common illnesses that people present with at your health centre?
	b) Why are these illnesses common in this area? Have they always been common in this area? (*Probe about the drastic drop in malaria cases in the recent past and how this has impacted on his work at the health centre)*
3. Experience managing patients for the illnesses they present with at the health centre	*During the time I spent conducting observations at this health facility, I noticed that patients often presented with multiple conditions some of which they had been grappling with for a long time. You sometimes said for instance 'these people come with cough or diarrhea every month'. Can you tell me more about this? What is going on here?* a) Can you tell me about your experience managing patients that present at the health centre? (Probe for w*hat works well in their job managing patients that present with different health problems?)* b) Tell me about the challenges that you face in managing the patients that present at your health centre. *c)* How do you overcome the challenges you face in managing patients that present at

	your health centre? d) During my observations, I noticed that most patients were known to you and seemed more comfortable being treated by you? How does your relationship with your patients' impact on your work managing them at the health facility?
Medicines and supplies at the health centre	*c)* Can you describe the way that medicines are stocked at this health centre these days? (*Probe for what is working well and what the challenges are)* d) What happens when you run out of medicines and supplies at the health centre? *(During my observations I noticed that you had a system of preserving some medicines for emergency cases. How did you learn to do that? Probe for any other ways in which they try to be efficient with the medicines and supplies that they receive.)*
Medicine use in the community	*During my observations at this health facility, you mentioned that you could not withhold medicine from patients if it was available. It sounded like the patients needed to walk away with something even if it was for 'pychological' treatment. You talked about patients cursing you when you told them there was no medicine. You also talked about patients coming in big numbers when medicines were delivered at the health facility.* d) Tell me more about this. What are medicines used for in this community? What medicines do people stock in their homes? Why is there need for people to stock medicines at home? e) Can you tell me about anything that has happened in the past or that is currently happening that you think has affected the way people use medicines in this community? f) Can you tell me about any programmes or initiatives that you have heard about in this community addressing use of medicines or the quality of health care provided at different sources of health care in this area?

9. Closing	Is there anything else you think is important about managing patients at this health centre or use of medicines at the health facility or in the community that we have not talked about?
✓ Summarise Thank participant	

Appendix 4. In-depth interview topic guide - Private Clinic

IDI DATA COLLECTION TOOL HEALTH WORKERS (Clinic/Drug shop)		
Clinic code [_____|_____]	**Study ID** [_____|_____]	**Date** [_____|_____] / [_____|_____] / [_____|_____] day month year

Qualification:

1 = Senior medical officer	5 = Nursing officer	9= Nursing aide/assistant	13= Other_____
2 = Medical officer	6= Enrolled nurse	10 = Laboratory technician	
3 = Senior clinical officer	7 = Midwife	11 = Laboratory assistant	
4= Clinical officer	8= Public health nurse	12=Volunteer	

DEMOGRAPHIC INFORMATION			
1. Age	Years	[_____|_____]	**5. Highest level of education or qualification achieved** 1 = Primary (P1 — P7) 2 = Secondary (S1 — S6) 3 = Certificate 4 = Diploma 5 = Bachelor's degree 6= Master's degree 99 = Refused to answer 77 = Other_____ [_____|_____]
2. Gender	1 = Male 2 = Female	[_____]	
3. Originally from this area?	1 = Yes 2 = No	[_____]	
4. Number of years worked in this clinic or drug shop		[_____|_____]	**6. Year graduated** [_____|_____|_____|_____]

PART 2: IN-DEPTH INTERVIEW – HEALTH WORKERS (Clinic) (1)	
Domains, topic questions, and probes: Use the table below to help you administer the questions during the interview.	
Domain	Topic and Probes
1. Your role at work	a) Can you tell me the story of how you came to work at this clinic? (*Probe for how the clinic was started, where they came from and how long they have worked there)*

	b) What is the most important thing to you personally about doing this job?
	c) What does your usual day consist of at the clinic?
2. Common illnesses presenting at the health facility	a) Drawing from your experience working at this clinic, what are the common illnesses that people present with here?
	b) Why are these illnesses are common in this area? Have they always been common in this area? (*Probe about the drastic drop in malaria cases in the recent past and how this has impacted on her work at the clinic)*
3. Experience managing patients for the illnesses they present with at the health centre	*During the time I spent conducting observations at this clinic, I noticed that patients often came with less than 1000 shillings and sometimes needed several medicines. I also noticed that many times children were sent by the people at home to buy medicines. Can you tell me more about this? What is going on here?* a) Can you tell me about your experience managing patients that present at the clinic? (Probe for w*hat works well in their job managing patients that present with different health problems?)* b) Tell me about the challenges that you face in managing the patients that present at your clinic. *c)* How do you overcome the challenges you face in managing patients that present at your clinic?

	d) During my observations, I noticed that many of the people that came to the clinic were known to you. How does your relationship with your patients impact on your work managing them at the clinic?
Medicines and supplies at the clinic	*e)* Can you describe the process of stocking medicines at the clinic? (*Probe for what medicines they usually stock and why, how they make decisions on what medicines to stock at the clinic, how often they buy medicines and where they buy medicines from, what is working well and what the challenges they encounter in keeping the clinic stocked with medicine)*
Medicine use in the community	g) During the survey that I conducted in selected households in Nagongera Sub County in November 2018, we learnt that people kept several medicines at home. What are medicines used for in this community? Why is there need for people to stock medicines at home? h) Can you tell me about anything that has happened in this area in the past or that is currently happening that you think has affected the way people use medicines in this community? i) Can you tell me about any programmes or initiatives that you have heard about in this community addressing the use of medicines and the quality of health care and medicines provided at different sources of health care in this area?

9. Closing	Is there anything else you think is important about managing patients at this clinic or use of medicines at the clinic or in the community that we have not talked about?
✓ Summarise ✓ Thank participant	

Appendix 5. In-depth interview topic guide - Animal health workers

IDI DATA COLLECTION TOOL HEALTH WORKERS (Animal health workers)	
Study ID [____|____]	**Date** [____|____] / [____|____] / [____|____] day month year
Qualification: 1 = Senior veterinary officer 2 = Veterinary officer 3 = Animal husbandry officer 4= Animal production officer 5= Other_____[____|____]	

DEMOGRAPHIC INFORMATION			
1. Age	Years [____|____]	**5. Highest level of education or qualification achieved**	
2. Gender	1 = Male 2 = Female [____]	1 = Primary (P1 — P7) 2 = Secondary (S1 — S6) 3 = Certificate 77 = Other_____	4 = Diploma 5 = Bachelor's degree 6= Master's degree 99 = Refused to answer [____|____]
3. Originally from this area?	1 = Yes 2 = No [____]		
4. Number of years worked as an animal health worker	[____|____]	**6. Year graduated**	[____|____|____|____]

PART 2: IN-DEPTH INTERVIEW – ANIMAL HEALTH WORKERS (1)	
Domains, topic questions, and probes: Use the table below to help you administer the questions during the interview.	
Domain	Topic and Probes
1. Your role at work	a) Can you tell me the story of how you came to work as an animal health worker in this area? (*Probe for where they came from and how long they have worked in this area)*

	b) What is the most important thing to you personally about doing this job?
	c) What does your usual day consist of as an animal health worker in this area these days? (*Probe for any changes that have taken place in their role as animal health workers over the years that they have worked in this area)*
2. Common illnesses among livestock & birds in this area	a) Drawing from your experience working in this area, what are the common animal health problems that people in this area seek veterinary services for?
	b) Why are these problems common in this area? Have they always been common in this area? (*Probe about the history of trypanasomiasis in this area*)
3. Experience managing illnesses in livestock & birds in this area	*During the medicines survey that I conducted in selected households in this area in November 2019 and from spending time in households in the area in 2019, there seemed to be a scarcity of or a lack of access to veterinary services in the area. People were eager to get more information on management of illnesses in livestock and birds. They seemed not to have access to medicines for treating illnesses in their livestock. What are your thoughts about this?* a) Tell me about the way veterinary services are organized in this community? *(Probe for what happens when someone in the community has a sick animal or is in need of veterinary services)* b) Can you tell me about your experience managing animal health problems in this area? (Probe for w*hat works well in their job managing animal health problems in this*

	area?) c) Tell me about the challenges that you face managing animal health problems in this area. *d)* How do you overcome the challenges you face in managing animal health problems in this area? e) During my observations, I spent time at the different markets in the area observing what happens with treatment of animals. Can you please tell me more about how you came to start offering veterinary services at the market? f) During my visits to the markets, I noticed that everyone that bought a cow had to get it injected with an antibiotic, an anti tick borne disease injection and a dose of de worming medicine? Can you please tell me more about this approach? How and when did this start? What have been the benefits of this approach? What are the challenges?
Supply of medicines	*f) Tell me about the* process of stocking the medicines that you use to manage health problems in animals? (*Probe for what medicines they usually stock and why, how they make decisions on what medicines to stock, how often they buy medicines and where they buy medicines from, what is working well and what challenges they encounter in ensuring they have medicine)*
Medicine use in the community	j) During the survey that I conducted in selected households in Nagongera Sub County in November 2018, we learnt that people kept some medicine for animals at home. Why is there need for people to stock medicines for animals at home? What medicines do they usually stock and why?

	k) Can you tell me about anything that has happened in this area in the past or that is currently happening that you think has affected the way people use medicines for livestock and birds in this community? l) Can you tell me about any programmes or initiatives that you have heard about in this community addressing the use of medicines in animals and the quality of animal health care in this area?

9. Closing	Is there anything else you think is important about managing patients at this clinic or use of medicines at the clinic or in the community that we have not talked about?
✓ Summarise ✓ Thank participant	