How do health professionals in a Kenyan health facility learn to tackle Antimicrobial Resistance?

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Thesis submitted to The Open University for the degree of Doctor of Philosophy

Institute of Educational Technology (IET)
The Open University
2023
Declaration of Authorship

I declare that the work contained within this thesis is my own. My academic supervisors (Dr Alison Fox and Dr Carina Bossu) have contributed through reflection and suggestion at all stages of research. Several sections of this thesis have been edited and published or are being prepared for publication. Publications to date and articles currently being prepared are listed below.

My academic supervisor is credited co-authorship to reflect her significant contributions the paper.

References to Relevant Work:

Tegama and Fox, (forthcoming) Ethics, the university, and society: toward a decolonial approach to research ethics. Manuscript submitted to Alliance for African Partnership Perspectives


Abstract

In 2015, the World Health Organisation set the goal to reduce Antimicrobial Resistance (AMR) as a global priority on their agenda. It is estimated that AMR could kill as many 10 million people per year. Tackling AMR requires concerted efforts of which many recommended approaches highlight the important role of the workforce. This has been pivotal in directing the line of inquiry for this thesis.

This thesis uses mixed methods research to examine the challenge of AMR in Kenya. Mapping its underpinning historical and social roots with the view to explore how health professionals in a peri-urban, Kenyan health facility learn to tackle AMR using learning technologies. The thesis demonstrates the development of a body work that negotiates the tension between western methodologies that are emblematic of the modern university with African ways of knowing, thinking, and living. It engages with the materiality and praxis of decolonisation as grounded in resistance, adroitly creating small ruptures from Eurocentrism to conceptualise the challenge of AMR though an African lens in an attempt to comprehensively answer the following questions:

- To what extent and through what methods do health professionals engage with continuous professional development?
- What socioeconomic factors impact learning for health professionals?
- What are the barriers and facilitators to learning about and practicing AMR stewardship?

The thesis methodologically demonstrates critical engagement with theoretical tools and develops a conceptual framework that leverages Cultural-Historical Activity Theory and Design based research in mapping context, informing design, and facilitating analysis. The theoretical framework furthers a sociocultural and sociomaterial understanding of practice and practice-based learning and illustrates a decolonial approach that centres spatiotemporal nuances in ethics, culture, and practice to develop a feasible and contextually appropriate solution to tackling AMR through the use of e-learning.
Dedication

For my dad,

I am because you were.
Acknowledgements

Our achievements are never entirely our own, and this couldn’t be truer for this project which has been a series of collective action from so many people. I therefore would like to thank everyone who has been a part of this project.

I am grateful to the UKRI’s Global Challenges Research Fund and the Open University, who funded and made this work possible.

To my supervisors, Alison Fox & Carina Bossu, your brand of supervision has spoiled me. It has been a careful balance between patience, care and support that has anchored me throughout this process. You have challenged and inspired me to grow both as a scholar and a person, you have been a reminder that munhu munhu ne vanhu – a person is a person through others (trans). Alison, you opened the door into the world of ethics where I have found my sense of self in African philosophy, thank you. Carina, I am grateful for your insight that is always delivered with humour, I have become a less reluctant editor and perhaps a more precise communicator. Thank you for bearing the weight of this work with me.

I am grateful for the support of the Faculty of Wellbeing, Education and Language Studies and the Institute of Educational Technology. I am especially grateful to Bart Rienties and Inma Alvarez, without whose unwavering support this project would not have been completed. Many thanks to Wendy Whiteley, Chiedza Gonhi, Chrispina Odenewu and Darsini Raghavan who provided logistical support.

I am grateful to Koula Charitonos and Allison Litttlejohn who applied for the funding that made this project possible and provided input in the early stages of this work.

To Paola De Munari, thank you for kindness and support with so many aspects of this project.

I am grateful to the team at AMREF who were gracious in facilitating use of the Leap platform, I am especially grateful to Peter Otieno, Brenda Ndichu and Edna Osebe.
To all those who made fieldwork possible, the health workers in Kenya who were gracious with their time and Collins who made it both possible and joyous for me travel across the Western region of Kenya, thank you.

I am grateful to the WELS PhD community, who brought much needed comic relief and support, Vicky, Jake, Jos, Sylvania, Eli, Stephen, Emily, Ruth. My comrades; Jo Buxton, Sam Goodliffe, Jude Taylor thank you for your support.

To my wonderful family, mum, Mudiwa, ka sisi, Trevor, Maiguru Vee & my darling sister, Shumi thank you for your support and patience, and for listening to me think and theorise out loud.

To my friends who are mostly bored of me bailing out of everything because “I am working on my thesis”. Thank you. To Bob, Opee, Marlis and the TL thank you for journeying with me. Your support has meant so much. To Izzy, Indie, Hannah, Chloe, Lil lady and HQ my diary has finally opened up.

To those who were here at the start of this journey and would have loved to see this moment, my Danny & antru Ernie, thank you.

Finally, to the community of black scholars, I am glad you wrote. I am especially grateful for the works of Walter Rodney, Cedric Robinson, Pascah Mugwini, John Mbiti, V.Y. Mudimbe, Frantz Fanon, Claude Ake, W.E.B Du Bois, Sabelo Ndlovu-Gathsheni, Sylvia Tamale, thank you. I have found new depths of freedom through your work.
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Chapter 1: Introduction

1.1 Introduction

This chapter introduces the problem of antimicrobial resistance (AMR). It begins with a brief background on global health challenges that the continent has faced in access to medication during previous global health crises. It then contextualises the AMR challenge that is quickly hurtling towards the continent in order to expound on the moral precept behind the study, the role of education in tackling AMR and the importance of engaging with the question of how health professionals in Africa learn to tackle AMR.

1.2 Africa’s relationship with modern medicines

Modern medicine has drastically transformed our collective life chances across the globe, yet for some large parts of the global population these gains are yet to be fully realised. For Africa, gains made in medical advances are lost in inaccess to timely, appropriate, affordable medicines, vaccines, and health services that are undermined by various factors, including low healthcare worker to population ratios (Pheage, 2016). Challenges in access are in part due to global supply chain structures; most sub-Saharan African countries import 70-90% of drugs consumed in country. To this end, African modern health care systems and technologies are heavily dependent on external markets; these are sometimes volatile, other times politicised, acutely so during periods of crises and high demand for new entrants to the market (Buckholtz, 2021; Tegama, 2020). I have lived through two such crises; the AIDS epidemic and the COVID19 pandemic, during both of which Africa was left behind. In the latter and most recent crisis, United Nations chief Antonio Guterres labelled Africa’s lack of access to vaccines “a moral indictment of the state of our world... an obscenity” (Dearden, 2021, n.np). That “the companies and countries that control the global supply of vaccines think the world’s poor should be satisfied with leftovers”(WHO, 2021b,n.np). As another health crisis, AMR hurtles towards us, if the Shona\(^1\) proverb ‘mbada haichinje mavara ayo’ ‘a leopard does not change its spots’ (trans.) is anything to go by then, all things being constant, accessing medication whilst African, whilst black, whilst poor,
whilst in a low-income country will remain as deeply politicised as it has been during the last two crises. This puts the impetus on us (Africans) to preserve the efficacy of antimicrobials in our countries, and to ensure we maintain access to the cheapest, generic drugs. Below I outline our collective story of inaccess to explicate on my moral drive and the urgency with which we need to engage with preserving antimicrobials. Understanding how health professionals learn to tackle antimicrobial resistance is amongst the key ways that we can address the challenges that lie in front of us. This thesis aims to make a contribution to professional development for those on the frontline of medical practice in Kenya.

1.3 COVID19 Pandemic & HIV/AIDS epidemic

In 2020, as COVID19 begun to sweep across the globe, western leaders gave speeches about building back better, building back together and global citizenship at home. In foreign policy governments adopted nationalistic stances, imposed export bans on essential supplies and effectuated a series of “beggar-cum-sicken-thy-neighbour” policies (Evenett, 2020; Tegama, 2020, p. 4). India and South Africa proposed a waiver of Intellectual Property rights under the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), ahead of the discovery of the vaccines. In the first instance it floundered, then gained variations of traction. However even with some traction, it failed to comprehensively meet the request to suspend the enforcement of Intellectual Property rights for COVID19-related medical technologies, including therapeutics, vaccines, and diagnostics (Mercurio and Upreti, 2022). The proponents of the waiver argued that it would facilitate cost reduction in manufacturing and distribution to benefit low-income countries (see Mercurio and Upreti, 2022).

For Africa and its global south counterparts this move was prescient because vaccine discovery did not translate to access and supply chains were politicised. In some cases, pharmaceuticals hiked the cost per dose for African countries, such that countries like South Africa were paying more than double what their European counterparts were paying for vaccines (Sullivan, 2021). By December 2021, 74% of all COVID19 vaccines had been distributed to upper- and middle-income countries, while low-income countries had received less than 1%, which equated more booster shots administered in rich countries than single shots in poor countries (Kilpatrick, 2021). This was in part due to the agreement that low- and middle-income countries (LMICs), had with high-income countries (HICs)
where the former agreed to source vaccines through a single source - the Global Alliance for Vaccines. Whilst HICs sourced vaccines directly from pharmaceuticals and bought out doses ahead of production, in effect freezing out LMICs from access (Milken Institute, 2022). As the Delta variant began to quickly spread across South Africa the population remained in-waiting for the delivery of the majority of the 31 million vaccine doses it had ordered from Johnson & Johnson as the company exported shots manufactured in South Africa to Europe (Burke, 2021; Komminoth, 2022; Okereke, 2021). For Africans, the parallels to the AIDS epidemic were unnerving.

23 years earlier, amid the AIDS epidemic at a time when the annual cost of antiretroviral therapies was more than the average annual salary, the government of South Africa, then led by Nelson Mandela, enacted the 1997 Medicines Act (Fisher III and Rigamonti, 2005). It was a bid to decrease the cost of HIV/AIDS medication by increasing availability of generic medicines to reduce the devasting rate of HIV/AIDS. The US, under the leadership of Bill Clinton accused South Africa of violating the agreement on TRIPS, it subsequently put South Africa on a ‘watch list’ and threatened sanctions (Fisher III and Rigamonti, 2005). At home, Clinton gave “pious speeches” about tackling HIV/AIDS whilst his administration was proving to be “the pharmaceutical industry’s favourite attack dog when [it came to] protecting patent rights” (Chaudry, 2000, n. np; Furrer, 1998). 39 pharmaceutical companies, including GlaxoSmithKline, Merck and Co, Bristol-Myers Squibb, Roche, and Boehringer Ingelheim, took the South African government to court in a case that is commonly referred to as Big Pharma vs. Mandela (Fisher III and Rigamonti, 2005). It was meant to set the precedent, detract any other leaders with populations that could not afford medicines from the US from adopting the same approach to making medicines more accessible (Chaudry, 2000). Campaigners took to the streets over drug profiteering, public opinion shifted, and suing the South African government became politically unsavoury (Chaudry, 2000). The South African government won the ethical argument. Clinton’s administration stopped threatening sanctions. Big Pharma dropped the case and paid the government’s legal bills. However, an astounding 400 000 South Africans had lost their lives to AIDS-related deaths in the intervening period and so had many more across the continent and globe, including in Zimbabwe where HIV/AIDS had a devastating impact because of the of the high cost of treatment (Oxfam, 2001). As a Zimbabwean and an African, my fear is that the next great
health challenge that is quickly hurtling towards us will undermine the progress we (Africans) have made. AMR poses a threat that, should it get to crisis level, will be underscored by the same challenges in access and cost that will see us once again at the back of the line. To this end, AMR threatens the gains we have made and the progress we have salvaged in preceding crises.

1.4 Contextualizing the Antimicrobial resistance challenge

Antimicrobials are medicines that kill or stop the growth of microorganisms, for example antibiotics kill or stop the growth of bacteria (WHO, 2021a). Overuse and ill-use of antimicrobial medicines cause standard treatments to become ineffective. This is applicable to diseases such as HIV/AIDS and cancer, but also an infection developed after a cut. If a patient is not treatable using a given antimicrobial, the patient is said to be resistant, thus they have antimicrobial resistance (AMR) (Bisen et al., 2013). The challenge for Sub-Saharan Africa is that, not only is it home to a high infectious disease burden, but it has also home to a high incidence of chronic disease; this dual burden of infection and chronic disease is known as a protracted epidemiological transition (Agyei-Mensah and Aikins, 2010). The challenge is particularly acute across the ‘AIDS belt’, this consists of 16 countries across East and Southern Africa that have the highest HIV/AIDS prevalence across the world including Zimbabwe and South Africa as well as Kenya where this study is based (Goiber, 2002).

Whilst gains have been made in HIV/AIDS treatment and the epidemic has shown signs of levelling out across the continent, it is yet to subside to zero transmission. For example, there has been decline in incidence and countries have made progress in access to antiretroviral treatment with many meeting or working towards meeting the UNAIDS 90/90/90 goal (UNAIDS, 2017). The 90/90/90 goal means having 90% of people living with HIV aware of their status, 90% of people diagnosed with HIV infection receiving sustained antiretroviral therapy and 90% of therapy recipients having viral suppression². Meeting this goal is threatened by the rise in AMR (Mugurungi et al., 2007; UNAIDS, 2017). Recent studies, conducted between 2004 and 2019, show that HIV drug resistance is globally rising. However, the threat for the African continent is particularly acute. Africa is home to 70% of

² Viral suppression antiretroviral therapy (ART) reduces a person’s viral load (HIV RNA) to an undetectable level. Viral suppression does not mean a person is cured; HIV still remains in the body. If ART is discontinued, the person’s viral load will likely return to a detectable level (National Institute of Health, 2021).
the HIV infected global population and two thirds of all new infections (UNAIDS, 2022). Of those new infections, some African countries have reported a pre-treatment resistance rate that exceeds 10%. Across nine African countries covered in one study, one in every two children newly diagnosed with HIV showed resistance to the most affordable and most commonly used ARV drugs: Efavirenz and Nevirapine (WHO, 2022b). These two drugs are classed as first-line drugs – the first drugs that are commonly prescribed in given contexts to treat a particular disease, in this case HIV/AIDS. Drug lines are classed as a result of a trade-off between three factors: fewest side effects, high clinical effectiveness, and affordability. If a patient shows resistance to these drugs, the antibiotic will have failed to stop bacterial growth in their body rendering them untreatable with that given antibiotic. In this case the patient is prescribed second-line drugs and, should they be resistant, they hope to be able to be prescribed third-line alternatives, which get progressively more expensive. The number of ‘lines’ – treatment options - are unfortunately not infinite. Thus, if a patient reaches the last line and they are resistant there is no medical help that can be offered to the patient and the case will most likely resort in mortality (WHO, 2022b).

AMR is a global health threat that requires concerted efforts by governments, the pharmaceutical industry, medical professionals, and the members of the general public to engage in multi-stakeholder collaborative approaches. The COVID19 pandemic was a wake-up call for African governments, citizens and private sector that highlighted the need to broaden manufacturing at home. This should prove beneficial in the fight against AMR by increasing supply chain efficiency. For example, Kenya has made headway towards building Africa’s largest drug manufacturing factory (Tegama, 2020). However, on the level of the continent the pharmaceutical industry is in its infantile stages, with comparatively low investment capacity. Thus, it is unlikely that investment will be geared towards the development of new antibiotics because development is costly and investment intensive. A recent WHO report notes that whilst there are renewed efforts to bring new antibiotics to market “most proposed market-shaping mechanisms focus on high-income countries, and fail to reflect the realities of LMICS, which may not be able to afford novel antibiotics” (WHO, 2022, p.26). As such it is imperative that Africa joins the global fight to preserve the efficacy of antimicrobial drugs, particularly first line drugs these are older, cheaper more
likely to no longer be under IP protection and therefore more accessible to African populations.

1.5 Study Focus

My doctoral studies focus on Kenya with the view to produce work that has transferrable elements that can be utilised across the sub-Saharan African region, where the burden of AMR is likely to be comparatively heavier than other regions, given the rate of infectious disease (Agyei-Mensah and Aikins, 2010). This situation is because of a combination of factors including poor infrastructure, lack of political will and lack of access to Universal Health Coverage (UHC). UHC refers to the broad access and availability of the full spectrum of health services to all individuals in all communities, either free at the point of care or affordable so as not to impose financial hardship (Evans, 2013). This requires adequate and competent healthcare workers who have access to professional learning to support optimal skills mix and equitable distribution at facility, outreach, and community levels. With adequate support structures to foster decent and enjoyable work for health workers (WHO, 2020b; Wilson et al., 2018). Despite this, literature on initiatives to tackle AMR and more specifically technology enhanced professional learning (TEPL) with a regional focus remains sparse with very few studies such as Kelani and Khourey-Bowers (2012) who focus on the TEPL albeit in the education sector working with teachers. Though publications are gaining traction, in a recent systematic review Porter et al. (2021) were able to identify only 14 relevant studies across 11 countries. This makes co-creation with participants imperative in providing evidence to an emergent, region specific area of study. It allows participants to bring their invaluable experience to expound on both working and learning culture which is foundational to creating effective educational strategies that are contextually appropriate and relevant. I discuss my approaches to this in the ethics (chapter 3) and conceptual framework (chapter 4) chapters.

1.6 The rising global threat of AMR

The WHO in 2015 set the goal to reduce AMR as a global priority on their agenda (WHO, 2016a). Selecting the appropriate approaches to address AMR requires contextual specificity, factoring in variables such as prevalence of disease, the legal structure that
concerns how antibiotics are dispensed, the availability of high-quality pathology and laboratory services. Underscoring each approach is the role of the workforce (WHO, 2018). The quality of the workforce and its fitness for purpose and practice are central to addressing AMR. The health workforce’s pivotal role in addressing AMR, coupled with the moral drive outlined in this section, have been influential in directing my doctoral studies to focus on the quality aspect of the workforce. I am interested in how health professionals learn to tackle AMR as well as whether, and how, learning technologies can be incorporated in the learning process. The next section describes the wider AMR landscape and shows how that shaped my thinking and the direction of my work around the role of the workforce.

Effective antimicrobial drugs are at the core of modern medicine’s response to infectious disease, acting as both a preventative and curative measure. The emergence and spread of AMR in humans and animals pose a threat to modern medicine (WHO, 2016a). A panoply of behaviours and patterns, from over prescription to fragmented adherence, as well as overuse in farming and food production have led to an increased incidence of drug resistance globally. As a result, there is a global movement to redress the balance and halt the move towards a post-antibiotic era where common infections could kill again (WHO, 2016a). Drug-resistant infections currently account for more than 700 000 deaths per year globally (Fleming Fund, 2016). This is set to increase to an estimated 10 million deaths annually by 2050 (Fleming Fund, 2016). Whilst new antibiotics are in the process of being developed, their development is both a lengthy and expensive process that requires an estimated £1 billion investment in drug development and trial costs to bring a new antibiotic to the market. Returns to investment are dependent on volumes sold, newer antibiotics are less likely to be prescribed and low returns translate into a reluctance to invest on the pharmaceutical industry’s part (DHSC, 2019). This makes reliance on the development of new drugs the last resort, giving rise to solutions that centre around monitoring, surveillance and proper use of antibiotics within the framework of a One Health approach. In subsequent paragraphs I describe three such solutions, namely, prudent prescribing, antibiotic stewardship and surveillance and introduce the concept of One Health.
1.7 Tackling AMR through a One Health approach

One health recognises that humans, animals and the environment are interrelated by way of being bound to the health of the ecosystems in which they exist in (World Organisation for Animal Health, 2023). This has implications for our understanding of, and approaches to tackling AMR. From an AMR perspective, effective management of the health of one element of the ecosystem is as important as the next element because of the possibility of transmission across the three elements. To further contextualise AMR transmission, resistance in animal health and more specifically agriculture is transmissible to human health. For example, because of the ways in which many antibiotics are used in animal production, sometimes in sub-therapeutic doses and over long periods of time, production systems can create conditions whereby resistance is likely to occur (Robinson et al, 2016). Resistance can then subsequently be transmitted to humans via food or through the environment (WHO, 2021). From a climate perspective, extreme weather events such as flooding can negatively impact sanitation efforts and increase the spread of infectious disease and by extension AMR. Equally, challenging may be higher than average temperatures that may cause pathogens to expand into new regions, and in this way exacerbate AMR. Of the three domains, Robinson et al. (2016, p.377) argue that “human health takes the spotlight, with multidrug-resistance genes now highly prevalent in many important and common pathogens”. Thus, heightening the urgency with which there is a need to respond to AMR. With this understanding, the World Health Organization (WHO), the Food and Agricultural Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE), have moved towards joint action over the last few years, working collaboratively on advancing a One Health approach that monitors antimicrobial use and interaction across human, animal and environmental health (World Organisation for Animal Health, 2023).

1.7.1 Tackling AMR in human health

The notion that human health “takes the spotlight” Robinson et al. (2016, p.377) where the emergence of resistance is concerned, is rooted in the knowledge that AMR is in part driven by behaviours that include misuse and overuse of antibiotics (Dryden et al., 2011). As a result, approaches like prudent prescribing, antibiotic stewardship and surveillance are
underpinned by centralising education as a key strategy in tackling AMR, with the view to drive behavioural changes (WHO, 2019c). In this section, I discuss approaches to tackling AMR and conclude the section with highlighting the role that educational technology can play in advancing these approaches at scale.

1.7.2 Prudent prescribing

*Prudent prescribing* follows the four Rs - ‘right drug, right time, right dose, right duration’ (Dryden *et al.*, 2011, p. 241). Proponents of the four Rs argue for its employment in general antibiotic practice as a resistance incidence reducing factor. Prudent prescribing can fall within the scope of antibiotic stewardship as stewardship is a broad term that refers to the adoption of a multidisciplinary, intervention-based approach with the view of promoting optimal use of antibiotics, including drug choice, dosage, route of drug administration and duration of administration (Dryden *et al.*, 2011). These choices can be in part informed by *surveillance* data through programs such as a hospital antibiogram - an overall institutional profile of antimicrobial susceptibility testing results of specific microorganism to antimicrobial drugs that can be used to track changes and trends in AMR, in order to guide clinical decision making (Truong *et al.*, 2021). As such, there are many responses, institutions can employ to tackle resistance and improve *antibiotic stewardship* (Fleming Fund, 2016; The British Society for Antimicrobial Chemotherapy, 2018; WHO, 2019c). In order to address antibiotic resistance from a stewardship viewpoint, there is a need to understand the determinants of both the emergence and continued spread of AMR. Dryden *et al.* (2011) displays common determinants as per Figure 1.1

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Figure 1.1: Examples of misuse of antibiotics (Source: Dryden *et al.*, 2011, p. 2442, figure 1)
Actions to optimise antibiotic use are summarised using guidelines from the European Centre for Disease Control (ECDC), the UK Department of Health and Social Care (DHSC) and The British Society for Antimicrobial Chemotherapy (2018). See Figure 1.2.

Figure 1.2: Start Smart – Then Focus (Source: Dryden et al., 2011, p. 2442, figure 2)

This guidance preceded adoption of the Global Action Plan on Antimicrobial Resistance in 2015 at the World Health Assembly, from which Africa Centre of Disease and Prevention, and the Kenyan National Stewardship Guidelines emerged (African Union, 2020; GovKenya, 2020). The principles of ‘start smart – then focus’ are globally applicable to the use of antibiotics in general. However, there are aspects that may be simple to adopt in the British health system and indeed health systems in other HICs with contextual parity but may pose challenges in other contexts.

1.7.3 Context specific challenges to tackling AMR in human health

For example, challenges in LMIC facilities that are rural based include limited access to microbiology laboratories and services. Limitations in practice may include data collection
methods, where a lab may be collecting data manually (Charitonos et al., 2019). Figure 1.2 makes recommendations to act based on data from the laboratory, however manual data collection makes data analysis a laborious and difficult process that cannot cater to the immediacy that is required by the recommendation in Figure 1.2. Many institutions in LMICs do not have antiograms. Poor data collection methods or non-existent data programs not only limit the degree to which a facility can engage in antibiotic stewardship but also limit a facility’s capacity to contribute to public health surveillance data. Public health surveillance is the continuous and systematic data collection and analysis of health-related data (Nsubuga et al., 2006) that informs planning and resource allocation at national and regional levels. AMR surveillance is a branch of public health that tracks changes in evolutionary patterns of bacteria and enables microbiologists to track the emergence of new strains of resistance (WHO, 2020b). These data are key to providing guidance, locally including on clinical therapy decisions and regionally and nationally – these feed into bigger databases that build an epidemiological picture that forms the evidence based for action including resistance containment interventions (WHO, 2020b). In 2015, The WHO launched a Global AMR Surveillance System (GLASS) – a global data sharing platform for AMR. GLASS offers a standardised approach to AMR data collection, an integrated analysis system that enables data sharing of microbiological and epidemiological data. Despite this, data collection in LMICs has been slow or non-existent due to infrastructural cost and the lack of sustained domestic funding, to this end the Fleming Fund developed a roadmap to GLASS to help LMICs with lower investment capacity navigate their way to GLASS (Fleming Fund, 2016; WHO, 2022). The success of principles of ‘Start smart- then focus’ (Dryden et al., 2011) and GLASS (Fleming Fund, 2016) are underpinned by the important role of healthcare professionals and their capacity to enact good workplace practice in line with recommended approaches. This highlights the need to redefine and adapt workplace practice to align with tackling AMR and makes apparent the role that education and lifelong learning can play in encouraging good practice among professionals involved in AMR-related activity. Similarly, it highlights the opportunity to leverage the affordances of technology. Literature on affordances of technology, broadly defines affordances as possibilities for actions enabled by a technological object and what it provides or furnishes (Gibson 1979; Mikesell, 2018). Within educational technology, there now exists platforms for learning that can be accessed on mobile phones, these platforms are still growing, still changing and “pushing the
boundaries of traditional pedagogies and epistemic belief” (Crompton 2014, p.7). In the health sector these platforms fall within the scope of mobile health platforms, commonly referred to as mhealth (Soloe et al, 2021). The affordances of mhealth that include, portability, connectivity, and interactivity of mobile devices make apparent the possibilities that lie in educational technology and the scope to leverage educational technologies for AMR-related mobile learning. Mobile learning is defined as “learning across multiple contexts, through social and content interactions, using personal electronic devices” (Crompton, 2014, p.8). It is concerned with access and learner mobility and pedagogical soundness. The concern with pedagogical soundness has subsequently instigated an increase in microlearning focused scholarship (Alqurashi, 2017; Hug, 2010; Kamilali and Sofianopoulou, 2015). Microlearning also called bite-size learning uses a series of small units of topic-focused content and activities that constitute a mini course (Alqurashi, 2017). It can be designed in a way that invites learners to “become active co-producers of content through active social participation”, this is particularly beneficial in emergent fields such as AMS (Kamilali and Sofianopoulou, 2015, p.129). This thesis looks to explore how professionals learn to tackle AMR in a Kenyan facility and whether there is scope to leverage mhealth and microlearning to improve health workers’ competency in AMR practice.

1.8 Health workers’ competency in AMR practice

The importance of health worker’s competency in AMR practice is demonstrated by the first objective of the WHO Global Action Plan on Antimicrobial Resistance which focuses on awareness raising and the education and training of health workers and more specifically, improving antimicrobial prescribing and dispensing behaviours (WHO, 2016a). In 2018, the WHO broadened this objective, and produced a competency framework for health workers’ education and training on AMR (WHO, 2018). This sets out health worker competencies, framed as skills, attitudes and behaviours that promote stewardship. The framework was designed to support national action plans (NAPs) as well as to address the variability in quality and coverage of AMR education initiatives. The aim was to provide countries with a foundation for enhancing and standardising AMR education and training. Adapting it to national contexts in order to reflect best practices based on global evidence, whilst ensuring recommendations are fit for local contexts. The challenge has been in adapting framework
competencies to the fit the local contexts in line with NAPs and available resources. AMR NAPs are a recent development in public health policy. The Kenyan NAP was published in 2017, covering the period between 2017 and 2022 (GovKenya, 2017). At the time of writing this thesis, alike its SSA counterparts Kenya is yet to publish the NAP for the next period beginning in 2023. This is in part due to the impact of the COVID19 pandemic government funds and priorities in healthcare. The COVID19 pandemic has impacted the attention accorded to AMR policy over the previous three years and particularly, AMR education and training policy for health workers as learning focused on COVID19. Shortcomings in training and education are highlighted in a recent WHO brief on AMR in Kenya (WHO, 2022). Kenya is yet to release a policy that incorporates the WHO competency framework into its national policy, in order to standardise aspects such as knowledge and attitudes across the country and tailor recommended behaviours specific to context and resources. There now exists the opportunity to consider mhealth platforms for learning as cost-effective approaches to disseminating knowledge and standardising practice. This sits alongside the opportunity for policy makers to critically engage with the adaptation of the competencies framework, to local contexts, to reflect challenges in public health in Kenya, not only including epidemiology but extending adaptation to social context. To consider the spatiotemporal and cultural nuances of AMR in Kenya alongside ways of knowing and thinking that are bound to a Kenyan way of being and by extension to the practitioners whose competency must be developed meet the challenge of AMR. I expand on Kenyan public health context in chapter 2, the next section presents the structure of the thesis.

1.9 Structure of the thesis & chapter conclusion

This thesis is arranged in 10 chapters that aim to address the question of how health professionals in a Kenyan Health Facility learn to tackle AMR. Chapter 1 offered an introduction to the problem of AMR and the role that educational technology can play in tackling AMR. It introduced the moral drive behind the study and provided a background on Africa’s relationship with modern medicine and the challenges the continent has faced in access. Highlighting the need for the continent to draw lessons from previous outbreaks to effectively leverage the use of education and more specifically, cost-effective approaches to
education through mhealth platforms as a safeguarding mechanism against the threat of AMR that the region and indeed the globe are now facing.

Chapter 2, introduces the reader to the Kenyan context, offering a background on the socioeconomic landscape, the health sector, challenges in access and equity and the opportunities to embed decolonial scholarship. Chapter 3 maps out the ethics that underpinned the thesis, it introduces the reader to African ethics, specifically Ubuntu ethics, presents the researcher’s ontology, epistemology, and positionality. Chapter 4 presents the conceptual framework; it introduces multiple generations of Activity Theory to map the journey to arriving at the use of Cultural Historical Activity Theory (CHAT) within this thesis. It presents Design Based Research and transfer of learning. Chapter 5 presents a literature review, that introduces the reader to literature relevant to the health workforce in Africa, technology enhanced professional learning and useful thinking from scholars of workplace learning. Chapter 6 presents the methodology; it introduces mixed method research to frame it with CHAT and DBR. The chapter details the research design, methods of data collection and approaches to reliability, validity, and data analysis. Chapter 7 presents findings form two surveys that constituted the first iteration of the study cycles. Chapter 8 presents study findings from iterations 2 and 3, that included interviews, observations and an edtech intervention. Chapter 9 discusses the study findings and chapter 10 concludes the thesis with limitations and recommendations. Throughout the thesis I use the chapter summaries to outline the case for the contribution of the thesis to decolonialising research in this field and in research conducted within African contexts.
Chapter 2: Context

2.1 Introduction

Having recently elected a new president in August 2022, Kenya is poised for its next stage of development. This is 13 years since reforms that brought in a decentralised form of governance. Dispersing power and responsibilities in public governance, including fiscal decentralisation (Tsofa et al., 2017; World Bank, 2023). Over the previous decade, the country has enjoyed sustained economic growth and social development. This has included significant poverty reduction, a two-year increase in life expectancy (from 61 to 63) and importantly, an increase in the number of trained health professionals (World Bank 2020b, 2020c; Okoroafor et al., 2022). Despite enjoying broad-based growth, Kenya maintains high levels of inequality that translate into inequity in health access across the socioeconomic strata (Ilinca et al., 2022).

2.2 Kenyan health system

The Kenyan health system comprises of a public system, that is run by the Ministry of Health (MoH) and private sector hospitals, which include private for-profit, Non-Government Organisations (NGOs), and Faith Based Organisations (FBOs) (Muga et al., 2005). The focus of this study is on an MoH public health facility that is run by a regional, county level government that receives administrative help from an NGO. Since the enactment of its new constitution, Kenya now has 47 semi-autonomous county governments (Tsofa et al., 2017). Whilst the MoH in central government maintains charge of national health policy, regulation and reforms, decentralised public health finance is granted to county level government with financial autonomy to run facilities (Barasa et al., 2017; 2022). At county level the MoH manages healthcare resource allocation and service provision. The public health service constitutes six levels of health facilities, namely: national referral hospitals, provincial general hospitals, district hospitals, health centres, and dispensaries (see figure 1.3 below).
National referral hospitals are at the apex of the healthcare system, providing diagnostic, therapeutic, and rehabilitative services and with the most sophisticated medical technologies available in country. There are two national referral hospitals, with equivalent private sector counterparts that serve a smaller part of the population, typically the middle and upper class demographic. Provincial hospitals act as referral hospitals to district hospitals and provide more specialised care than at district level (Muga et al., 2005).

Similarly, private hospitals exist at provincial level. The hospital that is the centre of this study is a provincial teaching and referral hospital. Therefore, in the first instance it is intermediary between the national referral and district levels. In the second instance, it absorbs patients from levels 1 to 4 (as per figure 1.3). That is to say lower-level facilities feed into the provincial hospital (East et al., 2014). For confidentiality this will be referred to as Hospital X, Health Facility X or X Teaching and Referral Hospital (XTRH) the latter being an abbreviation of the hospital and how teaching and referral hospitals are commonly referred to in Kenya. The three are used interchangeably throughout the thesis. Whilst the study focused on XTRH, given that the health system is networked, feeder facilities and facilities that provide services for XTRH are mentioned at different points throughout the thesis. These are not referred to by name and also anonymised and referred to in reference to the counties they are located County Y and County Z). Medical supplies and pharmaceutical supply chains that deliver to public hospitals are run by a body of the national government, Kenya Medical Supplies Authority (KEMSA).
2.3. Monitoring AMR in Kenya

There are some limited data based on point prevalence surveys that have captured antibiotic consumption as well as prescribing practices and use in selected health facilities over the last three years. KEMSA has experienced challenges in maintaining efficiency in its supply chain. As a result, health facilities frequently experience stock outs of antimicrobials across MoH facilities, which has an impact on AMR practice. In the private sector, there is limited enforcement of regulation in reference to over-the-counter sales of antimicrobials and unauthorised pharmacies run by lay people. This encourages circulation of lower quality medicines in Kenya and endangers the public. The Kenyan government has developed several strategies to combat challenges in AMR. Central to these is the establishment of a National Antimicrobial Stewardship Interagency Committee (NAISC) that is reported to be largely functional and at county level. There is limited data on the levels of functionality across County Antimicrobial Stewardship Interagency Committees (CAISACs) (WHO, 2022c). Central to approaching AMS is the development of education and training strategies for health professionals in line with the Kenyan National Action Plan on antimicrobial resistance (NAP on AMR). With specific reference to stewardship, the Kenyan government has released guidelines for healthcare settings and AMR awareness and knowledge communications (GovKenya, 2020). The latter have broadly focused on exercising prudence in antimicrobial use. However, it was not possible to find available evidence of their reach or impact. Whilst the government’s strategy includes extending AMR education to all health providers, most personnel in human health do not yet receive training (WHO, 2022c). This is true across all three sectors concerned with One Health (see section 1.7.1 for a discussion on One Health) (WHO, 2022c). This study’s focus on understanding how health professionals learn to tackle AMR in Kenya is therefore timely. It provides data that can underpin the next stage of engagement in education strategy for the Kenyan government at national and county level. In the next section I discuss AMR education in the global health context.

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3 A prevalence survey is a count of the number of patients with a particular condition/treatment (i.e. antibiotic treatment) at a particular time
4 Stock outs are periods of time when the pharmacy/hospital is out of stock
2.4 Global health education and AMR context

The most recent World Health Organization (WHO) progress review of the NAP on AMR (WHO, 2022c) highlights medical education as a significant facilitator for mitigating the misuse and overuse of antimicrobials in the human health settings. It also highlights current shortcomings in AMR education and training implementation across both in-service and pre-service healthcare professionals (WHO, 2022c). The research questions guiding this study can help to elucidate what an AMR education tailored to the Kenyan context may look like.

Research was guided by three research questions:

1. To what extent and through what methods do health professionals engage with continuous professional development?

2. What socioeconomic factors impact learning for health professionals?

3. What are the barriers and facilitators to learning about and practicing AMR stewardship?

To comprehensively answer these questions required boundary crossing to draw insights and perspectives from various disciplines, integrating tools, methods, and theoretical frameworks and concepts from philosophy, health, and educational technology. This in keeping with the broader move towards interdisciplinary research in higher education, global health and confronting some of the challenges of our time, not least among them AMR (Minssen et al., 2020). The call to interdisciplinary research is based on the rationale that we are increasingly facing complex problems that require insights from multiple disciplines in order to address those problems at their scale (Robeyns, 2022). There is increased visibility of scholars who are proponents of factoring in social, cultural, and economic aspects as pathways to understanding how to tackle AMR in different communities. Scholars such as Minssen and colleagues (2020) argue in their editorial for interdisciplinary approaches to the problem of AMR, noting from that, from their perspective, “current engagement with the full range of social sciences is inadequate; greater collaboration within and between social science disciplines must be prioritized. Only then can we generate sufficient cross-sectional knowledge to overcome obstacles to addressing antimicrobial resistance” (Minssen et al., 2020, p. 823). Elsewhere, Leadingham
and colleagues, (2019), in their brief for the World Health Organisation (WHO), endorsed and, in their own work, adopted a cultural approach to responding to the contemporary challenge of AMR. They advocate for a move away from top-down approaches in responding to AMR towards understanding social drivers and adopting a “systematic understanding of the histories and cultures of medicine uses, structural issues surrounding health and health care” (Leadingham, 2019, p. 2). This in keeping with scholars, such as Agyei-Mensah and Aikins (2010), Minssen et al. (2020), Kulesa & Brantuo (2021), and Tamale (2021), who argue that Africa faces unique challenges. They point to these: at a continental level, where similarities and overlaps in resource constraints and in epidemiology abound, and at country level, where there are sharp differences based the unique histories of each of the countries. Agyei-Mensah & Aikins (2010) therefore argue for the need to adopt a multidimensional approach to the African health sector to map epidemiological transitions – complex changes in epidemiology – of which AMR is a recent complex change.

2.5 Macrosocial context

Agyei-Mensah and Aikins (2010) call for approaches to analysing complex changes in epidemiology that situate health systems and their challenges in reference to respective countries’ development trajectories. Noting this to be important for building a better understanding of protracted epidemiological transitions that have become archetypal African health systems (Tegama, 2020). A central argument of Agyei-Mensah and Aikins’ (2010) paper is that a comprehensive understanding of “epidemiological transition requires a longitudinal and integrated treatment of macro- and micro-social processes, an approach that situates recent complex changes within their historical context” (Agyei-Mensah and Aikins, 2010, p. 880). They assert that historical context would in part explain the polarisation of the double burden of infectious and chronic disease across class, demographics, and geography. This double burden is polarised in terms of risk. Wealthier communities are at higher risk of chronic disease, whilst the challenge of the double burden of infectious and chronic diseases disproportionately affects poorer communities. This is as a result of, amongst other factors, disparity in access to health-enhancing factors, such as water and sanitation, that impact infection control and, in turn, the volume of antibiotic use.
In terms of the Kenyan macrosocial and historical context, Kenya is a former British colony. It gained independence in 1963 (Dill and Crow, 2014, p. 187), inheriting an enclave economy structures (Kanyeze et al., 2011). This is an archetypal economic structure of former colonies, where economies that had been created to serve small white populations, absorbing them into a formal modern economy, have come to be defined by a dual structure. Whereby a relatively well-developed and modern formal economy employing small portions of the population sits alongside an agrarian economy that constitutes the majority of the black population, of which the research site is based; in a largely rural county where agriculture is the mainstay. The agrarian economy is characterised by pre-industrial technology and peasant agriculture and different social and economic structures (Kanyeze et al., 2011). The enclave remains visible in today’s Kenya where neighbouring counties Nairobi and Kiambu – the largest contributors to GDP at 27.5% at 5.9% respectively - are comparatively more modern than other parts of the country, where 72% of the population lives, in rural areas. However, Nairobi is a tale of two or three cities, marked by extreme economic inequality that translates to inequity in access to healthcare services and affects AMR use amongst populations (Ilinca et al., 2019; Omulo et al., 2021). Of the urban population, 51% lives in slums. Here too colonial history as a macrosocial process has significance that is attached to the epidemiological landscape and challenges in AMR that Kenya is facing now and, in its near future (World Bank, 2020a). Nairobi is home to one of Africa’s largest slums – Kibera, a derivative of the word ‘kibra’ meaning forest in Nubian. “Its origins are rooted in the segregation of colonial rule, it is sustained by the continuing injustice of land policies and the multiple complications involved with upgrading urban settlements” (Dill and Crow, 2014; p. 187).

The Nubians were brought over by the British to serve in its colonial Army over a century ago. Dubbed the King’s soldiers, the Nubians were known for loyalty to the crown, even though the crown would deny them an education as a preventative measure to ensure they would not agitate for their rights (Ackay, 2014). During the African struggle for independence, Nubians resigned from the British army and abstained from the struggle (Ackay, 2014). As a result, the British refused to transfer their shamba passes – temporary title deeds - to title deeds. Five generations later, Kibera has mushroomed into a large informal settlement riddled with challenges for health-enhancing sectors such as water and
sanitation and waste management services. In post-independence Kenya, the Nubians are now a smaller part of Kibera. However, they remain landless and stateless, with no access to basic citizenship rights such as birth certificates and national IDs. On her father, Nubian, Kenyan writer Waziri, (2019) wrote “It is so absurd, to the extent that without an ID, one cannot legally die, which is what happened to my father. He does not have a death certificate because he did not have an ID. The state neither recognized his life nor his death – he never existed”. It is worth noting not possessing an ID presents challenges in accessing medical treatment, that can encourage AMR promoting behaviours. This is recognised in a recent WHO publication on the challenge of AMR amongst refugee and migrant populations (WHO, 2022d). Thus stateless persons who reside in informal settlements such as Kibera and do not possess national IDs may be more likely to turn to authorised pharmacists for over-the-counter dispensing of antimicrobials without prescription, or to unauthorised pharmacists and/or open markets. Whilst Mukokinya et al. (2018) found low levels of over-the-counter sales of antimicrobials in Nairobi and recognised that their study findings were limited in as far as not being representative of rural areas, I would argue that another limitation was not mapping open markets and unauthorised pharmacies. These uncontrolled sources of antimicrobials are recognised as key challenges in the NAP on AMR (GovKenya, 2017). Whilst there is no comprehensive AMR data for Kenya at national level, there have been relevant studies, at local level including in Kibera. Studies in Kibera and Kisumu – a city located in the Western region with a similar demographic composition to County X reported concerningly high levels of resistance and antibiotic usage patterns (Omulo et al., 2017; Karimi et al., 2022). In another study in Kibera, Omulo and colleagues (2017) reported high levels of misconceptions about antibiotic use in the same population, one that is highly likely to be plagued by infectious disease based on environmental factors.

This discussion is by no means an attempt to cover every variable relevant to macrosocial processes because this would require a broader study. Instead, it is beginning to expound on intricacies and complexities of the AMR challenge with the view to highlight the role of macrosocial processes, histories and cultures that emerge around taking antibiotics and how these are, in part, shaped by socioeconomic factors including poverty.
2.6 Inequity and inequality with reference to rural populations

A challenge that Kenya now faces is in maintaining continuous gains in poverty reduction and life expectancy and to make disease specific gains where there is high mortality. Leading causes of mortality include HIV/AIDS, respiratory infections, and tuberculosis (TB) and enteric infections. These are diseases caused by consuming contaminated food or water and are more common amongst populations with limited access to water sanitation and hygiene and wastewater management. Of which the WHO (2020a) considers WASH and wastewater management as critical for infection control and reducing the spread of AMR (Kamer, 2022). According to the World Bank’s (2020d) most recent statistics, 29.4% of the population lives below the international poverty line of US$2.15 per person/per day. Given the high levels of inequality in Kenya, the tale of the other side is quite different and makes visible the inequality and inequity in use and access to healthcare services. These differences are discernible even in national policy documents on AMR (Ilinca et al., 2019). For example, the only institutions that have been able to implement AMS, according to the National AMS guidelines, are in private facilities in Nairobi (GovKenya,2020; Ngugi, 2022). Of the population residing in the rural areas, there are challenges in access to services and inequitable distribution of health workers, with a higher density of health workers in urban areas (Okoroafor et al., 2022). Specific to the health workforce, the countrywide ratio of doctors to population is low at 0.2 per every 1000 people, with nurses slightly higher at 1.2 per 1000 people (World Bank, 2020b). At county level, the density of doctors per 1000 people is 0.03, the density of nurses per 1000 people is 0.65 and the density of clinical officers – a cadre with similar roles a doctor, in terms of skillset they are an intermediary between the doctor and nurse at county level is per 1000 people is 0.18 (Okoroafor et al., 2022). County X, where hospital X is located is home to 2.4% of the country’s health workforce, 1.2% of the doctors, 2.5% of the nurses, 3.1% of the clinical officers and 2.3% of pharmacists and pharmacy technologists (Okoroafor et al., 2022). In terms of health facilities, 66% of health care facilities in Kenya have access to clean water sources, and 86% have access to improved sanitation (WHO,2022c) However a recent survey on access to clean water found that only 23% of healthcare facilities in County X had access to clean water (Oketch, 2022). The county ranks amongst the 10 counties with the least access to water coverage in the country (Water Services and Regulatory Board Kenya, 2022).
There is little available data on the impact of AMR in rural communities, despite the majority of Kenyans living in rural areas. For example, data on pastoralist communities, such as the ones that the XTHR serves is sparse (Okoroafor et al., 2022; Makau et al., 2022). Such communities, such as for example, those of Nilotic tribes who are traditionally nomadic peoples who maintain close proximity to land and animals and practice a form of animal husbandry that maintains livestock production by tracking and using of grazing and water across a given landscape (Scailabba, 2022). This in contrast to agriculturalist communities, across for example Bantu tribes who traditionally built stationary communities with visible barriers between their homesteads and animals i.e. individual homesteads with kraals – an enclosure for cattle. Despite the proximity of land with animals, there is little that is known and understood about the antimicrobial burden or usage patterns amongst pastoralist communities. This includes studies of antimicrobial usage in animal rearing despite their considerable contributions to food supplies in their communities and indeed further afield. Antimicrobial use in animals may have an impact on the broader resistance landscape (Makau et al., 2022). Whilst many pastoralists maintain nomadic lifestyles, others have over periods of time become more stationary, fusing nomadic lifestyles with maintaining specific homesteads. In communities across County X this has come with challenges of living in a modern space and maintaining traditional lifestyles, for example keeping free roaming animals in a town that is still developing water systems and sewers. There is limited access to closed sewer systems, so increasing for example levels of enteric disease (Kamer, 2022). Thus, this study looks to understand the contextual and environmental factors that shape AMR, in a predominantly Nilotic community to understand what and how contextual factors can shape learning to tackle AMR for health professionals living in and serving those communities. This is in line with WHO recommendations to adapt the AMR Competency Framework for AMR to specific contexts. Whilst there is little data on AMR in these communities, there is literature on practices in pastoralist communities. For example, Scailabba, (2022) notes that pastoral systems are distinguished by traditional knowledge systems that are rooted in long tested experiences, based on inference, and grounded in a truth and the propensity to adapt to new circumstances.
2.8 Decolonial Scholarship in global health

Centralising the community; patients and practitioners is a move towards a cultural approach and away from the top-down, policy expert led approach that is currently dominant in AMR policy making (Leadingham et al., 2019). In the context of this study, I am interested in moving towards a cultural approach to consider what role decolonial scholarship can play within education for global health. Moving not only beyond policy expert led but also beyond the boundaries imposed by Eurocentric thought. To facilitate consideration of how communities can be supported in fusing their centuries tested traditional knowledge to solve the challenge of AMR in the context of now using western medical traditions and the problems it comes with such as AMR. Decolonial scholars such as Mingolo and Walsh (2018), contend that what matters most is not disciplines as transcendental entities, but is instead the knowledge that is woven around those disciplines. It is the praxis of living and the relationality that exists between living things that should be our focus. In the context of this study, the focus is on the interconnectedness that exists between people, animals, and land and how that is both impacted by and shaped by the use/mis-use/overuse of antibiotics. Ways of living are underpinned by philosophy, history and are ever-evolving. In the context of this study this therefore includes the cultural use of medicines and the cultures of communities of practice which have developed and are important in understanding how to tackle antimicrobial resistance in Africa. The call to decolonisation is a call to prioritisation of indigenous knowing, research methods and epistemological pluriversality (Chilisa, 2020).

Within the broader field of global health education and educational technology there are increasing calls to decolonise. This is in part by disrupting what decolonial scholars refer to as the ‘core to periphery’ pipeline, which is characterised by designing solutions in the global north’ and deploying them in the global south. This positions the global north as a site for knowledge production and the global south as a site of what Mudimbe, (1993, p.103) refers to as the “ethnologization” of Africa. Though Mudimbe uses the concept of “ethnologization”, with specific reference to art, the base of his argument remains relevant in the context of global health, and the question of othering (Mudime, 1993;p101). It is relevant to how “the other” is treated in research and the labelling of the spaces “the other”
engages in the praxis of living. This sees the global south broadly as sites of ethnography rather than being conceptualised as the complex and multifaceted spaces they are, where knowledge can and does grow and evolve. This challenge is in line with the premise of Farmer’s (2020) scholarship in *Epidemic Illusions* where he charts how the discipline of epidemiology and global public health practices are shaped by their colonial genesis and propagated by maintaining the same colonial matrices of power in knowledge. Such that even the term ‘global health’ is contested by decolonial scholars who view it as a colonial legacy of the study of tropical medicine (Global Heath Unfiltered, 2023). Socially constructed, tropical medicine entered medical discourse as a distinct conceptual field that facilitated a Eurocentric view of disease that was well-suited to colonial ideology and the colonial need to subjugate (Snowden, 2010). The development of international health/global health as discipline corresponded with driving out of colonial governments in newly independent countries, and the birth of bilateral agencies that were well suited for the systemic effacing of colonial matrices of power from view, such that Kwete and colleagues (2022,p.2) argue global health to be “old wine in a new bottle”. Thus, the use and reference to global health here, is an example of the tension laden nature of decolonial scholarship. Whilst I am not critical of all the work that falls under the scope of global health, I advocate for decolonisation of the term to extend to abolishment, and engagement with the use of public health in low resource settings, whether those settings in the global north or south (Global Health Unfiltered, 2023). This would move the field away from notions of universal applicability of certain concepts to the global south population and towards context specific, place-based approaches that take into account complex local histories, cultures, knowledge, and philosophies. This thesis is therefore positioned in part to de-peripheralize African ways of knowing and the role that Africans take in research about Africa, whether in researcher positionality and the capacity to think and write unencumbered by Eurocentric thought, to manoeuvre adaptation of and methods or in researchers reflexively engaging in co-productivity to ensure that enough room in afforded to collaborating communities in African research. To exercise agency and self-determination this study was therefore a collaborative work between Africans including this Zimbabwean academic, Kenyan health workers, Kenyan software engineers, Kenyan programme managers, Kenyan programme administrators, Kenyan ethical boards - all of whom made this work possible. Importantly, this is demonstrating that Africa is a site of knowledge
production, and that decolonisation is best done pragmatically, to centre the African in designing, building, implementing and evaluating research outputs and their accompanying technological products for Africa. I expand on my philosophical underpinning and decolonial reasoning in the next chapter I introduce the ethics that guided this study.

2.9 Conclusion

This chapter introduced the study context and mapped the Kenyan health system against the historical backdrop of the county. Effectively highlighting how micro and macrosocial processes have shaped the Kenyan health sector and how some of these processes impact AMR-related health issues in today’s Kenya. The chapter introduced decolonial scholarship and the role it can play in meeting current challenges in global health. This included problematising the term ‘global health’ to bring to the surface, tensions that exist in attempting to decolonise within the academy. For example, advocating for the abolishment of the term global health because of its colonial genesis and challenging universality of some of the concepts fall under the umbrella of global health. Whilst on the other hand highlighting the importance of some of the work that is characterised as global health furthering the argument on the need to decolonise and perhaps reconceptualise the field of study.
Chapter 3: Ethics

3.1 Introduction

This chapter begins with a contextualisation of African struggles in ethics and discusses epistemic justice with a reference to a colonial history. It then expounds on ethical process, exploring present opportunities to move researchers and institutions toward the adoption contextually responsive ethics. Later sections of the chapter discuss Ubuntu and Kenyan ethics, present researcher ontology, epistemology, and positionality. The chapter concludes with a presentation of the ethical framework that underpinned this study.

3.2 Contextualising African struggles in ethics

As the colonial project drew to an end, Nizan (1971) asked of philosophers to be put on the spot, to state their stance. On “the things that occupy the minds of the planet’s inhabitants. [such as] war, colonialism, the speed-up in industry...the varieties of death, unemployment, politics” (Nizan, 1971;38). Those questions of morality that were then, relevant to the colonial project remain just as relevant now because whilst we now exist in a post-colonial era. Where former colonies, such as Kenya, who long achieved political independence in 1963, now self-govern, the destruction to native social forms and systems of reference of the economy and the customs has been sustained (Dill and Crow, 2014; Fanon, 2001). In part through knowledge production that has propagated the remnants of colonial structures and upheld Eurocentrism beyond declarations of political independence. Structures of knowledge production, that relegated African peoples and their ways of life as sites to be studied, rather than sites of knowledge, (Mudime, 1993; p101) refers to this as “Ethnologization”. It’s a practice that maintains asymmetrical power relations underpinning coloniser - colony relations. This can be understood as coloniality and fuels the research and aid industry (Farmer, 2020; Mazrui, 1986; Mignolo and Walsh, 2018). Given that my research also exists within the frame of these relations, as it is funded by, and I am based at a British institution, there is a need to engage with a myriad of ethical and moral questions on coloniality and Eurocentric values. “Broadly speaking, Eurocentrism is a pervasive bias... grounded in the metaphysical belief or Idea (Idlee) that European existence is qualitatively superior to other forms of human life” (Serequeberhan in Eze, 1997; 142). It has served as a
foundation for an ever-deepening chasm between the historically colonised and the coloniser and this study is conducted from a place of commitment to bridging that gap and engaging with philosophy in a way that promotes African ethical systems as a way to promote ethically responsible engagement in African research. I aspired to ensure that my work does not feed into the continued reproduction of colonial matrices of power through knowledge production.

The process of moving away from Eurocentrism, toward decolonisation and the reclaiming of indigenous knowledges within the academy requires challenging racist notions of indigenous knowledges as non-existent, unscientific, and illogical (Sefa Dei, 2008). Du Bois, (1903), Fanon, (2001) De Sousa Santos (2007) and Ndlovu-Gathsheni (2018) use the idea of a divided world, a world cut in two by invisible lines. These have been drawn as points of distinction that have historically excluded and continue to exclude the global majority from, amongst other violations, being recognised as producers of knowledge. I find most useful, Du Bois’s (1900,p.np) conception of the colour line. I use the work of Sefa Dei, (2008), Du Bois, (1903), Fanon, (2001), De Sousa Santos (2007) and Ndlovu-Gathsheni (2018) to consider the ways in which these lines still manifest. This has been helpful in actively engaging through broaching into local knowledges and negotiating what epistemic justice and epistemic freedom may look like within the boundaries of a thesis on education in health settings in Kenya.

Justice seeking scholarship concerned with issues such as the global inequality is needed, particularly in the context of former colonies needs to exact a decolonial approach. This recognises that the global system continues to exclude and/or marginalise other knowledges, imposing limitations that deny epistemic freedom – “the right to think, theorize, interpret the world, develop own methodologies, and write from where one is located and unencumbered by Eurocentrism”. This also acknowledges that this has implications for how inequality materialises in our world, including in knowledge ranking/valuing systems such as the university (Ndlovu Gathsheni, 2018, p.3). Epistemic injustice and the sustained colour line are evidenced in the language of resistance and the continuously burgeoning justice seeking scholarship. That in it attempts to keep up with the continuous reinvention of the colour line it reinvents itself accordingly; “national liberation, national renaissance, the restoration of nationhood to the people, commonwealth [post-
colonial, coloniality, decolonisation, decoloniality] whatever maybe the headings used” (Fanon, 2001;27). I contend that the language of resistance in a post-colonial era evidences the mirage of progress, regardless of how inclusive the progressive language of the west has become. At present, the language of progress in of itself is a function of the ignis fatuus of the dissolution of the colour. This is the sorting line that was evidenced in, for example, pious speeches about togetherness and global citizenship from western governments, whilst they imposed export bans and policies that ensured unequal access to medication in the COVID19 pandemic (Tegama, 2020). I am therefore committed to moving beyond weaponised use of progressive language that is designed to hush the murmurs of the disenfranchised. Instead, I have chosen to engage in progressive work and the pragmatics of decolonial work. This is required at every stage of the research process from initiating design and in addressing and approaching research ethics committees, through to its reporting in this thesis.

3.2.1 Ethical Applications

Whilst the study was conducted in Kenya, it required ethical approval from the UK Higher Education Institution where it is based. Locally, in Kenya ethical approval was also sought at the county level and health facility level as well as from an NGO that supported the project through provision of software. I approached research ethics reflexively, with the understanding that research governance by design is largely Eurocentric and broadly reactionary; “it is a retrospective response to unethical practices” (Schoeman, in Nortje et al 2019;1). Whilst on one hand this demonstrates an openness to evolving, there is a need for proactivity within research ethics. In the UK HEI context for example, ethics requirements did not extend to a requirement to understand local ethical systems and values. The OU HREC did not ask of me as a researcher to engage in local ethics nor ask for a demonstration of awareness of the ethics of Kenyan people, their values and how my work would align with the ethical systems in place or where there was a risk of ethical breach in line with local ethics. This is linked to the question of inequality in knowledge production and coloniality because, though research ethics governance recognises the impact of colonisation in a globalised world, this is not synonymous with decolonisation. The gap in ethical requirements creates room for an imposition of western value systems on the communities that engage with researchers as the current UK HEI context prioritises engaging with ethics
through Western Ethics. The processes of gaining ethics approval in the UK and in Kenya varied.

I was required to gain ethical approval in the UK first. I adopted an iterative approach to ethical applications. This was in keeping with my research design and enabled me to comprehensively reflect on each aspect of the study. For example, I applied for the ethical approval for the surveys, conducted the surveys and engaged in initial analysis that informed the next phase of the cycle. I then considered local ethics and how they could inform the next phase of design. This was followed by a submission of what is termed an ‘amendment’ to the initial research ethics approval. A better name may have been an ‘addition’ as I was not amending but rather building on the previous ethics application. In the UK HEI context, there were no obstacles to using this iterative approach.

In the Kenyan context there is a deeper awareness of abuses in research ethics, given the history of ethical abuses and the ways in which coloniality has impacted the local communities in Kenya. Therefore, as part of one of the ethical applications in Kenya, researchers are required to undertake an ethics course, with a focus on abuses in human health. The course had a test with a pass/fail threshold. A certificate evidencing passing was required as part of the ethical application (see appendix N). However, whilst focused on abuses, it did not provide learning on local ethical systems, values and how one may responsibly research within the context of local ethics. It’s worth noting that additional requirements for ethics certificates were for the health sector. I would argue that there too is a need for asking researchers engaged in social sciences for further and more comprehensive reflection.

3.2.2 A decolonial turn in research ethics

Within research ethics, a decolonial and proactive approach is needed to research ethics that may decrease the cases of exploitative research practices by some researchers from the global north in the global south. The requirements of Human Research Ethics Committees across global north universities and research institutions currently should serve, not as an end, but as a step toward ethical, decolonial practice amongst researchers. The call to decolonisation is a call to de-centring western thought (Wa Thing’o, 1993) and to change
the order of the world. Fanon (2001) asserts that it is quintessentially a call to a programme of complete disorder.

On a macro level, there is a need for universities and research institutions concerned with research ethics to create room for greater epistemological inclusivity and yet to do so there is a need to embrace disorder, other ways of knowing and disqualify the idea of westerners as final arbiters of philosophical discourse. In the context of this study this necessitated thinking about what an ethical framework that embodies the humanistic morality, normative social rules and principles that guide an African way of life may look like (Nortje et al., 2019). The study needed an ethical framework with the capacity to facilitate and include the rich history of oral traditions, collective folk thinking that is reflective of an inherited philosophy or the unwritten, original contribution to knowledge of the sages of a tribe, without seeking epistemological justification based on western tradition (Murove, 2013).

On a micro level, a decolonial approach necessitates proactivity in the adoption of deeper levels of self-scrutiny amongst researchers through an intersectional lens that places the researcher and the researcher’s work within the frames of historical and present-day contexts. Enabling the researcher to contend with the complexities of the aftermath of a “colonial turn which produced global coloniality and affiliated itself with racism, imperialism, capitalism and modernity to create an unholy alliance” (Ndlovu-Gathsheni, 2018;71) that led to the reconfiguration of conceptions of power and knowledge. Thus, the researcher can consider the direct impact of the colonial turn on the self as the researcher, the study, the sites, participants, and the evolution of the discipline. I have come to appreciate that my job as a researcher is therefore to understand the philosophies that are held by my potential participants, to understand the reality that has shaped their philosophies and hold them in as much regard as those personal to the researcher. Further, I need to allow them a higher regard still when conducting research as a guest in another society (Sefa Dei, 2008). That was the beginning of my earnest pursuit of decoloniality.
3.2.3 Navigating Kenyan Ethics

I conceptualise Kenyan ethics in relation to broader African ethics and suggest a framework for understanding the evolution of Ethics across African societies (see ethical framework in section 3.6). However, in doing so, I continue to contend with tensions, rising over the question of epistemic freedom. For example, one constraint imposed on me by the Eurocentric academia requires me to seek bibliographic references for all my sources of knowledge. Yet there is no guidance about, and presumably sitting behind this no value given to, the knowledge imparted in me from the sages in my family or from oral sources. For instance, in explaining an African philosophy, I question whether I can be afforded the epistemic freedom to reference a maxim to the sages or simply the Shona and Chewa people from whom I descend as opposed to a western scholar who wrote it down. In subsequent paragraphs, though limited, I undertake the task of philosophical self-scrutiny in relation to Kenyan ethics, and analyse the socio-cultural, historical, and political dynamics of Kenya that have a bearing on the ethics of the study. I begin with a brief deliberation on framing Kenyan ethics and later return to the evolution of Kenyan ethics.

In considering how to ethically navigate the process of doing research in Kenya I centralise Kenyan ethics and peripheralize western thought. I endeavour to lean away from the propensity to compare or attempt to understand African philosophy through a western lens or in proximity to western ethical traditions (Eze, 1997). Given the call to a virtuous life, the African outlook on virtue-centred living characteristically differs from the most influential virtue-centred western thought (Murove, 2009). Subsequently, this enables me to consider the consistent set of principles that apply to Nilotic (see, section 2.7) and Ubuntu (see next section 3.1.4) philosophy in their own respect. It is worth noting that there is little that is written about Nilotic ethics, this is in keeping with oral traditions, and of what can be found the set principles in discussion are consistent across both indigenous groups Bantu and Nilotic alike (Ochollo-Ayayo, 1976). I therefore leverage my own background in Ubuntu ethics and my previous interactions with Kenyans across the tribes in respect to the oral literature we have exchanged. I also consider that the ethics that guides people within Kenya is a shared ethic that is a result of the collision and co-evolution of philosophies across Kenya’s 44 tribes, to converge and create a branch of ethics that is particular to Kenya (Ogunyemi, 2020). In the following sections I expound on ubuntu ethics with the view
to demonstrate the synonymity that exists across tribes in terms of normative postulations such as primary moral directives and imperatives that shape social life and inform basic value interactions. These similarities form the basis for leveraging my background in Ubuntu ethics in approaching this study.

3.2.4 Ubuntu Ethics

Ubuntu philosophy is an African philosophy of personhood and communitarianism that forms the base of most ethical traditions in Africa (Ogunyemi, 2020). Ubuntu philosophy can therefore be understood as a conceptualisation of self, wherein the full formation of the self-identity is fostered through the network of relationships in one’s community (Battle, 2009). Thus, being virtuous, not only concerns the individual becoming a better person but is characterised by individuals becoming responsible members of a community, thus better for the community. This is best summarised through the Xhosa maxim, "Ubuntu ungamuntu ngabanye abantu" (Battle, 2009;3). This means a person is a person through others to be understood as our humanity is fully realised in relation to one other.

African traditions of morality and the wisdom of African ethics are largely unwritten (Ogunyemi, 2020). Though African people maintain a deep sense of right and wrong, this moral sense often eludes outsiders because it is unwritten. It has produced customs, laws and traditions and is passed on from generation to generation through storytelling, folklore, poetry, songs, idioms and proverbs. As an African woman who grew up under the guidance of ubuntu philosophy, or as the Shona call it ‘hunhu’, I consider the wealth of knowledge of an Ubuntu philosophy inherited from the sages in my family and tribe, contained within parables, proverbs and idioms passed on in the oral tradition. I opt to use my personal history having been schooled by Du Bois (1900), Lewis, (2009) and Sivanandan (1990) whose work focused on the politics of linking the individual to the collective. They advocate that, by making individual cases, issues that translate into causes and movements may contribute to building a new political culture.

I seek to link my individual academic journey and the negotiation of epistemic freedom to two collectives. First, those who exist on the intersections that the academy has traditionally marginalised, like me, a black, African, working class, woman. Secondly, to
those within the academy, who are part of and those who are yet to join “an epistemic community that shares a political and academic project that heralds power of indigeneity and subverts the tendency for certain knowledges to masquerade as universal” (Sefa Dei, 2008; 91). Whilst I recognise the limitations of subjectivity, given that my experiences are unique to the very intersections I exist within: of blackness and womanhood, of being African, of having existed in spaces that lie on either side of the abyssal line that separates the colonised and coloniser, what I lose in breadth, I gain in depth. In depicting the world as I see it, I highlight my own African agency (Sefa Dei, 2008) and importantly an African woman’s story, perspective, and voice unmediated by another party, whether it be male or western. That importance was highlighted in literature searches for African ethics papers and books by African women that produced a limited number of outputs such as Chilisa, (2020), Ogunyemi, (2020) and Tamale, (2020). I therefore draw on my personal history in elucidating the moral precept behind the study as well as in opting to lean into oral traditions of storytelling that were traditionally used to pass on wisdom including Ubuntu philosophy through proverbs and fables. Where possible I attempt to honour the tradition of storytelling throughout the thesis. What I lose in authority, I gain in vividness. I do so by opting to use my voice rather than a disembodied authorial voice of the scholar that speaks from some place, “that place which is no place” (Bhambra, 2018:xx). I do so in an earnest pursuit of my own epistemic freedom and to honour the participants’ ways of knowing, as well as to pose the question to the reluctant corners of the academy of whether the story told in the likeness of our traditions invalidates the knowledge contained within the story?

My moral conduct, the foundations of my understanding of philosophy, by enlarge came from the stories I grew up hearing. Their moral basis echoes Aristotle’s virtue ethics with a deep-rooted communitarianism that could be framed alongside consequentialism. The stories often featured animals, ascribed characteristics that would be carried across different stories by different storytellers. The commonality across storytellers extended to the highly descriptive, somewhat poetic storytelling form that was enriched with similes and metaphors to keep young minds engaged during the storytelling and pondering long after the storytelling was done. These stories would be referred to in rhetoric, for example in the classroom when one was up to mischief, the teacher would perhaps remind the class of how hare’s antics never ended well for hare. The philosophy contained within these stories is an
Ubuntu philosophy that can be likened to traditional Kenyan ethics across the tribes. I use the term ‘likened’, rather than ‘the same’ as, though the base of the ethics maybe the same, the nuances that are subject to time, space, cultural shifts and language are ever more important in philosophies that are passed on orally. As such I position myself as an outsider to Kenyan ethics but an insider to Ubuntu philosophy, which I use as a gateway to understand Kenyan ethics.

3.2.5 The multiplicity of ethics in Kenya

The conceptualisation of, for example Kenyan ethics as a branch of African ethics, can be understood as people with a shared history comprised in the territory that we now know as Kenya. That shared history and co-existence within the same space brought about a more generalist understanding of Kenyan philosophy across the tribes. This will have been shaped across communities, in the way they related to each other, for example in engaging in business and trading (Ogunyemi, 2020). The relationship across tribes would be governed by a shared understanding of ethical conduct in business, therefore when one speaks of Kenyan ethics this can be understood as a shared philosophy that governs interactions across tribes. Mundia & Martinez, (in Ogunyemi, 2020) propose an understanding of Kenyan ethics demarcated by three time periods – pre, during and post-colonial Kenya. I propose using the same time periods to understand the wider scope of Kenyan ethics with the view to explore the ethics that influence and shape workplace culture including in health facilities.

Pre-colonialization, Kenya had contact with Arab, Chinese and Portuguese cultures. Of the three, Arab culture was most pronounced, made visible in the eastern coast’s architecture, in the introduction of Islam to Kenya and the adoption of Arabic words into the national language, Swahili (Mwawila, 2008). The traditional Kenyan call to a virtuous life, is associated with individuals flourishing within the bounds of communitarianism. Notions of joy are associated with being a good person in the community. Interactions with others subsume personal growth and development. It is therefore through interaction that one can achieve happiness in a way that fosters cooperation, thus happiness should be achieved with, rather than at the expense of others.
During colonialism - colonial Kenya presented a direct challenge to traditional Kenya (Kinoti and Wakuraya, 2010). The arrival of the British brought with it the what the late President Kenyatta typified as confusion in cultural values and a fundamental shift to the western ideology. Shifting from the household as the primary economic unit of a shared wealth to the prioritization of an individualistic outlook. This would permeate the Kenyan way of life during colonial occupation (Ogunyemi, 2020).

Then came an independent, post-colonial Kenya and the advent of post-colonial liberalism that brought yet more culture shock to the traditional Kenyan way of life and value systems (Ogunyemi, 2020). It is therefore apparent that an understanding of the Kenyan political economy lends itself well to examining the evolution of a rich and complex ethics in Kenya. Shaped by the collision of multiple ethical ideologies that has produced an intricate ethical system that subsumes a multi-racial, multi-lingual, multi-tribal, multi-religious society, that even as it engages with lithography, maintains oral traditions, it is therefore important to make room to hear those oral traditions.

3.3 Oral versus text-based literature

In his seminal work ‘Of grammatology’, Derrida (2016) devotes attention to reasoning that necessitates relinquishing of the oral versus written dualism, and other age-old binaries such as primitive (read petroglyph - rock paintings) versus civilised (read alphabetic writing systems) (Mugwini, 2019). Following this line of thinking shifts the focus from binaries to a continuum, where one can map points of conceptual divarication illustrating where conceptual grounding may divaricate. This gives way to an understanding of the possibility of conceptual differences as ‘degrees apart’ rather than as ‘absolutes’ (see illustrations in Figure 3.1.)
The question may then become, if the conceptual differences are only degrees apart, then why centralise decoloniality? A rationale could be that because, even where conceptual divides are not diametrically opposed, the degrees in-between matter. These degrees implicitly contain the differences in methodologies and philosophies, reasserting that “philosophy is always there in the plural” (Van Hebsbroek, 2013, p. 1). It is therefore in those degrees of difference that Africans can assert their identity, culture, and history from their own representations (Sefa Dei, 2010, p. 76). This is particularly so with reference to the dialogic, oral traditions, which are central to many traditional African villages, and, in that way, are part of African intellectual heritage. Thus, the intellectual density accorded to oral literature or lack thereof is a central challenge. It sits at the nexus of conferring with Africa’s dialogic intellectual heritage and understanding, as well as solving Africa’s problems from a historically and contextually rich standpoint. It is this devaluation of knowledge systems that scholars, such as Ake (1978), argue to be the source of perennial underdevelopment, because it contributes to the paucity in understanding Africa’s issues. Thus, there is a need to accord African intellectual heritage the same deference and immortality afforded to classical European ideas, in that way revaluing devalued systems (wa Thiong’o, 2013).

3.3.1 Of oral histories and community palavers

As has already been presented, embedded in Africa’s oral histories are the underpinning philosophies that guide African society, passed on from generation to generation, through sage, song, myth, fable, proverb, and artwork. These teachings and philosophies are a
marker of evolved philosophical systems that have been “preserved since before the advent of lithography in Africa” (Ogunyemi, 2020, p. 2). They have continued to play a key role in traditional village life, and in varying ways been distilled into urban Kenyan life including medical spaces. Thus, the tradition does not exist opposition to, but rather co-exists with, and in many ways shapes what the medical profession looks like in practice. For example, village life, by its nature, yields critical dialogues through ‘community palavers’ (Mugwini, 2019; Bell, 1989). Centring on discourse, palavers are liberated spaces for community members to speak, not without criticality or reflection, but as collective reflections (Bell, 1989). Community palavers transcend the village, into Africa’s towns and cities and the spaces where they still include on Kenya’s estates and in its workspaces. Maganjo’s (2020) fictional work, hailed for capturing the essence of estate life in the 1990s attests to the vibrancy of community palavers. Given that amongst the repeatedly cited challenges in professional learning in the SSA health sector is communication across the different health worker job roles and hierarchies (Gebretekle et al., 2021; Mula et al., 2019), community palavers may prove to be a useful tool for facilitating and improving communication in professional health care settings. To for example, leverage community palavers in collaborative and reflective AMR decision making. Community palavers are traditionally spaces where communities can evaluate disputed matters as well as engage in the re-evaluation of community life, particularly in relation to external factors and consciously evolving traditions to meet modernity (Bell, 1989, p. 373).

The embedded collective reflection and responsiveness in community palavers is particularly important for medical communities, such as the community of practice that is the focus of this study, because it is here that the dialogic falls within the degrees of difference and those differences may very well account for the variation in different aspects of medical practice that exist across geographies (Oyedokun et al., 2016). More specifically, with reference to tackling AMR, changes to practice are behavioural and discussions may preclude changes in behaviour. Within this context, a community palaver can translate into a discussion about whether or not to use a given instrument to test for an infection. For example, the GeneXpert assay, a widely used technology, introduced to many Sub-Saharan health contexts, to bring greater efficiency to the detection of tuberculosis (TB) was largely abandoned in a health facility that was part of my pilot study in Ghana (Meyer et al., 2017).
The GeneXpert has been documented as providing inaccurate results in certain cases, these are associated with sample quality amongst other “clinical and operational factors” (Meyer et al., 2017, p. 2). At the health facility in the pilot study, the GeneXpert had historically produced some inaccurate results that led to collective reflections and discussions much alike community palavers. Reflections about the GeneXpert were led by a senior member of staff who felt that his capacity to diagnose empirically was more accurate than the GeneXpert. This was coupled with an expression of greater trust in an old technology – microscopy, that was previously used to diagnose TB, such that the output of the palaver was the collective decision to abandon the GeneXpert. Where the community could have engaged in questions around quality control and the factors that impact the results, they chose to largely abandon the technology. Methodologically speaking, what matters most is not whether the community of practice was right or wrong. Rather what matters is their capacity to engage in collective reflection, decision making and learning about another way of diagnosing. This apportions a degree of importance to cultural memory and the pedagogical histories that are attached to the embedding of the culture into memory and practice. Thus, to adequately address one of this study’s research questions pertaining to how health professionals in a Kenya health facility learn to tackle AMR I must employ a methodological approach that is underpinned by philosophical assumptions that can effectively facilitate alternative frameworks. In order to understand the various ways communities of practice have and continue to learn (Mugwini, 2019). In the next section, I discuss my philosophical assumptions.

3.4 Ontology and Epistemology

Ontology, a derivative of two Greek words: on, meaning being and logia, meaning study. Thus, ontology is the study of existing and of being alive (Doolan, 2011). My worldview sits in line within an African ontology based on Ubuntu philosophy, with particular reference to the Shona people of Zimbabwe, from whom I come from. The Shona have a proverbial saying that encompasses their philosophy and guides their way of life, “Munhu munhu ne vanhu” (Mugwini, 2019). It is a proverbial expression that means a person is a person through people. The proverb exists in other bantu languages such as Xhosa and Zulu (Battle, 2009). Thus, personhood is a construction based on the individual and their interactions
with others. I would therefore argue that, whilst I am with the school of thought that the African philosophy can sit independent of western philosophy, providing reference to western concepts without dichotomising can be useful for outsiders to glean into a vibrant African philosophy. It is in that gleaning that one can begin to understand the argument for the continuum, rather than the binary.

In that way, my research paradigm is constructivist based on Ubuntu ontology and the epistemology of the shona. In shona, ruzivo means knowledge, it is a comprehensive term that encompasses varying forms of knowledge from trades, to comprehensions of facts, traditions and religious rituals (Mugwini, 2019). The latter requires one to have dedicated time to learn from the elders. Additionally, ruzivo, constitutes zano or mazano, idea/s, that is important ideas both theoretical or practical. Socially, people can organise themselves to seek ‘ruzivo’ knowledge. In doing so ‘vano ronga zano’ they seek to collectively come up with ideas that will constitute knowledge. Thus, for the Shona, knowledge has a strong social character (Mugwini, 2019). Ideas are truth-based, truth can be translated to ‘chokwadi’ with other phraseology constituting truth ‘zvomene, zvirokwazo’. Truth can take on a variety of meanings, not limited to scientific fact, but including the equating of truth to a viewpoint. This also extends to truth-based on the experiential. In that way it places an importance on storytelling that fits well with the idea of interviewing people as a method of gaining knowledge by prizing people’s views and experiences. In shona phraseology, experience can be captured by relating truth to the senses i.e. ‘chowadi ndozvandawona’. Direct translation would be ‘truth it’s what I saw’, whilst contextually it means honestly. This extends to other sensualities. For example, ‘chokwadi ndozvandanzwa’ translates directly to ‘truth it’s what I heard’. Contextually truth is once again replaced with honesty. This speaks to meaning making amongst the shona, where truth can be factual but extends to giving truthful account. Thus, there is a moral preoccupation with truth where honesty and intention are prized. This speaks to the axiological driver in this study as sitting well within constructivism. Effectively, and illuminating the vibrancy of an African philosophy that is both organic and alive in Africa (Hoppers, 2000).

3.4.1 Positionality
The location of myself, the researcher, as an African is useful in facilitating the dialogic relationship with a largely undocumented intellectual heritage, including intellectual works that are evolving on the ground in the present. Whilst the manner in which African intellectual heritage evolves varies, across tribes, communities, and national boundaries. There are similarities and shared beliefs, in for example, Ubuntu philosophy that are communicated through everyday indigenous vocabulary that is laced with proverbs, and songs and stories with philosophical value that are part in parcel of navigating African society (Murove et al., 2009). These are nuanced often make African intellectual heritage elusive to outsiders who seek to categorize it through their own schema (Ogunyemi, 2020). Though elusive to the outsider, it is tangible to the insider, which I consider myself to be. The historically dialogic manifests itself in culture and practice and guides ways of life and work (Ogunyemi, 2020). In seeking to understand these components I opted for the use of a cultural-historical theory to frame understandings of practice in the workplaces of Kenyan healthcare settings against the backdrop of the cultural and historical evolution of practice relevant to these settings (Engestrom, 1987). To understand this and engage in a process of drawing these tacit understandings into the explicit requires dialogical engagement through qualitative research methods. I have set forth the decolonial arguments for, and the conceptual grounds to confer with African intellectual heritage and allowing it to my shape methodological choices, locating myself as a researcher. In the next section I expand on my philosophy and begin expounding on the triangulation between methods, theoretical framework, and philosophical beliefs.

3.5 Ethics and activity theory

The conceptual framework for this study uses Engestrom’s (1987) CHAT. This conceptualisation of activity systems creates room to explore how change is introduced to a system, how it evolves and is embedded (Engestrom, 2018). Whether it is resultant of big events or small and repetitive events often found in the mundane. It recognises tensions that are created in an interactive system and the process that then instigates changes through the repeated encounter of disturbances, that become aggravated. Causing a shift in behaviour or practice in order to resolve the tension, in this way bringing about change. The ethics and culture of a space are in a state of constant exposure to ‘novelty’ – new things.
Whether big or small have an impact on the existent ethical system. There is scope to consider how CHAT’s conceptualisation of change in activity systems can be used to consider change in ethical systems. In the next section I set out a framework for analysing ethics that draws on CHAT.

3.6 Incorporating ethics into a CHAT framework

In endeavouring to adopt an African ethic, I consider Ubuntu ethics (as discussed in section 3.2.4), its evolution and variation across the time and geographical space, for example Kenyan Ethics and Zimbabwean ethics - I use these terms broadly. The broader base of the ethical systems is an African philosophy of communitarianism and humanism, this is very evident in Ubuntu philosophy (Ogunyemi, 2020). Humanism is here framed in the sense that the concept is used in exploring an African philosophy through the lens of Ubuntu philosophy by scholars such as Mugwini, (2019) and Murove et al (2009). This broad base forms the foundations of a shared African philosophy, which determines how people live and their guiding moral code of conduct. These similarities are tangible in the lived experience. As a Zimbabwean visiting Kenya for the first time, I was struck by how at home I felt. In conversation with a friend whom I was at the time visiting, I realised that, whilst the Kenyan hospitality had gone some way in making me feel welcome, the sense of homeliness that was attached to Kenya was in part due to its resemblance to Zimbabwe. This was through the colonial architecture and in the town planning that sprawled its streets with the same Jacaranda trees that turned streets into seas of lilac when in bloom. I would later visit Ghana to conduct the pilot study. On arrival in Accra, Ghana’s capital I would not be immediately overwhelmed by a sense of home, but in driving through Cantonments, an old colonial neighbourhood in Accra, I experienced, a transient sense of knowing, relating and perhaps false understanding the space. The experience, for me, evidenced the role of social and political realities in shaping persons and communities and their philosophies. I will expound on this notion using the example of the Jacaranda tree.

The Jacaranda tree was imported into colonies along with other trees that were useful for timber purposes, but the Jacaranda, introduced by British botanist, Alan Cunningham was brought in from Latin America solely for aesthetic purposes (Baraka, 2019). It is a common feature across urban and peri-urban areas in the South and Eastern African former British
colonies. As a result, those of us who grew up in those urban and peri-urban areas may be inclined to feel a sense of nostalgia or homeliness when in other Africa countries that have a similar town planning structure due to colonial history. Yet this does not make those spaces home, instead there is something that resembles home there. I think of Ubuntu ethics across spaces in a similar way. Its application in Kenya may very well resemble Zimbabwean ethics, but it is not the same. It differs based on histories that are personal to the given communities. Therefore, whilst I am aware that the base of our Ubuntu philosophy is similar and that the indigenous people of Kenya and Zimbabwe have faced, fought and won battles against the colonial oppressor, I remain aware that the developmental trajectories of both countries and governing and underpinning philosophies are effectively different branches of Ubuntu philosophy. The framework is therefore an attempt to conceptualise how those branches evolve. Below, in Figure 3.2, I introduce an ethical framework for integrating locally-applicable ethical thinking into my chosen conceptual framework to ensure ethics are embedded in the study and as a potential contribution to applying CHAT to decolonialising research.

![Diagram](image)

**Figure 3.2 Model mapping novelty in ethical systems (Tegama, 2021 First presented at REC21)**

The framework drawn above as a triangle, demarcated in the middle to form a smaller triangle, creating a triangle within a triangle, explains the interaction of varying elements that determine the co-evolutionary process recognisable in CHAT (Engestrom, 2018). It
details elements connected in symbiotic relationships, demonstrated by the use of arrows. However, this particular interpretation of an activity system I introduce and centralise ethics, adapting third generation CHAT triangle to incorporate ethics and the and the underpinning factors that shape an ethics system.

As outlined above, Ubuntu philosophy centres on communitarianism. Thus, the community is central to the philosophy. The arrow that links community and ethics can therefore be considered the most important. All the elements within the triangle maintain a level of symbiosis, interreacting and shaping each other in different ways. The lines and arrows reflect the most tentative relationships, all formed in relation to community and the ethics. I see the community and ethics as having a symbiotic relationship. The community is guided by an ethical code but also maintains agency to shift the ethical code, to change it; expand it, evolve old codes, and introduce new ones to, effectively rising to meet the challenge to govern itself in an ever-changing world.

The smaller triangle conceptualises the relationship between the community, ethics, and novelty. As illustrated above, I see novelty to be understood as new people, new cultures or technologies that are introduced to a community. Novelty has an impact on both the community and the ethics of the community. For example, the introduction of a new person, idea or thing causes a behavioural shift in the community. The process of absorbing or rejecting novelty into the community requires a new form of engagement with novelty thus creates a new experience within that community. Whether absorbed, rejected, marginalised, or ejected from the community. Its mere existence and coming into contact with the community requires the attention of community and in that way impacts the ethical code. I borrow from the Greek philosopher Heraclitus, in explicating on the idea of shift by mere contact “No man ever steps in the same river twice, for it’s not the same river and he’s not the same man.” (Bradford Research School, 2022, p.n.p) I recognise that novelty in of itself maintains a symbiotic relationship with ethics. For example, the interaction with a new technology is guided by an existent framework and may cause or demand a shift in ethics. The existent ethical code would adopt the new technology into its ethical framework i.e. the introduction of modern medicine and the subsequent evolution of ethical codes of conduct in medicine. Or, in the context of the introduction of modern medicine with specific reference to public behaviour, caused for example a shift from
traditional medicine to modern medicine and within that a culture of antibiotic use/overuse/misuse has evolved, landing in the moment that we now find ourselves where AMR is a challenge (WHO, 2022). The political economy impacts the community and how it is governs itself. It subsumes a capacity to shift community perspectives and behaviours that is also linked to its symbiotic relationship with ethics. The political economy subsumes its own rules and culture that shape governance and that in turn shapes rules including laws of the land and cultural norms. The rules (laws, customs, and cultural norms) maintain a symbiotic relationship with ethics and subsume a capacity that ranges from impacting to shaping the political economy. The rules and the community also maintain a symbiotic relationship. The community maintains agency and can amend or alter the rules whilst the rules govern how the community behaves. Including attitudes toward changing rules subsumed in both the understanding, interpretation and importance placed on tradition.

The larger triangle facilitates an investigation of the relationship between novelty and the political economy. For example, the rise of a new political leader or the introduction of new technologies can be conceptualised as novelties. These exist on a spectrum that ranges from impacting to shaping the political economy. Alternately, political economy impacts novelty including the rate at which particular novelties can be introduced into the political economy. At the base of the triangle sits norms, these can include regulatory and cultural laws. Norms maintain a relationship with novelty. Novelty often demands shifts and changes in the law to for example govern how novelty is used and accessed in line with the cultural norms and ways of being, for example, out of the introduction of the novelty of modern medical medicine governing medical ethics and laws were born. This ethical framework is applied to thinking throughout the thesis and used in analysis to evaluate cultural changes specific to AMR, as well as in considering how existent culture can be leveraged to facilitate the adoption of AMS promoting behaviours. In the next chapter, I discuss the conceptual framework in greater detail. With a focus on how AT facilitates mapping of workplace activity systems.

3.7 Conclusion

This chapter contextualised challenges in navigating institutional ethical processes with the view to centre African ethics and elucidated on the ethical thinking that guided and
underpinned the study. It presented tensions that exist within the academy in relation to challenging colonial legacies and systemic devaluation of African knowledge systems that are attached to institutional practices, including within research ethics. The chapter made apparent drawbacks within institutional ethical processes and requirements for conducting research in the global south. It effectively highlighted opportunities for tension resolution, through revaluing knowledge systems, advocating for greater epistemological plurality and the prioritisation of place-based ethics, that are steeped in history and context. To for example, facilitate the revaluation of Africa’s dialogic, oral traditions that can be leveraged in research and practice-based contexts, such as through the use of community palavers within medical communities of practice. An ethical framework that was developed over the course of the study is thus presented as a possible framework to underpin and help navigate both practical, field based ethical processes and institutional process. Of which the latter was which were explored in relation to African ethics specifically Ubuntu and Kenyan ethics. The chapter presented researcher ontology, epistemology, and positionality.
Chapter 4: Conceptual Framework

4.1 Introduction

This chapter expounds on the conceptual framework that was used in this study, in part guiding the methodological decisions and data analysis. The process of defining the study-specific conceptual framework required an interrogation and reflection on different theories that are used in research about workplace learning and technology-based interventions in education and health. I reflect on some of the prominent theories in workplace learning research highlighted in the review of the literature and in this chapter aim to expound on why I arrived at Cultural Historical Activity Theory and Design Based Research as the underpinning conceptual frameworks for this study.

4.2 Why Cultural Historical Activity Theory?

Early works in the study of Human Computer Interaction (HCI) focused on the use of technology to support tasks/activities that people engaged in to achieve specific goals. The reasons a person carried out a given task often sat outside the scope of design, analysis, and evaluation (Collins et al., 2004). This has changed since because of the ubiquity of technology, and a shift toward an ‘attention economy’ where in the face of a tremendous amount of information and limited cognitive resources stimuli competes for our attention in our everyday lives (Simon, 1971). Design has therefore shifted towards focusing on why people engage in particular tasks and understanding how technology can be integrated into workflows and patterns to bring efficiency. Maintaining the centrality of activity in HCI whilst adopting a different, context focused lens that takes into account purpose and meaningfulness of activities (Collins et al., 2002). As discussed in the introduction (see section 1.9), within the health sector, there has been a rise in the use of technological tools to support health and health-related fields. These technologies are known as electronic health (ehealth) (WHO, 2005). Within this field there are technologies that perform various functions. These are disaggregated into subsets, for example mhealth is a subset of ehealth. This refers to the use of mobile devices such as mobile phones, smartphones, and tablet
computers for medical and public health practice (Schliemann et al., 2022). This study uses an mhealth platform to deliver education, with the view to understand how educational technology can contribute to tackling AMR. The challenge from the outset of this research project and the broader use of mhealth including for educational purposes has been in the paucity of evidence of efficacy and a lack of evidence of theoretically sound underpinnings (WHO, 2019). As a result, there has been a proliferation of short-lived digital interventions that have provided limited understanding of what underpins good design. In a recent review of digital health interventions in sub-Saharan Africa, Karamagi and colleagues (Karamagi et al., 2022; 1) questioned the lack of evidence-based interventions, characterising the current landscape as a combination of “e-health [and] e-Chaos”. Therefore, in recognising both the potential transformative capacities of digital technologies and the need for evidence of theoretically-sound, evidence-based, locally-relevant approaches to design, the case for interdisciplinary research is strengthened (see section 2.2) (Minssen et al., 2020, p. 823). In the context of this study there is an opportunity to leverage the comparatively larger evidence-base and theories in the learning sciences, with specific focus on literature and theories that can have the capacity to facilitate considerations of challenges specific to workplace learning and contextual limitations. I therefore adopted the use of Cultural Historical Activity Theory (CHAT) (Engestrom, 2019) and Design Based Research (DBR) (Barab and Aquire, 2005; Pool and Laubscher, 2016). In the next sections I discuss CHAT and leveraging its conceptualisation of the sociomaterial within the context of this study. In subsequent sections I discuss DBR and how the combination of both shrinks the theory-praxis gap for understanding how health professionals in Kenya tackle AMR.

4.4.2 CHAT for mapping AMR practice

Amongst the challenges in designing mhealth is the paucity in available literature on systematic approaches to elements that are key to design. Within HCI this process is typically referred to requirement elicitation. This involves engaging in a process of researching requirements of a system from users and stakeholders to inform designers of end-users’ abilities and preferences with the goal of strengthening design (Alexa & Avasilcai, 2018). CHAT facilitates mapping the context, the sociocultural environment, potential points of integration and barriers to acceptability of e-tools in context. This also sits in line with the British Society for Antimicrobial Chemotherapy’s (BSAC), recommendations for the strategic
use of education to effect behavioural changes in AMR practice amongst health professionals (BSAC, 2011). In order to strategically address drawbacks in practice through education, BSAC recommends implementing frameworks that can indicate where and how practitioners can make changes to antibiotic practice. This highlights the need to deconstruct work practices into smaller units, which is endorsed elsewhere (e.g. WHO, 2018). At a granular level this would facilitate the process of identifying AMR-related knowledge gaps that commonly exist for individual roles within health settings, for example, knowledge gaps that more commonly exist amongst clinical officers as opposed to doctors. This would be done with the view to create an educational plan across different job roles in the workforce, with the view to map and address knowledge gaps that exist in both the immediate and wider health ecosystem. This in turn creates room to engage practitioners in the necessary process of correcting practice by targeting AMR-promoting behavioural changes, through education.

The process of creating a targeted education strategy for health professionals who interact with antibiotics and play a role in the antibiotic recommending, prescribing, and dispensing pipeline can be challenging because of the diversity of roles (WHO, 2017). Particularly because the group of health professionals expands beyond the hospital. However, the primary focus of this study is on health workers within the hospital setting, specifically doctors, nurses, pharmacists, lab professionals and microbiologists who play various roles in getting the appropriate antibiotics, to the right patients at the right time, dosage and for the optimal time. Creating an educational strategy that will have the propensity of being effective across the diverse roles would require an understanding of the individual roles within the health facility, how they interact and collectively work together toward the same goal of bettering health outcomes for patients. It therefore becomes important to consider the roles from the conceptualisation of the roles, in terms of practitioners’ pedagogical history – how they learnt to do their job pre-service and how they continue to learn to do their job in-service through CPD. It is also important to consider the tasks that individual employees engage in, the tools they use to engage in those tasks (Engestrom, 2018) and elucidate on how all those dynamic elements interact and shape antibiotic practice. There is an added need to situate the health facility within the wider context, considering, how it operates and where it sits culturally and historically within the Kenyan health system and
broader Kenyan society as presented in chapter 2. As such, considering how sociocultural factors impact antibiotic use and practice amongst populations, sociocultural factors to a degree account for variations between practitioners in different geographical spaces (Oyedokun et al., 2016).

4.4.3 CHAT for mapping the hospital system

CHAT facilitates a multidimensional and systematic approach that enables analysis of complex and evolving systems and practices on multiple levels. This includes capacitating the researcher with tools for partial consideration of psychological motives and ever present subtleties of power and money, history, and culture (Foot, 2014). For example, Kwan et al., (2022) found that antibiotic prescriptions by practitioners in the private sector were in part driven by economic incentives. Providers considered individual health impacts alongside business-driven benefits in decision making associated with prescribing antimicrobials. Where further research maybe required to delineate on the degrees to which economic incentives are drivers, their presence is indicative of the need to consider other influencing factors, extending to for example legislation and regulatory factors in antibiotic dispensation and the culture around antibiotics. CHAT provides a framework that can capture the hospital as a system, against a historical backdrop that factors in the socio-political and cultural elements that underpin practice (Foot, 2014). Therefore, within the main study in Kenya, CHAT is used as a framework to contextualise the role of the individual practitioner within both their immediate setting and the broader sociocultural setting in order to understand individual practice and collective practice (Engestrom, 2018). To understand where and how education could be strategically leveraged, to effectuate positive change in health professionals’ antibiotic practice. By deconstructing work practices into smaller units in order to pinpoint where there is potential to implement change. CHAT lessens the theory-praxis gap, seeking not only to define what is, but also to chart what could be and bring about qualitative change in human praxis (Engestrom, 1999). This is of importance in defining and charting AMR practice in my study. Importantly, CHAT through expansive learning embodies the idea that human beings are endowed with agency to bring about change within the social context they are embedded, I discuss expansive learning in section 4.5. In the next section, I provide historical and expansive lens to discuss the evolution of CHAT. Whilst the commonly used versions of Activity theory, are largely based on later
generations, stemming from Engestrom’s (2014) conceptualisation of CHAT, I find that using CHAT in reference to work by Leont’ev (1978) and Vygotsky (1978), that underpins Engestrom’s conceptualisation provides a richer understanding of CHAT. I therefore aim to explain how this study has leveraged useful thinking across the breadth of the generations of Activity Theory in the next section.

4.3 First and second generations Activity theory

First generation activity theory (AT) brought the foundational concept of mapping the relationships between human beings, their tools and environments. Fundamentally, AT is about “who is doing what, why, and how” (Hasan & Kazlauskas, 2014, p.9). It is a theoretical framework that analyses praxis, change and developmental processes at both societal and individual level (Mwanza, 2001). It does so by focusing on human praxis and framing the ‘activity’ as the base unit for analysis. In the context of this study, it frames tasks relating to antibiotic-practice. The term activity within the frame of activity theory is not to be misconstrued as ephemeral structured tasks with definitive start and end points, instead activity here is to be understood as a complicated and evolving structure whose evolutionary process is subject to mediated collective human agency (Roth and Lee, 2007).

Within the hospital context, ‘antibiotic practice’ captures decisions made by a number of practitioners and tasks undertaken during the workday each one shaping the other, resulting in an ever-evolving process. Activity theory is rooted in the Vygotskyian concept of tool mediation which introduced the notion of interactions between humans and their environment (Mwanza, 2001).

![Figure 4.1: Mediational Model (Vygotsky, 1978)](image)
Figure 4.1 depicts the subject-object relationship, the subject (the human doer) and the object (the deed or rather the thing been done) are mediated by the tool (instruments). The object of the activity subsumes the focus and purpose of the activity whilst the subject, the human doer in the single or collective incorporates motives of the doer. The variation in how the object is understood or treated is subject to the meaning making for individuals or the group. As such the same object can mean different things to different individuals, for example Hasan and Kazlauskas, (2013) give the example of the building of a house as an object whereby the builder and the house owner construct different meanings of the same object. The house is to the builder another building and source of income generation. The motivation to build it may be linked to the builder’s reputation and the capacity to make more money in the future. Whereas for the new homeowner, the object maybe linked to ideals of building a new life. The same logic follows in the context of the hospital, where the same physical object, for example patient record, can take on different meanings based on who is using it, for example the accounts department, the lab and doctor. It would mean different things to all three and as such they would engage with it differently. The subject and object are mediated by tools and, in the context of this study, tool mediation is of interest because of the role of tools in medical practice and how those tools in turn shape practices around antimicrobial surveillance and stewardship in antibiotic practice. Within the hospital, tools are resources available to practitioners. The quality and availability of those tools impact the efficacy with which they can conduct day to day tasks, this impacts quality of patient care and antibiotic practice. Additionally, tools impact how practitioners learn to do their jobs for example, deviating from standard protocol can stem from dysfunctional tools. Therefore, the capacity to map tools, understand their functionality and role in mediating the subject/object relationship can provide insight into how health professionals learn to tackle AMR in Kenya.
4.3.1 Second generation CHAT

Building on Vygotsky’s (1978) work, Leont’ev (1978) put forward the notion of activity as a multi-level, collaborative construct that underpins the wider understanding of AT today. As depicted in Figure 4.2, the activity sits at the top of a multi-level hierarchy, driven by motive and underpinning actions, goals, tasks and operations. Importantly, Leont’ev’s, (1981 English translation) construction of and distinction between activity, action, and operation makes apparent their dynamic nature. An understanding of that dynamism is important in elucidating on how practice in the workplace changes and evolves. Leont’ev (1981) expounds on this using the example of learning to drive a manual car, beginning with the first lesson in gear changing whilst a car is stationary. The learner’s actions are goal orientated toward moving the clutch and gear. Where moving the clutch and gear are conscious, they are dependent on unconscious operations in this case the learner need not consciously consider the mechanics of moving their hand and foot, in for example thinking ‘how do I place my hand on the gear stick?’ According to Leont’ev, (1981) once the learner masters gear changing in the stationary, a new activity begins, that is gear changing whilst in motion. The object of that activity becomes to safely drive the car, thus gear changing would now contextually be an action, executed consciously by the novice driver, though progressively this becomes an operation because with experience it can be done with less thought. Driving a car is no longer an activity in of itself but rather becomes an action that is part of activity for example going to work. This then remains the case until there is a contextual shift, as is often the case of the occasion when something goes wrong. In the
context of this study, borrowing thinking from Leont’ev, (1981) English translation) is useful, in particular in reference to the deconstruction of the development of expertise in the health setting workplace. This helps think about how the activities of trainees become actions of novice practitioners, evolving over time to shift into operations that are executed without too much thought as expert practitioners. However, there are limitations in applying Leont’ev’s theoretical work to this context. Where there is a focus on the object and conscious actions there is little to offer for explaining the learning or how learning in one circumstance is transferred. Leont’ev’s (1981) work offers insight into automation that is useful for deconstructing antibiotic practice into smaller units, in order to understand where and how change can be brought about through learning (The British Society for Antimicrobial Chemotherapy, 2018).

The same notions of change and dynamism in Leont’ev’s (1981) model are present in later generations of AT and are useful in understanding the underpinning concepts of AT. These notions facilitate analysis of the workplace and the mapping of where change has taken place and the role of tools, (physical and psychological) as mediators in activity associated with the change. Hasan and Kazlauskas, (2013) put forward the idea of tool mediation as two-way relationship, where the tools mediate an activity and vice versa. The construction of mediation as a two-way concept gives rise to the role of the social context and, in turn, of historical knowledge. The conceptualisation of the tool in this way has implications in two ways. Firstly, the tool’s capabilities and availability in the context of this study shape practice. Secondly, the tool derives its meaning from the manner in which it is used, this may differ from its original use. Progressively through tool/subject interactions it evolves into something that has social and historical knowledge embedded within it. That embedded knowledge is based on the ways it has been used. For example, taking on a first line broad-spectrum antibiotic tablet - commonly prescribed to treat many bacteria – and conceptualising it as a tool. Let’s assume the tablet was at a given point in time introduced to County X hospital and patients. It would have shaped practice by becoming a ‘go to’ prescription drug for practitioners to issue, as a broad-spectrum treatment for infection. If in the first few years it was effective it would evolve into something that embodied social and historical knowledge, i.e. a curative for certain bacteria. If the population was to then grow resistant, the embodied social and historical knowledge within the tool would
incorporate this new knowledge i.e. this is not always curative and may not work. If a large portion of the population grew resistant to the point where it was proving ineffective in more cases than effective, then again this would shape social and historical knowledge embodied in the tool and cause a shift in practice. This maybe to for example abandon the drug and prescribe 2nd line antibiotics as standard practice.

4.4 Cultural Historical Activity Theory

Engestrom (1987) expanded Vygotsky’s conceptualisation of the tool-mediated subject-object relationship by building in the social and cultural elements of Leont’ev’s (1978) human activity as mediators to produce an activity triangle model (see Figure 4.3). Though I have explained how I found first and second generation AT useful, this study predominantly uses this version of CHAT. This allowed the leveraging of the model’s embedded affordances in mapping the hospital as a system and situating it in its broader socio-historical context, whilst maintaining a degree of granularity to analysing the tool-mediated, subject-object relationship.

Figure 4.3: Activity Triangle Model (Engestrom, 1987)

Figure 4.3 depicts the six elements that comprise, Engestrom’s (1987) conceptualisation of an activity system. Namely, the subject, object and tools underpinned by division of labour, community, and rules. In this model, Engestrom (1987), places emphasis on the object or
the motive as distinctive from the outcomes. These can be undesirable or unanticipated. It is here that Engestrom’s (1987) conceptualisation earns its place in this study. It facilitates a holistic interpretation of the complexities of situations that arise in the real world, modern workplace such as health settings. In distinguishing between the object and outcomes, it provides a useful framework and language for sense making of what has been discovered in this context about the health setting through observations, surveys and interviews. In the next section I expound on activity systems, conceptualised through the lens and language of CHAT and the applicability to this study. I then successively turn to the methodological implications of using activity theory in the context of this study.

4.5 Expounding on CHAT in context

CHAT conceptualises activity systems as diverse, multi-voiced formations characterised by heterogeneity in perspective, interests, and traditions (Warmington et al. 2005). The division of labour with particular reference to the health setting not only creates divergent histories, but in the context of this study it also stratifies participants into various positions that are distinct and hierarchical based on role and years of experience. This, in turn, introduces a multi-level facet to the system (Engestrom, 1999). Activity systems are therefore multi-layered and endowed with multifarious histories that are engraved in the system’s artefacts, rules and norms. The heterogeneity in perspective is heightened in networks of interacting systems. Engestrom (2018) asserts that this is synchronous to both trouble and innovation. I limit my explorations here to one system and discuss tensions, disturbances and contradictions that can be the source of trouble and innovation in subsequent paragraphs.

An activity system is an ever-evolving, “virtual disturbance-and-innovation-producing machine” (Engestrom, 2005; p95). Innovation, change and progress are resultant of contradictions. These are structural tensions that amass over a period of time, initially manifesting as disturbances (Engestrom, 2018) that the system is invariably working through. Contradictions can arise from the adoption of new technologies. The interaction between established practices and new technology may generate new tensions and contradictions with old elements. These can lead to aggravated secondary contradictions (Engestrom, 2018, p.16). Within medicine new technologies are routinely introduced. As
such it is an ever-evolving field where the system continuously adapts to novelty and works through disturbances. Synchronously disturbances and contradictions bring about innovation, changing and shaping the activity. They are therefore important principles of development that harbour “invisible breakthroughs” (Ilyenkov, 1977; p.330 as cited in Engestrom, 2018). As contradictions arise, some individuals may challenge and diverge from accepted norms. This may widen to a ‘collective questioning’ and envisioning of change that leads to an effortful attempt to bring about change. In some cases, the group can engage in expansive learning, that is to collectively ‘chart’ or recognise the problem and engage in a solution producing cycle, as shown in Figure 4.4.

![Expansive learning cycle](image)

*Figure 4.4: Expansive learning cycle. (Engestrom, 2014, p. 63)*

In line with the case for a sociocultural approach, based on historical context and socioeconomic formations presented in chapter 2, Engestrom (2014, p13) asserts that “the theory of expansive learning implies a radical localism”. Societal relations are based on socioeconomic formations of a given society and these are embedded and present in every local activity of the society. That is to say, whether activities take place in high office (i.e. AMR policy making at national level), on the medical frontline (i.e. doctors prescribing medicines) or in illegal spaces (i.e. open market sales of antibiotics) all of these levels demonstrate the multi-layered nature of society and the interconnectedness of activity. Activities on each level have a bearing on the activity system at the hospital level. Whilst legislative power resides in high office, the conceptualisation of a single centre of power in interconnected cases such as this seldom facilitates a broad analysis of power. As conceptualisation of a single centre of power forgoes analysis of how power moves through the different levels or how its level of influence on decision making at micro level differs based on circumstance. In the context of this study, where legal power may reside in high office, that power is undermined by the socioeconomic conditions that then determine how
people make decisions to for example buy or sell at an open market (GovKenya, 2017; Engestrom, 2014). In this sense there are advantages to analysing society as multi-layered network of interconnected activity systems.

According to Engestrom, (2014; 11) “the theory of expansive learning is based on the dialectics of ascending from the abstract to the concrete.” This is in keeping with African ways of knowing, in which knowledge is passed on through proverbs and idioms that invite the listener to move from the abstract to the concrete. For example, as outlined in section 3.2.4, in asking how a proverb about two animals interacting applies to one’s life. There is therefore room to consider how learning by expanding can be leveraged in the African context. For example, in chapter 3, section 3.2.1 community palavers are discussed as interactions based on an African way of life where members of the community gather to collectively reflect and chart a new way forward. Within expansive learning, practitioners are invited to collectively analyse disturbances of their activity using for example, audio visual recordings of disturbances together with the researchers’ use of the same conceptual tools of analysis.

Whilst there exists the recognition that an activity system is a ‘disturbance producing machine’ where disturbances are addressed invariably, my doctoral studies place attention in the mechanics of addressing the disturbances and the impact of change in one aspect of antibiotic practice on other aspects of practice. I am therefore interested in defining, for example, whether the lessons learnt when engaging in the expansive learning cycle around a specific problem will go on to contribute to wider practice positively or negatively. In seeking to define the direction of impact as negative or positive, I here encounter a limitation with CHAT as a theoretical framework. Where in the context of this study I do not use the change lab, that is recommended in engaging expansive learning using CHAT, I borrow useful thinking on the dialogic and collaborative aspects of the process (Engestrom, 2018; Roth and Lee, 2007; Virkkunen, J. et al.2014). I aimed to engage practitioners in the necessary critique of antibiotic use and practice and revision of practice through surveys, interviews, and a focus group. The use of this approach was particularly important given that the fieldwork of the study was conducted during the COVID19 pandemic. Health practitioners were under increased time constraints, thus the prospect of engaging in a temporarily binding process for 7 -10 sessions as are usually required for executing change
labs was not feasible. The study therefore borrowed useful thinking and triangulation with Design Based Research (DBR) (see section 4.7) and methods that are archetypical of DBR, whilst also responsive to the CHAT framework. This was with the view to bridge the theory-praxis gap identified in the review of literature related to this study’s topic and focus.

Through expansive learning, CHAT facilitates re-mediation of work activities by making visible the contradictions of an activity and challenging subjects in the activity system to use conceptual tools to analyse, develop and redesign their practice. In this way CHAT facilitates learning and begins to elucidate on how learning takes place within the collective whilst accommodating the insertion of varying dynamics such as history, social and cultural constructs that have evolved over time alongside that which is still evolving (Foot, 2013). However, CHAT falls short of delving into the cognition of problem solving in individuals and the collective. I therefore deviate here to transfer of learning in order to effectively understand the cognitive mechanisms and problem solving that enables the working through disturbances.

4.6 Transfer of learning

Effective problem solving is interlinked with the transfer of learning, which “occurs when learning in one context enhances (positive transfer) or undermines (negative transfer) a related performance in another context” (Perkins & Salmon, 1992; p.1). This includes transfer to closely linked contexts (near transfer) or different contexts (far transfer). Studies of transfer of learning (Perkins & Salmon, 1992) have elucidated on how the process of refining competencies gained in one context and applying them in another occurs. For example, if in an expansive learning cycle or in a community palaver one learns something, how does that transfer to individual clinical practice? Peters et al., (2017) explore transfer of learning within clinical practice, bringing attention to the dynamic and complex mechanics of transfer of learning within medical workplaces given the myriad of variables – a variable is an element or factor that is liable to change. Medical practice involves an exchange of goods and services between the patient and doctor. The patient who needs care (the demand side of the exchange), the doctor and the team around the doctor (the supply side of the exchange). There are therefore variables on both sides of that exchange. On the patient side there will be variables associated with perception of for example pain, discomfort and the
experience of being ill (Engestrom, 2018) and on the medical practitioners side there will be variables such as experience of diagnosing the given disease - this is linked with transfer of learning in as far as transferring what one learnt in medical school and knowledge gained on the job and applying it to medical practice (Peters et al., 2017) additionally variables will present in the form of instruments for examination and therapy (Engestrom, 2018) this would include the team around the doctor as they serve as an instrument and resource for examination in their various roles. In analysing learning and particularly, deviation from protocol I borrow useful thinking from the concept of learning transfer.

For example, if a patient (patient Z) goes into hospital X with a suspected case of infection, the process of diagnosing whether or not they have an infection would involve several healthcare actors including the doctor, nurse, phlebotomist/or another that assumes the role, lab technicians, and a courier that transports the sample this can be one of the professionals already named above. Each one’s due diligence is imperative to getting the correct diagnosis. The doctor’s prognosis that patient Z may have an infection kickstarts a process whereby a request is made for human tissue sample to be tested for infection, this involves drawing blood from patient Z. The sample would then be transferred to the lab for processing and testing, this would take some time and then once tests are complete information would be fed back to the doctor who initiated the sequence.

In this example, I use the team around the doctor as the variable. It is a loaded variable in that it is made up of several practitioners working collaboratively towards ‘an object’ - a common goal that is to diagnose the patient. Each practitioner is a variable within the ‘instrument’. I will break that down only more step further in saying their ability to effectively do their jobs which speaks to the quality of care provided can also be classed as a variable. Where I could now go into menial and the effortful tasks that make up each job role and discuss those as variables. I would be presented with a myriad of variables that would make meaningful analysis near impossible. I therefore assume due diligence based on the hospital having conducted its own due diligence and appointed persons qualified, certified or skilled to conduct tasks demanded by the job. Thus, all things constant, the doctor should get an accurate result however the lab at Hospital X and indeed elsewhere in the LMIC, resource-constrained setting inaccuracy is a reported challenge. Meyer et al (2017, p2) point to “the need for deeper understanding of clinical and operational factors
affecting real-world performance” (Meyer et al., 2017; p2). To elucidate on the ‘variables’ things that are liable to change on the ground, that are affect the accuracy of certain diagnostic tools. The feedback of inaccuracy, lack of reliability has implications for practice and transfer of the experiential learning that occurs in the feedback circuit. Perkins and Salomon (1992), posit that transfer occurs through one of two mechanisms. Reflexive or low road transfer sets well practiced routines in motion when an individual is exposed to stimuli similar to the learning context whilst high road transfer requires ‘effortful abstraction’ (Perkins and Salomon, 1992; p2) and deliberate search for links between the point at which learning took place and the situation an individual is presented with. Repeated experiences with inaccuracy, may cause a deviation from standard protocol in the doctor’s individual practice, choosing to bypass the lab tests as recommended by protocol and instead diagnose empirically. That is to diagnose based on medical knowledge and rationale. Whilst this a valid form of diagnosing, it circumstantially can be poor practice and should not be standard response to stimulus in a low road transfer. Thus, transfer of learning adds a dimension to analysing an activity system. Where CHAT, allows me to look at the use of suboptimal tools that cause contradictions in the system and lead to a new way of doing things both in terms of negative or positive transfer. Understanding where learning is taking place and whether it is positive or negative is powerful for shedding light on the opportunities for learning and developing. Therefore, to only use the conceptual tools from CHAT such as expansive learning is limiting, transfer of learning offers the opportunity to define whether the lessons learnt in each problem solved will go on to contribute to wider practice positively or negatively when a practitioner encounters stimulus.

4.7 Design Based Research and CHAT

Design based research (DBR) focuses on shrinking the gap between theory and practice. Barab and Squire, (2004) assert that it is less of an approach and more of a series of approaches that are employed to produce new theories, artifacts and practices that are likely to have an impact on teaching and learning in naturalistic settings. The focus on contexts stems from the idea that humans are interactive beings, constantly engaged in multiple cycles of interpreting and reinterpreting daily experiences; routine tasks, challenges including those within the learning environment. The idea being that even within a
structured learning environment there is a multiplicity of ongoing, interacting cycles that impact each other and as a result move us away from laws of linear causality. As such, proponents of DBR question the ecological validity of learning research based on classical and well-controlled experiments (Engestrom, 2011) DBR emerged as a way to facilitate the development of new strategies with the capacity to bring contextually relevant solutions to educational problems. It is characterised by its emergent design of educational materials and distinguished by its theoretical yield. It interweaves the learning environment and the testing and developing of theory (Anderson and Shattuck, 2012). It typically has explanatory and advisory objectives and in the evaluation phases it seeks to generate design principles based on theoretical inputs and empirical findings to produce a new theoretical understanding (McKenney & Reeves, 2012). For example, this study seeks not only to understand how healthcare professionals learn but also to discover factors that may improve or hinder AMR-related learning and more specifically technology mediated learning. Thus, in chapter 9 (see section 9.4) for instance, barriers and facilitators are offered to guide thinking for others who may be interested in conducting a study in similar settings (Barab and Aquire, 2005). This is in keeping with DBR’s development of domain-specific learning theory that has practical implications by combining the often-separated research approaches of understanding and changing a situation through the use of educational ‘things’, in this context the use of an mhealth platform is employed to understand how health professionals in Kenya learn to tackle AMR.

The idea of a symbiotic relationship between people and things in work practice aligns with my interest in a sociomaterial understanding of practice and practice-based learning. Sociocultural and sociomaterial theories, such as activity theory trace disparate elements both human and non-human creating a web of activity in order to understand the collective power to generate knowledge or change practice (Fenwick, 2012). This aligns with DBR’s focus “on understanding the messiness of real-world practice, with context being a core part of the story and not an extraneous variable to be trivialized... [involving] multiple dependent variables, and capturing social interaction (Barab and Squire, 2004, p3).

I have identified that activity theory facilitates the understanding of “how things themselves participate to produce and sustain practices (Fenwick, 2012; p7). I recognise that activity theory has the potential to straddle sociocultural and sociomaterial elements, theoretically
sitting between both. This is consistent with the conceptualisation of change particular to DBR where change is viewed as series of intricate micro-level negotiations from which new dynamics emerge to reconfigure a system. This for example mirrors practitioners’ encounters with inaccurate results from the lab, that caused some mistrust in lab tests. In certain cases, the lack of trust caused deviation from the practice of requesting lab tests, over time this may amount a destabilisation in the system. Giving rise to the need to understand the stabilisation and dynamism in moving elements in the system. In doing so establish the evolutionary elements of a practice and how it fixates itself and in time becomes a part of practice. An important aspect of activity theory which will be useful to addressing my research aims, is that it facilitates the understanding of disequilibrium and the mechanics of how that disequilibrium processes itself. It has been reported how this is initially as an emerging practice, evolving into a sustained practice until it establishes itself as the practice in a process where ambivalences create room for change and “openings for unknown possibilities” (Fenwick, 2012, p.7). Whilst DBR researchers have varying views on what DBR looks like in practice and the question of exact number of required cycles is met with diverse responses in literature, they are mostly nondivergent on the elements of the phases within each cycle. (McKenney & Reeves, 2012; Plomp, 2013, p. 19; Van den Akker, 2007). Amongst the popular and widely cited conceptualisations of the phases is Reeves’, (2006;p59) illustration of the phases as per figure 4.5.

Figure 4.5 Phases of research design cycles (Reeves, 2006;p59)

Whilst Reeve’s model is widely cited, its drawbacks are in its linearity and failure to capture the cyclical nature of the iterations (Pool & Laubscher, 2016), other models have delved deeper into the subdivisions of the process. This offers useful thinking for identifying
essential elements within the DBR phases through deepening our understanding of subdivisions and essential elements thereby facilitating conceptual space for DBR to be adopted in short term studies, such as this study without compromising the integrity of the essential elements. Below is schematic representation of cycles within a shorter project research (McKenney & Reeves, 2012, p. 78).

![Figure 4.6 Micro-, meso- and macro-cycles in educational design-based research (McKenney & Reeves, 2012, p. 78).](image)

Given the shorter time period within which this study was conducted. I adopted an approach similar to McKenney & Reeves (2012) who recognise the three phases in DBR, namely, analysis and exploration or design and construction or evaluation and reflection then add further granularity by conceptualising three micro-cycles as constituting a meso cycle and the entire process of micro and meso cycles constituting a macro-cycle. This is more comprehensively discussed in the methodological chapter (see chapter 6). In the next chapter I review literature relevant to the study.

4.8 Conclusion

This chapter presented the conceptual framework underpinning the study. It provided a historical background of the evolution of Activity Theory, beginning with earlier generations to expound on how they informed CHAT. CHAT was then explored in the context of this
study, to expound on its affordances, limitations and how useful thinking was borrowed from transfer of learning to expand in how learning can be transferred. The chapter then presents DBR and its triangulation with CHAT. The use of CHAT and DBR, though developed within the western context are highlighted as working with decolonial thought rather than in tension. They are presented as plausible frameworks that have the capacity to foster boundary crossing and other ways of thinking to produce new theories, artifacts and practices that are likely to have an impact on developing teaching and learning within the African context (Barab and Squire, 2004). This exemplifies the opportunities that exist for decolonial scholarship to leverage existent tools and reshape them to meet research needs.
5.1 Introduction

This chapter aims to provide a review of literature specific to the health workforce and the challenges it faces in workplace learning. It reviews literature on organisational change, of which the sector has undergone a period of deep change since I began this research in April 2019, most notably the advent of the COVID-19 pandemic. It also covers digital tools for professional learning applicable to the sub-Saharan African health context, placing emphasis on providing an overview of research on the use of digital tools for workplace learning in resource constraint settings in Africa. This highlights some of the gaps that needed attention at the beginning of this study and in part formed the basis of the research questions of this thesis. As this research developed, some of these gaps have begun to be addressed and new gaps have come to light.

The COVID-19 pandemic brought about the broad application of containment measures that centred on social distancing to prevent and contain COVID-19. This in turn placed greater demands on technology, its uses and capacity to replace in-person interactions (Baldwin and Weder di Maurao, 2020). Many institutions, private sector companies, governments and scholars rose to meet some of those challenges and gaps, the longevity of those solutions is yet to be seen as the globe transitions into ways of working that reflect both a pre-pandemic mode and embrace the winning outputs that emerged out of the lockdown period (Williamson et al., 2021). Traditionally, the literature review serves to show awareness of the broader field and position the researcher within the field. Whilst I found it useful to engage in a review of literature within this specific chapter, I also incorporated readings in other chapters. For example, despite reviewing broad literature on research ethics, I have not included this in this chapter (but this can be found particularly in chapter 3). Where possible, I aimed to fuse literature within other chapters to demonstrate engagement and relevance in a more detailed frame.
For the purposes of this review, I deconstruct my thesis question into components and review literature on each component accordingly. With the goal of to better understand literature relevant to the question of health professional learn to tackle AMR.

5.2 Rethinking professional learning after COVID19

The COVID19 pandemic began to sweep across the globe at the beginning of 2020. As it made its way across borders, devastating populations, it pushed some healthcare systems to their limit, overwhelmed others and highlighted existent fault lines and shortcomings in human capacity resources within the health sector globally (Dandara et al., 2020). The pandemic’s absorption of resources and impact stretched beyond health systems. Countermeasures to prevent, treat and contain COVID19 had externalities that readily spilled into the social and economic spheres. Social distancing measures for prevention and containment included population lockdowns, mass closures of educational institutions and diversion from in-person patient consultations to telemedicine, in-person professional learning to online seminars (Baldwin and Weder di Maurao, 2020; WHO, 2020c). It instigated a deep social transition that over the last 3+ years has brought about shifts in the relationships between society, technology, and medical practice. Subsequently, increasing the pace of change in digitally mediated education and work practices, transforming education on every level (Williamson et al., 2021). No discipline nor sector has over the last three years faced greater challenges than the health sector and its workforce. Individuals in health organisations faced the collective challenge of adopting to new ways of working and learning about the COVID19 virus even as it was evolving, with many health systems struggling whilst others such as Thailand demonstratively triumphed in crashing the COVID19 curve by tailoring their response to their sociocultural context (WHO, 2020c). Leveraging existent sociocultural structure to adopt a multi-stakeholder approach that targeted the entire social continuum to devise a telemedicine intervention whose success was dependent on the multiple stakeholders including a strong network of 1.1 million village volunteers (Rajatanavin et al., 2021). It created a strong case for steeping scholarship on medical interventions and the learning that comes with new interventions in the broader context of the sociocultural contexts.
Within both edtech and mhealth, the pandemic provided the largest test bed in history for experimentation with large scale use of digital tools for in health and education, including in places that had been left out of the edtech conversation (Adans-Dester et al., 2020; Williamson et al., 2021). In the same instance it highlighted challenges in equity and digital poverty. Innovative scholars and educators rose to the challenge of low connectivity, digital tool scarcity and engaged in creative repurposing of tools accessible to the targeted populations. For example, educational planners leveraged the ubiquity of the mobile phone, adopting the use of WhatsApp and SMS for learning on a large scale in low-and-middle income countries (LMIC) contexts (Boujikian & Carter, 2021). However, these solutions were not synonymous with pedagogical adeptness and as scholars begin to engage in analysis, we are able to tentatively reflect on the impact and efficacy of various tools in different social, economic, cultural, and geopolitical contexts (Jordan, 2022). There remains much to grapple with, to learn, to analyse from the experience of using digital technology during the pandemic, and as analysis continues to unfold different settings will be able to progressively build roadmaps of what certain tools may mean for the future of learning.

Specific to professional learning for healthcare workers, the pandemic catalysed conversations on digital tools and the impact of mhealth tools. For scholars such as Karamangi and colleagues (2022), it brought to the forefront the need for nuanced analysis of digital tools and their capacity to contribute to long term digital transformation in meaningful ways. In their scoping review titled “e-health or e-chaos” they explore the array of digital health interventions (DHI) in Sub-Saharan Africa, noting that less than a quarter of the identified tools in the review were available in academic literature and grey literature, many of the tools were missing in the global digital health repository (Karamangi et al., 2022, p. 1). Whilst the review sought to map DHIs across the breadth of the recommended WHO domains for DHI, namely, service delivery, health workforce, health information systems, access to essential medicines, vaccines, and technology, financing, and leadership/governance. Given the focus of this thesis, review of DHIs for health workforce learning was especially relevant. Karamangi and colleagues (2022), reported a paucity in evidence based, theoretically sound underpinnings, of the many DHIs that have been in circulation in Africa over the last decade, as a result many have had short life cycles. Failing to meet the demands on the ground and faltering in terms of scalability and sustainability.
Out of the 738 digital interventions mapped, 18% (n=135) were learning and training systems. Of those identified, only 23.7% were identified through articles and electronic databases or grey literature. This is in keeping with my findings at the beginning of this study, where I found a dearth in literature on digital health tools in the Sub-Saharan African context. This reflects a challenge in dissemination and knowledge sharing across the continent. Importantly there were no publications on failed pilots or implementations reflecting lessons learnt. Of the available DHIs, the majority concentrated on data mining, Karamagi et al., (2022) note this to be a worrying trend and advocate for evidence based DHIs with a focus on improving service delivery or a clear demonstration on how data mining improves service delivery and patient outcomes. This extends to the need for evidence based DHIs for learning in SSA.

This study therefore provides much needed evidence, that can contribute to addressing challenges in designing DHIs in resource limited settings as well as demonstrating an iterative and ethical approach that may contribute to building DHIs that can be integrated. The review highlights gaps in the use of digital health to strengthen health systems and for governments and private sector actors to engage in re-strategizing at ideation and development stages as well as to the scale-up of digital health in the region. The WHO’s health system strengthening approach is aimed at improving health outcomes and equity in health. Despite the framework’s guidance on greater alignment of interventions, to increase the propensity of effective integration. Kamarangi et al., (2022) highlight the need for the SSA digital health landscape to realign with the framework and investment areas. I would argue that whilst this is possible at policy level, for private actors and small organisations clarity in mapping what works at ideation is key. This research therefore contributes to understanding at a micro, project by project level, what alignment may look like.

5.3 The health workforce standards in Sub-Saharan Africa

The essential role of the health workforce in the effective delivery of health services has garnered traction over the last 15 years. The 2004 Joint Learning Initiative report on the role of the health workforce in overcoming crisis gave rise to the role of health workers as critical precondition of an effective health system and a critical driver of health system
performance. The report highlighted a burgeoning awareness of human resources as an important and yet heavily overlooked systematic barrier to progress (Joint Learning Initiative, 2004). This would be echoed in The World Health Report two years later, leading to the establishment of The Global Health Workforce Alliance (GHWA) in 2006 (WHO, 2006). GHWA, has since then made strides in assessing health workforce across the globe, offering, insight into inefficiencies in health systems with the view to enable the mapping of roadmaps towards greater efficiency and improved outcomes for patients. It has progressively empowered researchers and governments with tools to assess and develop human resource capacity through the minimum standards for health and social protection framework. The framework states that healthcare should be available, accessible, acceptable and of an acceptable quality. It maps out guidelines for developing those four components of health systems (WHO, 2014). Of particular relevance to this study is the quality of the health workforce, which specifically pertains to education and continuous professional learning. Whilst the other three standards are not in focus within this study they are factored in because they still have an impact on, and contribute to quality outcomes, for example, availability measures of physician density. Both high or low density have an impact on quality. The GHWA breaks down the four standards (availability, accessibility, acceptability, and quality) into secondary categories, enabling a more detailed analysis of health systems with the goal to stir respective countries in the right progressive direction. For example, Kenya’s country assessment offered insight into the country’s health service and the shortcomings of its human resources division pertaining to workforce challenges (WHO, 2014). The dataset provides a snapshot of how the country fairs across all four components reflecting low density, challenges in access and availability painted against a background of a growing population with high communicable disease related morbidity and mortality rates. For example, the report highlights malaria, HIV and sepsis were the biggest contributors, noting it to be a narrative that runs across the SSA region. The challenge of high HIV/TB burden and the threat of infectious disease coinciding with resistance puts Kenya in a precarious condition that in the least warrants an antimicrobial-prudent workforce but more importantly an available workforce, this is a challenge for Kenya (Feldacker et al., 2017; WHO, 2019).
Kenya’s health system faces the challenge of not only how many health practitioners it is able to produce and deploy across its geography, but how it sustains that provision and ensures competence at every stage of practitioners’ careers through professional learning. For Kenya, the challenge is acute, its health worker density is well below indicative thresholds, requiring a 315% increase to meet the recommended minimum of 22.8/10 000 health workers to population threshold and a 981% increase in trained workforce to meet the ideally recommended 59.4/10000 health worker to population threshold (WHO, 2014; Okoroafor et al., 2022). Part of the challenge is ensuring that the workforce in service now and those that will progressively join as new trainees will be able to demonstrate competency at all times, proving to be continuously fit for practice and purpose (WHO, 2014). The need for good and prudent practice that is matched by effective workplace learning programs is more pronounced in the context of an emerging threat of AMR, given that the growing AMR burden is resultant of antimicrobial misuse/overuse. Where some of the deficiencies in effective use lie with patient behaviours, practitioner behaviours are also large contributors to the AMR burden. The WHO, World Bank and OECD (2018) approaches to quality assurance in health systems mark education, people-centredness, reporting and feedback as key fundamentals to achieving quality. These are also fundamentals of effective programs of workplace learning.

Effective continuous professional development (CPD) has been touted by these organisations as a key contributor to quality assurance because it has been linked to improved patient outcomes (Masai and Boibanda, 2022; Giri et al., 2012; Mbisi et al. 2014). As a result, the WHO (2018) recommends upskilling health workers and, through its competency frameworks, clearly sets out the skills and knowledge that practitioners should possess to adequately execute their roles. Quality care provision therefore requires health workers to become lifelong learners, who are engaged in continuous learning, who update their professional knowledge, skills and the values that inform their attitudes to work and underpin their practice (Giri et al., 2012). CPD builds on initial education and training to ensure continuing competence, it extends knowledge and skills in line with new responsibilities, changing roles and emergent best practice the latter should, according to Gitunga and Muriuku (2014), be aligned with local needs. Gitunga and Muriuku (2014) assert that educational planning for the professional development of health workers should
be a balance between, prioritising local and national context alongside personal learning needs, this in keeping with the room left for adaptation to local needs in the WHO competency framework (WHO, 2018). In the Kenyan context, Gitunga and Muriuku (2014) advocate for greater flexibility in modalities of learning delivery, noting that the challenges that most SSA countries face in severe shortages in human resources should be factored in designing CPD. To that end, they advocate for the development of innovative ways to deliver knowledge and upskill health workers in their places of work, innovative modalities of delivery are echoed elsewhere in literature (WHO, 2020c; Boibanda and Masai, 2022). These include modes that for example, minimise demands to travel to other sites. Evidence shows that constraints such as staff shortages and increased demands on service delivery reduce available time for CPD, given that the SSA region carries a comparatively larger burden of infectious disease, and a lower health worker density, it stands to benefit from innovative modes of delivery (Baloyi and Jarvis, 2020). Within the Kenyan health sector, CPD is either delivered formally through learning opportunities that are integrated into national and local protocols or informally, the latter is discussed in subsequent sections after a brief discussion of formal CPD delivery (Masai and Boiband, 2022).

5.3.1 Continuous Professional Development in the SSA region

The Ministry of Health in Kenya describes CPD as “the systematic acquisition, maintenance of knowledge and skills and development of personal and technical competencies and qualities necessary for execution of professional functions”. (GovKenya, 2014, p.10). At local level it is integrated into health facility protocol to include on-the-job training, this can be understood as formal CPD (Masai and Boiband, 2022). Informal learning is available to health workers, and accessible through less structured mechanisms. For example, informal learning through spontaneous interactions with colleagues, or through professional reading and reflections. Whilst Giri and colleagues, (2012) assert that these too are important for a practitioner’s development. Accessing both formal and informal learning opportunities can be highly influenced by the practitioner’s geographical locality and working conditions. For example, practitioners based in remote areas with no other professional colleagues nearby will not have the same opportunities for spontaneous professional dialogue as their counterparts in an urban working environment with a higher health professional density (Cesario et al., 2012). To factor these challenges in would be to think of them as dynamic elements in a system and consider development of an intervention with
the capacity to address the need for CPD, to facilitate meeting necessary needs without negatively impacting other areas of practice (Long et al., 2018; Labrique et al., 2013). This required a comprehensive approach, adopting systems thinking, and more specifically, in the context of this study, the use of activity theory to map the system (Peters, 2012; Engestrom, 2014; Labrique et al., 2013).

Peters (2012) argues that systems thinking provides a powerful approach to communicating and investigating complex issues. It facilitates simultaneous consideration of changes in multiple elements, to for example investigate whether by solving the issue of learning and knowledge a tension elsewhere would be inadvertently created in another part of the system. Within a given activity system there are multiple continuously moving changing dynamics and elements, the healthcare sector is a traditionally fast-paced working environment. In the Kenyan context a fast pace is coupled with previously discussed challenges. Therefore, systems thinking in the Kenyan context would, for example, require factoring in the lower ratios, the distributional disparity, epidemiological landscape including seasonal changes that have an impact on specific disease in Kenya. This could relate to, for example, malaria transmission during the rainy season, peaking in June and falling to minimal transmission in November (Otambo et al., 2022). Presenting both context specific challenges and opportunities to professional learning that would require a tailored approach from the learning and development (L&D) teams or educational planners. Where there are clear challenges with a particular disease at specific times, which is more pronounced in certain areas, for example areas with bodies of water, such as the Western region that borders Lake Victoria in Kenya where this study is based (Okoroafor et al., 2022; Otambo et al., 2022). The opportunity for better planning lies in a data driven approach. For example, factoring in the relatively higher malaria transmission in Western Kenya against the comparatively lower ratios of workers in the rural areas to design learning based on the epidemiology. As a means of supporting decision making associated with scheduling and pushing out learning materials at opportune times. For instance, increasingly highlighting learning on AMR with specific reference to Malaria prior to and during the peak of rainy season, especially in the regions most affected. This would require accurate data on competence across the workforce and for planners to factor in increased caseloads and planning for reduced learning over certain periods where time constraints are greater, perhaps offering shorter versions of modules.

In order to effectively address skills deficit, L&D teams need up to date information on the state of the human resource knowledge and skills gaps, particularly given that the needs of the sector are subject to continuous change (Clow, 2010). This makes timely and accurate
information key. Yet the health sector in general invests less than 5% of its income to information services, compared to other sectors such as banking that invests 13% (WHO, World Bank & OECD, 2018). That paucity is more pronounced within LMICs and the broader SSA region. This adds a layer of complexity to planning for professional learning on a macro scale, the lack of timely and accurate data on workforce composition, distribution and evolution reduces the ability to effectively plan and distribute learning materials. Clow (2010, p. 5) asserts that, L&D teams exist in part to “facilitate the transfer of repeatable information and skills from those who have learned it to those who need to learn it at scale”. Digital learning offers the opportunity to facilitate learning at scale, including through peer-to-peer learning on platforms that can facilitate communication (Labrique et al., 2013). Limited data are available on the healthcare professionals’ experiences with online professional learning or continuous professional development in the SSA region and this is also true for Kenya. (Feldacker et al., 2017; Masai and Boinband, 2022; Long et al., 2018). This is not unanticipated given the limitations to broader digital data and information systems infrastructure previously discussed. Long et al., (2018) in their systematic review of DHIs in LMIC note evidence of improved efficiency and effectiveness in pilots and small-scale projects. However, they highlight the growing urgency to move beyond small-scale demonstration projects. Advocating that the next frontier selects, adapts and implements DHIs at for health worker development and management at scale, this urgency has been heightened in the advent of COVID19 and is echoed by Karamangi and colleagues (2022) in their review of DHIs in SSA.

5.3.2 Leveraging digital CPD delivery for robust health systems

Prior to COVID19, the co-evolution of technology and work practices was already having an impact on the pace of change in the workplace. Over the last few decades changes in technological capacity, its ubiquity and accessibility had brought about shifts in organisational structures and cultures. These have contributed to shaping thinking on workplace learning and facilitating the emergence of an interdisciplinary understanding of professional learning to include exploring traditional learning theories alongside socio-cultural theories and instruction design for technology (Littlejohn and Margaryan, 2014). The proliferation of mobile technology has presented new opportunities for delivering professional learning that have progressively gained some traction within the health sector and more so since the advent of COVID19, as highlighting how mhealth has proved useful in the response to global health emergencies including in the fight against Ebola in Sierra Leone (Donavan and Bersin, 2014). However, research on mobile learning for health professionals has
concentrated on small projects in high income countries (HICs) (Pimmer *et al*., 2014). There is limited
data on the use of mobile health platforms for professional learning in resource contained settings
and remote areas within low-and-middle-income countries (LMICs). Of the available SSA specific
literature on mhealth platforms, literature focuses on the training of community health workers
(Winter *et al*., 2019). There is limited literature, both on the pedagogical make-up of the platforms
and the underpinning theoretical concepts that influence their usage (Mastes, 2016). Platforms
largely use a push out method whereby information is sent or broadcast without interactive or bi-
directional elements, presenting limitations on the understanding of the efficacy of mHealth
platforms for delivering professional learning (Winters *et al*., 2019). This highlights the need for
broadening the evidence base to understand how mhealth can work to improve patient outcomes
and health workers experiences and knowledge, in keeping with governmental goals to strengthen
health systems across the SSA region.

In 2008, as part of the Kampala Declaration, African governments with a focus on delivering “health
workers for all and all for health workers” (WHO, 2008, p.1) agreed to focus of providing access to a
skilled, motivated, and supported health workers for all within robust health systems. The GHWA,
has year on year expanded on how that may materialise however subsequent reports have been
marked by the same challenges in availability and supply of qualified health professionals proving
insufficient for the effective delivery of essential health services across SSA (WHO, 2014). DHIs
therefore present the opportunity to meet those challenges, and where scholars such as Long and
colleagues (2018) argue for the need for at scale DHIs to be launched, the challenge in adopting DHIs
at scale has in part been due to the paucity of evidence-based interventions and a poor culture
around knowledge sharing that includes failures and lessons learnt in piloting as explained by
Karamangi and colleagues (2022). Yet DHIs hold the capacity to meet the skills gap challenges, by
enabling study at any place and anytime and can support health workers in reaching high standards
of care subject to effective pedagogical underpinnings and contextual and cultural relevance. E-
learning offers the prospect of bringing expert knowledge to health workers in the field as a flexible
learning option that is and adaptable to local settings and scalable without needing to gather time-
constrained individuals in one place like traditional workshops or seminars that prior to the
pandemic were common place and have remained broadly so with the addition of online seminars
using platforms such as zoom since the advent of the COVID19 pandemic (Masai and Boibanda,
2022; Gitonga and Muriuki, 2014; Kyalo and Hopkins, 2013). The drawbacks cited in literature in
terms of the use of particular technologies have been access related, in reference to the internet,
network and electricity (Kemei and Etowa, 2021). Specific to the challenge of internet connectivity is
also the challenge of financing access to the internet, there are technologies and platforms that offer
learning away from the internet, that can be leveraged by health workers with limited access to connectivity. These have broadly been used in the context of community health workers (CHWs) with notable use in primary and community settings, delivering learning through short message service (SMS) and Interactive voice recordings (IVR) and other messaging platforms (Winters et al., 2019; Agarwal et al., 2015; Mahmood et al., 2020; Adendaal et al., 2020). Elsewhere, in the Kenyan context, Henry and colleagues (2013) piloted a mobile learning intervention using whatsapp for the supervision and professional development of CHWs. They used groups and found that the multi-way communication features enacted a virtual one-to-one, group, and peer-to-peer forms of support and supervision. Elsewhere the SSA region, Diedhou and colleagues, (2013) found that participants reported positive experiences with the use of an mhealth tool. However, they reported back challenges in network and reception. Positively, the majority of participants reported significant increase in subject specific knowledge, with data showing that knowledge remained significantly higher when tested again, 10 months post baseline without further reinforcement. Such results are promising and highlight the opportunities that are contained within mhealth and the capacity for mhealth to offer certain affordances, such as accessibility, flexibility, and affordability in line with the Kenyan MOH’s principles for guiding CPD (GovKenya, 2014).

5.4 AMR-related continuous professional development

The WHO (2018) found effective antibiotic practice to be widely lacking in LMICs, owing to a lack of understanding of antibiotic stewardship amongst the health workforce. As a consequence the WHO recommends the establishment of surveillance systems and upskilling the workforce. This can be achieved through antibiotic stewardship programs (AMS), that deepen the understanding of good antibiotic practice and data capturing processes that are important for surveillance (Dryden et al., 2011; Cox et al., 2017; Gitaka et al., 2020). There are a variety of AMS that are delivered through Massive Online Open Courses (MOOCs) or in person delivery and blended delivery modes, for example Future Learn, a MOOCs platform hosts a number of courses from various institutions (Future Learn, 2023). Proponents of MOOCs highlight the advantages of MOOCs, including the open invitation to anyone to who is able to access (Milligan and Littlejohn, 2016). MOOCs are postulated for a learning dynamic that offers collaborative opportunities and fosters discursive elements that can be leveraged in learning spaces such as forums, where students can gather and discuss content. Other discursive elements may be fostered by inviting students to comment on content. Despite this openness, where students pay nothing to
participate, the challenge in LMICs is in the accessibility (Kamilali, D and Sofianopoulou, 215,). The touted openness of MOOCs is undermined by costs associated to access in the SSA region, more specifically Kenya is rated to be amongst the most expensive East African countries for internet with a significant portion of the population classed as internet poor (Ngila. 2021; GSMA, 2021). An additional challenge, concerning MOOCs are the routinely lower rates of competition and retention that are well documented (Khalil et al., 2016; Pursel et al., 2016). Studies have examined different aspects of learning to understand these completion rates, including the significance of motivation in self-directed learning (Pursel et al., 2016), the role of gamification (Khalil et al., 2018) and the level and form of instructor communication, such as personalised emails (Kutz et al, 2022). These studies offer insights that may be useful specifically to MOOCs and in the broader context of adult learning. However, the underpinning issues of connectivity and cost of connectivity, coupled with lower competition rates make MOOCs contextually redundant, in as far as meeting the challenge of AMR at scale, especially when factoring in the challenges that practitioners face on the ground.

The COVID19 pandemic has impacted face to face delivery and, in doing so, it highlighted the need for in-service health professionals to be able to upskill swiftly and at scale as populations experience shifts in epidemiology. Technology has the potential to be harnessed in transformative ways for medical education in as far as it can accessed and available at scale. To this end, it was useful to leverage the most accessible technological tool in the SSA region including Kenya – the mobile phone. Both smart and basic given that the smartphone adoption, though on an upward trajectory is still at 46% (GSMA, 2021). Therefore, maximising equitability required the designing of an intervention that was accessible on both phones. As previously discussed in section 5.3.2, strides have been made in community health education through mhealth (Winters et al., 2019). In which there has been successes in reaching remote and hard to reach areas as well as in supporting learning for CHWs and in some cases supporting health professionals in community and primary health (Diedhou et al., 2015; Long et al., 2018). AMREF’s Leap application used to train and upskill CHWs is a good example of leveraging mHealth to transform health education (Geniets, 2021; AMREF, 2021). The successes that Leap has seen in the delivery of training to CHWs is indicative of the potential to harness the same technology in a transformative
way that can address critical knowledge gaps in the health workforce, including AMR-related knowledge gaps. However, studies and programs that use mHealth apps to deliver training and education have been largely limited to CHWs, many have adopted a push out method where information is disseminated by text and lacking in learner interactivity (Winters et al., 2019). It is therefore important to explore how mHealth platforms such as Leap can be leveraged for the health workforce to include doctors, nurses, lab professionals, pharmacists and how pedagogical underpinnings can be leveraged.

To contribute to addressing this gap, this study looks to evidence pedagogically sound use of mHealth amongst health professions by adopting the use of a pedagogically sound AMR-related learning course designed at The Open University UK as part of Fleming Fund’s AMR Global curriculum (Fleming Fund, 2021). Fleming Fund is a UKaid programme that focuses on addressing AMR in low- and middle-income countries including Kenya (Gordon et al. 2020; Dacombe et al., 2016). The Fleming Fund program works in collaboration with the Kenyan Government and various Kenyan bodies and institutions to improve antibiotic practice and AMR surveillance in Kenya. Course materials for the MOOCs, evidenced the adoption of learning design principles that guide learning delivery geared towards encouraging retention at the Open University these include factoring in four elements to encourage persistence and completion (van Ameijde et al., 2015). Namely, design, delivery, personal factors and contextual factors (Wheeler, 2015). Design elements focus on course construction geared toward encouraging persistence. Delivery focuses on support and interventions that influence retention. Wheeler, (2015) contends that design and delivery are most directly under the control of the education provider. Within their research they placed greater emphasis on the first. They assert, as previously discussed, that context matters in systems thinking. Therefore, whilst concurring that there is greater degree of control in design and delivery, I also contend that the latter should be factored in from the beginning of planning to inform design, an approach adopted within this study (Peters, 2012). As a result of factoring in context from the beginning, and progressively building in personal factors into design through the use of an iterative design (see section 4.6), module materials were delivered to health professionals through AMREF’s Leap platform. Whilst AMREF’S Leap platform has seen some success in training CHWs, it too is subject to the same challenges as for example mhealth platforms covered in Betjeman and colleagues’
(2013), review, Winters et al., (2019) or the previously discussed Karamangi and colleagues’ (2022) review (see section 5.2). These studies found that, whilst some platforms have seen success, there is a lack of data that evidences pedagogical soundness of studies nor frameworks of design. This materializes as an obstacle to replicability and data to warrant DHI scale up. This study therefore focuses on developing and evidencing pedagogically-sound design to provide data for developing a potentially more equitable and scalable learning solution for health professionals. In the next section I discuss technology enhanced learning as relevant to the context of this study. Subsequent sections pay attention to the broader field of scholarship on learning including workplace learning.

5.5 Technology enhanced professional learning

Technology enhanced professional learning (TEPL) is a combination of ideas from disparate research domains that are of relevance to work practice and learning. TEPL combines scholarly work from multiple research domains including computer-supported collaborative work, leverages work on human resource development and computer science/information systems as well as professional learning and more specifically technology-enhanced learning (Littlejohn and Margaryan, 2014). As a result, TEPL is by design an interdisciplinary field, in keeping with the broader approach with this study. However, it is also useful to explore each of the research domains. Littlejohn and Margaryan (2014) argue that these each warrant an in-depth review in their own right. Thus, I consider the work covered in the review up to now, such as literature on human resource capacity part of TEPL, when considered as specific to the health sector. This is in keeping with Littlejohn and Margaryan’s (2014) assertion that TEPL is defined by the relevance of research domains where they assert that TEPL requires “the amalgamating of largely disconnected discourse and conceptualisations that traditionally exists within different schools of thoughts”, (Littlejohn and Margaryan, 2014; p.176) which reflects a necessary openness to crossing discipline imposed epistemic boundaries. In this thesis where research is specific to the health sector, the aforementioned amalgamation includes health. The challenge in conceptualising TEPL is that learning processes, work practices and technology are key parts of work in a modern age and, whilst they co-exist and run alongside each other in the workspace, they seldom do so in academic literature, pointing to the limited availability of
literature on the subject. This is more pronounced when looking for context specific literature on TEPL in Africa where technology, specifically phone penetration, is on the rise and global health researchers and policymakers are making strategic efforts to capitalise on mobile phone availability as a means of expanding programme reach (Winters et al. 2019). There are many mobile health (mHealth) platforms supporting various aspects of clinical practice including some for neglected areas in global health such as mental health and disability and yet there remains a dearth in the understanding of the role of mobile technology in training in SSA and how it leverages the affordances of microlearning. In the next section I discuss affordances of microlearning and, in keeping with the need to understand different research domains in their own right, I explore theories of learning and organisational change in the remainder of this chapter.

5.5.1 Facilitating Effective learning

The Ministry of Health in Kenya defines cross-cadre CPD courses as any courses that cut across more than 50% of the health professions (GovKenya, 2014). Cross-cadre CPD typically cuts across 12 thematic areas, namely, leadership and management, communicable diseases, non-communicable diseases, research, reproductive health, maternal and child health, information and communication technology, occupational health and safety, disaster management, waste management, quality management and disability mainstreaming. Given the adoption of a One Health approach in Kenya, I would argue that there now exists scope to add a thirteenth thematic area of AMR specific learning across the cadres to highlight AMR specific challenges and heighten the urgency with which practitioners need to engage in AMR-specific learning. These could potentially be earmarked whereby some of the AMR specific learning is compulsory across the cadres. The main challenge in developing cross-cadre CPD is in ensuring that the learning strategy is effective across the diverse group of health professionals. Part of the challenge with introducing learning about a specific topic across cadres is the variety of different professionals (doctors, pharmacists, lab personnel) whose roles have varying pedagogical histories and require engagement in different tasks with different tools to tackle the same problem. It was therefore useful to borrow thinking from the CPD specific research domain. For example, amongst key components of
developing a CPD program is, determining the purpose of the program (Campbell and Mackay, 2001). Within the context of this study, this was achieved through a combination of desk-based research including literature such as Dryden et al., (2011) that focused on the need to breakdown workplace practice into smaller units in order to understand where there existed opportunities to improve practice. In addition to this, context specific input was used, by leveraging the iterative design of DBR, there was room to elicit requirements and establish the purpose of the module from participant responses and stakeholder engagement, to ensure that the module was going to meet the needs of the participating health workers (Anderson and Shattuck, 2012). Once the module was decided, I leveraged scholarship on microlearning to develop an understanding of design for module delivery. Hug (2006), notes there are seven dimensions of consideration in the development of microlearning programs. These are design specific but facilitate thinking about pedagogy. Hug’s (2006) seven dimensions include curriculum, content, time, process, form, mediality, and learning type. Time and content for example, can be used to consider how microlearning content can be separated into small units whilst leveraging principles of scaffolding learners and increasing long term performance by incorporating elements from thinking such as Bjork and Bjork’s (2020) notion of desirable difficulty where learners are challenged to use considerable but desirable effort in learning which may be more effective in terms of long-term performance (Bjork and Bjork, 2020). Specific to mobile learning this can include variability and testing which were incoportaed into the mhealth platform used in the context of this study through for example giving learners regular low-stakes quizzes whilst building up to progressively more difficult testing at the end of the module. This fits in within a model that Baumgartner (2013) refers to as a “model of a competence spiral” whereby learners are scaffolded to competence through a series of activities, that include applying knowledge, discussing ideas and mastering concepts and progressively engaging in more difficult domains of learning. In the context of AMR for example, handwashing is an important, cost-effective but often overlooked mechanism for infection control that can curb health worker hands contamination between patients, which is a common cause of infection in Kenya (Kibira et al. 2022). Participants in a microlearning module for example, may be taught about the importance of handwashing, adopting correct procedure and have the opportunity to discuss handwashing amongst their peers on a shared platform as part of
scaffolding learners towards competence. The next section discusses the broader field of approaches to workplace learning.

5.5.2 Approaches to learning in the workplace

Studies of the mind and our understanding of thought, learning, competence development and the neurological activity that takes place during that process have made some significant strides in their evolution over the last four decades (Bransford et al., 2000). This gives us a richer narrative of how and where learning takes place and the factors that influence and shape that narrative. The growth in interdisciplinary inquiry in subjects such as TEPL have made education, ergo the study of learning a convergence point for various branches of science (Wilson, 2010). Deepening our understanding of causality and effect in knowledge acquisition processes both biologically and physically; internally; within the human and externally; with environmental interactions. In cognitive psychology, we have gained traction in our understanding of principles that govern knowledge organisation and determinant factors of subject specific problem solving (Bransford et al., 2000). This is relevant to learning within the workplace and sequentially professional learning. Studies of transfer learning (see section 4.6) have elucidated on the principles of how learning in one context or with a set of materials impacts performance elsewhere either positively (positive transfer) or negatively (negative transfer) (Perkins & Salmon, 1992). Section 4.6, for example, marks a point of convergence, for micro and macro analysis, effectively demonstrating the possibilities of adopting systems based thinking alongside a detailed frame of analysis through the use of transfer of learning. This facilitates the analysis of impact of tensions and contradictions using concepts from transfer of learning such as negative transfer from using suboptimal tools that cause a contradiction in the system and lead to a new way of doing things that later negatively impacts performance in another aspect of the activity (Engestrom, 2018; Perkins & Salmon, 1992). Points of convergence have materialised from other branches of science. For example, neuroscientists have been exploring whether learning alters the physical structure of the brain and in turn its functional organisation (Fields, 2012). Across the disciplines, psychologists and anthropologists are bringing clarity to the impact of setting-specific cultural and social norms and expectations on learning and the impactful ways they shape the process of knowledge acquisition and transfer (Billet, 2004; Hofstede, 2001). Studies on workplace
learning are producing new knowledge about reconceptualising the workplace as a learning environment, the role of practice and the impact of variation of setting in teaching and learning (Billet, 2001). Additionally, there is a growing consensus on the ‘wisdom of practice’ (Bransford et al., 2000, p. 4) and value addition through experiential learning. All the while, advances in technology are not only enhancing learning but, in many ways, providing pedagogical guidance in the direction of innovation. There are many ways in which one could examine theories of learning. Here, I limit my explorations to learning that is relevant to my current research, for example I pull away from examining and critically engaging with the foundational theoretical works such as works such as those of Piaget, (1978) or constructivism though having read and can see threads of his work in the secondary works I engage with who built on their theoretical works on those foundations, I explore learning from hence forth through professional learning.

5.6 Scoping knowledge of learning

Education - a derivative of the latin verb ‘educere’ meaning to train, mold and lead forth (Livingstone, 2001) is characterised by three elements, a teacher, a learner and an expected mental journey. With presumed greater knowledge the teacher is expected to lead and/or facilitate the learner’s journey to a ‘learning destination’ along a continuum from old to new knowledge, the idea being that new knowledge is rooted in old knowledge (Vygotsky, 1978). This is exemplified by the use of already existent vocabularies. To understand a new phenomenon ‘old’ language is used in the discourse surrounding new concepts and is therefore a conduit to a systematic map that leads to the understanding of the primacy of the new concept. These maps known as conceptual metaphors enable us to consider the primacy of our chosen lexicon, colloquially, we may think of this as language being loaded. For example, above I use the term ‘learning destination’ this sits within the school of thought that views knowledge as something to be acquired and as such has an end point. I here clarify my position on how I employ the language surrounding knowledge for the purposes of sense making within this work.

5.6.1 Metaphors of learning
Sfard (1998), offers useful thinking on the metaphors of learning which divides language on knowledge into two distinctive schools of thought: Namely, the acquisition and participation metaphors. The former encumbers the idea of passive reception of knowledge and the language around it treats the human mind as a container to be filled with certain [learning] materials” (Sfard, 1998; p5). The participation metaphor features language around discourse and communication and views learning as a process of becoming a member of a certain community, learning the language and norms particular to a community and participating within it (Wenger, 1998). I saw this as in keeping with ideas of becoming expressed in Ubuntu communities, Ramose (in Murove, 2013; p.308) describes it at as an “openness and ceaseless unfolding” in its essence it describes the process of humanness, this is embedded in the community and in learning through community. In Sfard’s (1998) conceptualisation, newcomers to the community have the potential to change and reform the community as such there is no ‘learning destination’. Learning is an ever-evolving process within which the role of the teacher is to preserve continuity (Sfard, 1998), in keeping with the concepts of multi-directionality in the “ceaseless unfolding” discussed by Ramose (in Murove, 2013, p.308). Sfard’s (1998) two metaphors are not mutually exclusive and can coexist within one learning experience, some scholars argue them to be necessary (Anderson et al., 1997; Sfard, 1998) as such I use language that sits within both metaphors interchangeably because drawing boundaries on knowing and the processes employed to increase knowledge with precision is difficult. For example, the research design for this study combines a pre-established curriculum that has learning objectives, achieving these objectives could be viewed as a learning destination. However, the study adopts a design-based research approach, borrows from Friere’s (1970) work on learning through dialogue and was as a result subjected to modification based on participants contexts, data provided and the input from stakeholders in iteration 0.5 (see section 6.7.2). Therefore, pedagogically it straddles different typologies of learning.

The boundaries of two of the previously discussed elements of learning, (teacher and learner) are subject to contextual shifts and those shifts create a conceptual distance between types of learning that allows for a categorization of learning experiences into typologies. I here, borrow from Livingstone’s (2001) thinking and use the notion of the directive control of learning as a proxy to draw distinctions between types of learning within
adult education, formal and informal learning. Formal education can be understood as “when a teacher has the authority to determine that people designated as requiring knowledge effectively learn a curriculum taken from a pre-established body of knowledge” (Livingstone, 2001; p2). Non-formal education can be understood as when learners opt to gain skills and knowledge voluntarily and the teacher plays an assisting role using organised curricula to assist self-directed learners. Informal education or training can be understood as “when teachers or mentors take responsibility for instructing others without sustained reference to an intentionally organized body of knowledge in more incidental and spontaneous learning situations, such as guiding them in acquiring job skills or in community development activities” (Livingstone, 2001; p2). This study can be situated within formal learning because the research design uses a pre-established curriculum. However, the pre-established curriculum is used as a springboard for dialogue with the view to facilitate the use of skills acquired through experiential learning and to bring tacit knowledge – unarticulated knowledge - into consciousness. This means knowledge and skills can be reflected upon individually and, where possible, explored amongst a group of learners. I argue this makes apparent the conceptual shortfalls of typifying the learning experience as formal, and within the scope of this study necessitates an exploration tacit knowledge which many scholars situate within the informal learning typology (Eraut, 2004; Paavola et al., 2004).

5.6.2 Tacit Knowledge and the workplace

In addition to Sfard’s (1998) two metaphors of learning, Paavola et al (2004) propose a third metaphor of learning that combines Nonaka and Takeuchi’s (1995) model of knowledge creation; Engestrom’s (1999) model of expansive learning and Bereiter’s (2002) model of knowledge building. Commonalities across the three culminate in a third metaphor for learning, as a social process (Paavola et al., 2004). This is distinct from participation, in that the contextual aim of participation as a third metaphor is not to socialise people into existing practices, but to develop new practices. In this way, the knowledge creation metaphor integrates the cognitive and social aspect of learning. I here limit my exploration of knowledge creation specifically to Nonaka’s work to further explore tacit knowledge and how understanding it and bringing it under critical control may benefit health professionals.
I explored Engestrom’s work as part of the development of this study’s conceptual framework (see section 4.5).

The dynamic theory of organizational knowledge creation (Nonaka, 1994) built on previous works by Polanyi (1966) to whom the term ‘tacit knowing’ is attributed. Central to the paper (Nonaka, 1994) are the seminal contributions to the conceptualisation of tacit knowledge and knowledge conversion within organisational science. Nonaka’s (1994; 1998) intellection of tacit knowledge shifted thinking away from primarily viewing organisations as information processing machines that are hardwired to respond only to quantifiable, codified data. Nonaka, (1994) illuminated the idea of knowledge that is unarticulated in work by exploring Japanese companies that famously responded to consumer needs, resultantly creating and dominating technologically driven new markets all the while developing innovative products to maintain a competitive edge, the secret to their success? Effectively managing knowledge creation and keeping underpinning knowledge (tacit) under critical control (Nonaka; 1998; Eraut; 2009). A series of Japanese companies historically achieved this at organisational level through a holistic business approach of treating companies not as machines but much alike individuals; living organisms with self-knowledge, self-awareness which in business translates into a collective sense of identity and purpose across the company based on innovation fuelling ideals. The essence of innovation is here viewed as the re-creation of the world according to a given vision and or ideal (Nonaka; 1998). Those ideals kickstart engagement in an ongoing process of self-renewal at both organisational and personal levels where knowledge creating becomes a way of being and behaving for knowledge workers within the knowledge company. Thus, enabling the company to tap into the highly subjective and intuition-based insights of individual employees and translating them into products that can be tested across the company (Nonaka; 1998).

Whilst this study takes place in publicly funded medical hospitals, the scope to borrow from organisation science studies alike Nonaka’s (1998) is two-fold. Firstly, whilst the health profession is not consumer driven in the traditional sense, it is disease driven and that encumbers a degree of volatility that is akin to businesses responding to consumer markets. Patient needs require medical professionals to be highly responsive and innovative this is ever more pronounced in resource limited contexts alike in the pilot study and where new
strands of disease or drug resistance develop. Secondly, the use of tacit knowledge in medical sciences is widely documented in literature (Engel, 2008; Eraut, 2004; Patel, 1998; Henry, 2006). Medical practice is a combination of the “bench and bedside” (Patel, 1998; p2). The bench here is representative of explicit theoretical knowledge that emerges from the laboratory bench and medical professionals’ understanding of biomedical sciences. The bedside is representative of the ‘artistic approach’ (Patel, 1998; p2) which is characterised by the use of tacit knowledge; intuition and experience and reinforces Nonaka’s assertion that knowledge that is connected to the senses goes beyond the sommelier’s nose or the idea that, whilst movement skills are visibly present in craftsmanship, they are not limited to that. “Physical experiences, intuition and implicit rules of thumbs” (Nonaka and von Krogh, 2009; p 635) all exist within the medical profession as exemplified in the pilot study.

5.6.3 Informal workplace learning

Literature on informal learning brings into context sources and spaces where learning can take place beyond formal learning, many of which exist in close proximity to formal spaces, including the workplace (Eraut, 2004). Learning, according to Bloomer and Hodkinson (2000), can be understood in terms of changes to individual thought and action, both momentary and permanent. The premise of which being everyday thinking and acting changes knowledge in some way, this is in line with the previously discussed process of becoming in Ubuntu thinking (see section 5.6.1). In addition, this aligns with (Heusser, 2018) assertion that individuals are constantly embedded in a flow of experience, and, within that aggregated experience, they can pull and reflect on discrete experiences. By calling them into attention they begin to form meaning. Hence, the process of calling them to attention brings them into conscious and becomes the definitive separator between the lived through and noted, extracted and committed to long term memory and maybe of use in the future. In furtherance of this, Eraut’s (2004) typology of informal learning (see Figure 5.1), importantly explicates on how that can be a deliberative process by expounding on different types of learning; implicit, reactive, and deliberative. Through the particularisation and deconstruction of aspects of various processes that constitute informal learning Eraut (2004), offers useful thinking for the study research design in offering time and learning differentials. Eraut, (2004) draws attention to the interplay between time and type of learning. Understanding this has implications for research design in terms of deliberative
learning, i.e. shaping discussion to draw on past experiences, discuss and review them with the view of recognising future opportunities to use that knowledge and further learning opportunities.

Figure 5.1: A typology of Informal learning (Eraut, 2004, Table 1, p.250)

In addition to understanding types of learning, Fenwick et al., (2012), highlights another area that requires understanding; the notion of interconnectedness in order to map disparate elements. Fenwick and colleagues (2012) assert this to be important to developing a comprehensive understanding of workplace learning, including an understanding of the people that work in a given setting, the tools that enable them to do their jobs and the rules that govern how their roles are executed (Fenwick, 2008). Theories such as activity theory that trace the social; (rules and culture that govern a workspace) and the material; (the tools and resources used in practice) (Fenwick et al., 2012) sit within a school of thought that explores the ‘sociomateriality’ (the intersection between work, technology and organisation) (Fenwick et al., 2012). This highlights the importance of engaging with sociomaterial theories and why it in the context, activity theory is useful in comprehensively understanding the workplace and accommodating the exploration of sociomateriality and sociocultural (Engestrom, 2018). This is in keeping with scholarship in the health sector, there are increasingly more conceptualisations of sociomateriality and theories that seek to understand sociocultural elements. For example, amongst the dominant theories, in introduction of technologies to health sector is sociotechnical theory. Sociotechnical theory
seeks to jointly optimise social and technical elements in introducing new, or developing existent organisational systems, alike activity theory it looks to map complex relationships between people, processes, and technological systems. The framework is designed to with the aim of helping health system planners consider how system design can contribute to organisational goals (Baxter & Sommerville, 2011; Sittig and Singh, 2010). Its affordances, include the facilitation of sociotechnical analyses for developing systems, evolving systems and the growing interest in sociotechnical theory for predicting malfunctions in sociotechnical systems (PreMiSTS) (Clegg et al., 2017). Whilst it shares similarities to activity theory in mapping domains, activity theory proves more useful in mapping malfunctions, as well as in effectively mapping disturbances, tensions and contradictions, similarly, I found other approaches to sociomaterial and sociocultural understandings useful in thinking however activity theory proved to be the best fit for this study.

5.7 Conclusion

In keeping with Littlejohn and Margaryan’s (2014) assertion that TEPL often requires a greater understanding of specific domain of research, this chapter explored a number of research domains relevant to both TEPL and the LMIC health system context within which the research took place. The review explored research relevant to the context of human resource management and capacity building, highlighting the challenges are specific to Kenya and the broader SSA region and applicable to other LMIC contexts. Gaps in literature and evidence were explored. These highlighted the challenges and limitations of conducting literature reviews in contexts where there exists a lot of grey literature, that whilst rich may not fit within the scope of the academy, as well as in contexts that traditionally prize oral literature. Such that it highlighted the need broach into other ways of knowing, to include consideration of the role that oral mediums such as podcasts by African scholars like Global Health Unfiltered (2023) and other forms of storytelling may play in reviewing literature to scope and develop an understanding what is emerging on the ground. This is especially important given the myriad of challenges in accessing publishing that African scholars face. Specific to mhealth, gaps in literature, in part highlighted the opportunities that now exist for health and educational planners to strategically leverage the use of DHIs, where the affordances such as cost, mobility and microlearning can rise to meet challenges in capacity
building and health system strengthening, building in elements of preparedness and resilience. The chapter also explored literature on workplace learning, including affordances of microlearning, formal and informal CPD and the facilitation of effective learning within the context of workplace learning and knowledge management in dynamic organisations. The chapter concluded with a reassertion of the utility of sociomaterial and sociocultural theoretical frameworks in the health sector and highlighting the specific relevance of CHAT.
Chapter 6: Methodology

6.1 Introduction

Chapter 5 outlined literature relevant to the study. It focused on the potential of various research domains to contribute to tackling AMR in Sub-Saharan African (SSA) and brought to attention existent gaps in the literature. Highlighting the need to broaden the evidence base in order to capitalise on technology’s potential to meet challenges in AMR-related learning. This chapter focuses on the methodology. It builds on the conceptual framework described in chapter 4, to present methods and a research design that has the potential to meet some of the identified gaps in literature. Expounding on methodological choices and building on the decolonial arguments that I set forth as conceptual grounds to confer with African intellectualism in chapter 3 where I located myself as a researcher and established the axiology as a central driver of this work. Allowing the axiology to underpin both theory and praxis - axiology refers to the beliefs about the role and value of ethics in research (Teddlie and Tashakkori, 2010).

6.2 Mixed methods thinking

The practice of social inquiry into human affairs is an attempt to understand complex, conceptually distinct domains that exist on different levels of abstraction but can and often interlock and overlap in practice and everyday life (Creswell, 2009; Greene, 2008). Abstraction in this frame refers to the mental construal; that is the process of meaning making and connecting ideas. It can be understood as the human capacity to think about for example the future, the past, counterfactuals and in hypotheticality. Counterfactuals refers to our capacity to consider what has not happened but, under different conditions, could, would, or might. Hypotheticality refers to our capacity to imagine and theorise (Trope and Liberman, 2010). To further contextualise this, thinking hypotheticality would require the transcending of self and immediate situation. This constitutes a different mental construal. The greater the distance of the object or an idea from direct experience, and the complexity associated with processing the idea/s and interpreting the idea/s in your world, the higher or more abstract the level of abstraction can be deemed (Trope and Liberman, 2010). Within the scope of this study, the focus is not on the hierarchical nature that may exist
across levels but in recognising that there exists a difference between levels of abstraction, yet those abstractions interact with each other across the levels. For example, abstraction on the level of the philosophical primarily concerns itself with conceptualising the nature of knowledge, existence, and reality. Wherein a question on the level of the philosophical may ask if it is possible to know anything and prove it, the theoretical is a supposition, that intends to prove something. It can lead to the use of empirical evidence to support the theory. The possibility of that tangibility dichotomises the two into different levels of abstraction. Once levels of abstraction are conceptualised, one can begin to understand that an interplay exists between the two levels; the philosophical and theoretical abstractions with the guiding inquiry, that is the research question as the central component that facilitates the interplay (Creswell, 2010). Therefore, arriving at a research design and the praxis of doing research is underpinned by a theoretical framework that is driven by beliefs about the nature of reality – ontology, and the nature of knowledge – epistemology, and guided by beliefs about the role and value of ethics in research – axiology (Teddlie and Tashakkori, 2010). The section below expands on the Mixed Methods Research (MMR) and its usefulness in the context of this study and broader decolonial works.

For decolonial scholars, MMR has embedded affordances, that allow works to exist on a continuum, rather than in the binary in multiple ways. For example, MMR moves beyond the qualitative (QUAL), quantitative (QUANT) binary to QUAL and QUANT research methods and modes of analysis and philosophical orientations (Creswell and Plano Clark, 2018). Greene (2007) offers a useful conceptualisation of MMR that highlights its capacity to foster decolonial approaches to research and enable a multiplicity in paradigm, method, and design to bring decolonial research to fruition with demonstrative rigour and validity. By centralising the idea of mental modes, the notion that Mixed Methods thinking embodies a multiplicity of perspectives. It moves beyond the rigidity of the binary and demonstrates how MMR affords the loosening of some tensions; epistemological and paradigmatic. In defining MMR as a form of looking at the world, Greene (2007, p. 20) conceptualises it as a method that

“actively invites [us] to participate in dialogue... multiple ways of seeing and hearing, multiple ways of making sense of the world, and multiple standpoints on what is important and to be valued and cherished.”
The question of what ought to be valued and cherished sits at the core of decolonial thought, thus the invitation to engage in sense making within designs that afford researchers paradigmatical flexibilities speaks to the suitability of MMR for this study. In keeping with that line of thinking, this study places the impetus of defining what ought to be valued on the participants who work in the given environment, using both their voices and actions; explored through interviews, surveys and observations, combining QUAN and QUANT analysis. Subsequently, both data types are triangulated in analysis to build a more comprehensive understanding of interacting elements, which is in keeping with prominent methodologist, Creswell’s, (2009, p. 102) assertions in an editorial on data compatibility, where he wrote,

“I am tired of the “incompatibility” argument that one cannot mix paradigms. It is as if a particular researcher’s worldview is a fixed trait that cannot be examined, changed, or combined.”

Thus, embedded within MMR, is a definitively vital element of research practice for the decolonial scholar, boundary crossing.

6.2.1 Boundary Crossing

Boundary crossing is particularly important within what I argue to be tempestuous conceptual waters such as in the context of this study. Where what is on the ground, within communities of memory and practice, is not necessarily reflected in academic spaces. For example, many of the digital health interventions (DHIs) in circulation on the ground are not available in academic and grey literature nor are they available in the global digital health repository (see section 5.2.1). This highlights the need to bridge the gap between what is happening on the ground and in academic literature (Hoppers, 2000; De Certeau, 2011).

There are several ways in which the study aimed to accommodate boundary crossing. Firstly, in the amenability that was embedded in the research design, to foster an openness to shifts and changes based on participants and the demands of the environment where the research was conducted (Teddlie and Tashakorri, 2015). Secondly, in flexibility in the dispersion of data types in relation to weighting. That is to say QUAL and QUANT data were treated interchangeably, where one could answer an aspect of the research question better
than the other, the former was adopted. The dispersion and weighting of QUAL versus QUANT that is presented in this thesis was therefore a best fit model based on the information that was available and accessible at the time of the study (Creswell & Plano Cark, 2018). Thirdly, the questions of which data type was most appropriate and how to frame analysis, whether best fit analysis was QUAL or QUANT were revisited iteratively. Decisions on analysis stemmed from the data, and how best to capture the story of what was evolving on the ground. This was coupled with the aim to centre the collective voices of the people on the ground. As well as capturing their experiences, thoughts and ideas and the contextual factors that affect their practice. For example, the impact of election or periods of strike action where workers would either completely disengage or engage minimally with work, including work related learning activities. For further explanation, see section 8.5.10. Key parts of the iterative approach included the facilitation of high levels of reflexivity and reflections whilst maintaining amenability to adapting the approach to the research design in practice, based on what was evolving on the ground to prioritise best fit approaches in terms of addressing the research question as the project evolved.

MMR has the capacity to interact with other approaches, that seek to address complex practical problems to create an integrated approach to problem solving that may prove to be more scientifically robust, to that end I use Cultural Historical Activity Theory (CHAT) as a framework to explore the socio-political and institutional factors, and (Design Based Research) DBR against the backdrop of those factors to shrink the theory praxis gap. In the next section, I discuss MMR, DBR and CHAT.

6.3 Framing CHAT, DBR and MMR

Conceptually, the use of Cultural Historical Activity Theory (CHAT) facilitates the analysis of professional practice within the context of the historical and situational, respectively (Engestrom, 2018). The cultural historical perspective accommodates analysis of not only how work culture has evolved but where possible facilitates engagement with the deductive process of questioning why, for whom and for what need. This then provides a lens through which I adopt a long term, broad (institutional and societal) perspective to analysing the continuous process of construction and reconstruction in terms of how knowledge has been and continues to be constructed and embedded into work practice (Gunnarsson et al.,
This broad view creates the backdrop for a situational analysis, that deals with the question of the now, which is “inherently tension-laden, unstable and open-ended” (Engestrom, 2018, p. 137). Thus, within the scope of a situational analysis, there exists a dynamism and open-endedness that is nearly always embedded in the present action and to a degree the future because actions are fundamentally future orientated towards emerging developments. Therefore, collective actions within any given activity system offer a window of opportunity into an emerging zone of proximal development. This perspective of action accords the power to imagine and urgency that the community of practice (Engestrom, 2018). Enabling the community of practice to not only imagine what is possible but engage in actions that can shrink the distance between possibility and reality, this can be more broadly understood as the theory praxis gap. The use of DBR, makes that gap shrinking process intentional, through its iterative design it capacitates the community to shape the output (see section 6.6). Where CHAT provides the framework for exploration and DBR offers a frame for shaping the intervention, MMR makes way for the employment of a myriad of tools (Greene, 2007). These allow engagement within the process of exploration, data generation and analysis. In a way, getting to the core of what works and what does not within the given context unencumbered by the binaural boundaries that exist in QUAL and QUANT research.

In discussing the relationship between experience and language, Giroux (1988), notably puts forward the notion that the meaning of experiences is embedded in the language we bring to it. Given my positioning on decolonial thought, and the often-elusive nature of African indigenous knowledge and aforementioned Ubuntu ontology, the use of participatory methods is particularly fitting for this study. It gives rise to the voices of the participants allowing their use of language to bring meaning to how they experience learning. This is important to gaining access to the loci where indigenous knowledge exists, within and beyond the communities of practice. Paradigmatically, this sits well with my positioning within Shona ontology and constructivism (see section 3.4).

6.4 Moving towards an expansive design

Whilst the need to address the research questions as comprehensively as possible remained invariable throughout the study, the approach to answering the questions and, by
extension, the design was subject to a continuous evolution. Revisions were based on the interactions between different elements, internally and externally driven. For example, reading literature on indigenous knowledge, such as Mugwini (2019), had an impact on how I reframed the research instruments. Instruments were restructured to enquire about participants’ perception of oral literature (voice-notes) as an instrument for learning on the mobile platform. This shift did not occur during a designated data analysis phase but did so during a period of data collection and was not derivative of the data but broader literature. In relation to external drivers beyond my control as a researcher, for example, the global pandemic had an impact on all of the elements of data collection. Therefore, whilst I remained aware that there would be limitations in capturing all of the influencing factors over the course of the study regardless of the design I adopted, the goal was to be as expansive as possible. This was to limit the risk of giving answers that were reductive of place, processes, and people.

6.5 MMR Typologies

I began my approach to design with the desire to maintain the aforementioned expansive view and explored Creswell & Plano Clark’s (2018) construct of typologies that denote typified approaches to MMR research. These were primarily defined by the intent of design and enabled me to reflexively engage with the question of design intent. Following that, there was room to raise questions attached to data flows. For example, the weight assigned to the data types; QUAL and QUANT and the timing of data; the point of interface - where data mixing occurs in the research process. Through this exploration I found that though there were aspects of the study that lent themselves well to the various typologies, the study did not neatly fit into the prescriptive categories. This was in part due to the decision to use CHAT and DBR, both as a conceptual framework and methodologically, informing what data ought to be gathered and data gathering and mixing. For example, DBR is fundamentally iterative, therefore data analysis ergo mixing was defined by the cycles, and the data that was collected within each cycle (Anderson & Shattuck, 2012). As such the cycles guided the design choices. The typologies did however remain useful in broader considerations of the design such as the impact of data type weighting and how that would shape the study. Typologies were also useful in presenting my positionality and contrasting
it against other approaches. I therefore set out some of the useful typologies and useful thinking in the following section and expand on my positionality.

Amongst the typologies are explanatory or exploratory designs, requiring two phases of data collection and analysis, QUANT followed sequentially by QUAL (or vice versa). Convergent designs (also referred to as concurrent or triangulation designs) are defined by a singular phase where data collection occurs across a QUAL strand and QUANT strand, concurrently (Creswell & Plano Clark, 2018). The two data strands are analysed separately before being integrated. At the point of interface, data integration is either done for comparative purposes or data is combined, through data transformation, for example, changing QUAL data into QUANT data by transforming codes into counts (Creswell & Plano Clark’s, 2018). Convergent designs can be complementary to a DBR approach, in terms of data collection across two strands followed by data integration. However, DBR is defined by iterative cycles, that facilitate shrinking the theory-praxis gap. Whilst what happens within a DBR cycle and is not at odds with the convergent designs, the singular data collection phase in convergent designs is at odds with iteration. I found that it was most suitable for the study to create multiple phases within a convergent design by combining it with another typology. Within MMR the combination of designs produces what are known as embedded designs. Embedded designs are those in which one form of data are embedded within another, these may be either a single or double-phase designs that have concurrent or sequential approaches (Creswell, 2009, p. 103). Thus, a multiphase, concurrent design is known as a concurrent, nested design. Whilst my design does not neatly fit into the concurrent nested design, I find the intent of the design and convergent embedded design to be complementary. In this way, the literature on the typology provided useful thinking for my design choices. The limitations of these typologies in design are however echoed elsewhere in literature, such that amongst evaluation researchers such complex designs have emerged where typologies have continued to mutate, in a way the design of this study can be considered a mutation (Teddliie and Tashakkori, 2010). Mutations as covered in literature such as Teddliie ad Tashakkori, (2010) include designs having multiple stages and the combination of both sequential and concurrent phases with unusual blends of methods, such as the combination of qualitative themes with survey data to produce new variables (Creswell, 2009, p. 104).
There is a shift in reconceptualizing research designs from typologies to other ways of thinking. Thus, another way of viewing design is to look at mixed methods procedures not as designs but as a set of interactive parts. This is important to this study because of the use of CHAT and the centrality of the activity system to understanding the working and by extension learning environment in the health facility. Based on systems theory, Maxwell and Loomis (2003) argue that researchers should weigh five interconnected dimensions of the research process consisting of: the study’s goal, the conceptual framework, research questions, methods, and validity. This interactive, system-based approach is expansive (see Figure 6.1 below) and it considers how design has been affected by external influences such as situational constraints, ethical standards, research skills arguing that in their interacting these factors influence design (Creswell, 2009, p. 104).

![Interactive Model of Research Design](image)

**Figure 6.1 Interactive Model of Research Design (Adapted from Maxwell & Loomis, 2003)**

Interactive, system-based approaches to study design provide useful thinking for strengthening the embedding of the activity theory into the methodology. They can be used to justify reframing methods based on the situational, in terms of the research site and broader national and global health outlook that have had an impact on approaches healthcare, education and more specifically learning within the healthcare context. This is discussed in the next section.
6.5.1 Interactive systems-based approach

The interplay of all these components have shaped and reshaped the research design in multiple ways, and I will expand on these in the research design, section 6.6 where I aim to capture shifts. It is here worth noting that to capture those shifts and gain an expansive understanding of research within this context, I opted to move my thinking toward an interactive, system-based approach to study design. Rather than considering sequence of interaction between the elements that follows a linear or cyclic sequence, I centralised the research question, maintained its invariability and looked at the other components as part of a whole, where other parts could be moved and reorganised to answer the research question (Teddlie and Tashakkori, 2010). Pragmatically, this involved continuously considering how elements were interacting and required flexibility in the reorganisation of how they interacted to address the research question, this is illustrated in Figure 6.1. I found moving toward an interactive system-based approach also enabled the design to absorb changes from the external environment (for example, the COVID19 pandemic) and facilitate documenting those changes in line with CHAT and DBR, whilst documenting how data from each research cycle shaped the next cycle. This is expanded on in the research design section 6.6. Where I have in this section expressed how the typologies offered useful thinking from which I borrowed. I have also expressed the reluctancy to fully commit to any of the given typologies. This is because where there are aspects of the designs covered in the above section that are indeed suitable for the study, and elements that were incorporated there are also elemental mismatches where the three core designs are concerned; convergent, concurrent, and embedded (Creswell & Plano Clark’s, 2018). This is because of the implicitly created cycles based on timing of data collection and points of interface that can sit at odds with DBR. This is because DBR is an iterative study design based on cycles and I opted to prioritise the DBR cycles. In this way opting for a process-driven rather than typology-driven design. This enabled me to borrow elements of the typologies, whilst allowing the DBR cycles to drive timing of data collection and data integration. Therefore, whilst I maintained visible elements of the embedded convergent and interactive systems-based approach thinking, I use an integrative approach to DBR and MMR. This according to Ivankova and Wingo (2018), is justifiable based on procedural as well as conceptual and philosophical similarities between mixed methods and action
research which has been argued to be similar to DBR. In the next section I outline the research design.

6.6 The final research design

As presented in the conceptual framework, this study uses activity theory to capture socio-historical and cultural elements of the research site and the broader national context. This can be understood as an in-depth needs analysis concerned primarily with practice and the points of tension and contradiction that arise in AMR-related practice against the wider background of health practice and the socio-historical and cultural context of the workspace. Enabling the capture of tensions and contradictions that may arise beyond individual practice but have an impact on collective AMR practice, and how professionals learn about AMR in the Kenyan context (Engestrom, 2018). As explained earlier, my aim is to elucidate on individual and collective practice against other sociohistorical factors. This led me to opt for the use of both QUAL and QUAN data to map the workplaces. For example, looking at the division of labour across a site, both QUAL and QUAN data prove useful. Where QUAL data gathered through interviews and surveys provided information on the experiences and practice implications of division of labour on a granular level, the use of QUAN data on human resources provides useful insights into the broader picture of what division of what labour looks like across the site and the broader Kenyan context, in as far as the potential for research to be generalised to other contexts (see section 2.6 for national human resource data and section 7.1 for site demographic data). This is an important aspect of answering the broader research question of how professionals learn about AMR in Kenya, because contextual specificity of the site, for example in terms how much time for professional development is accorded to job roles and how staffing numbers impact the time accorded as well as other contextual factors. Understanding the factors at play is key to clarifying the ways in which a community of practice is affected by interacting elements. Elucidating on those elements allows for the differentiation between shifts in practice that are subject to circumstances and shortcomings beyond an individual’s practice and those that are subject to a lack of knowledge. These need to be addressed separately and by different actors. For example, shortages in human resources are managerial, whereas a lack
of knowledge can be addressed through a course such as the one that professionals were offered.

Collected QUAN data on human resource demographics for example are presented in the findings section 7.1 and used in triangulation in the discussion, supporting QUAL data to expand on tensions and contradictions that arise in practice. This is an important aspect of elucidating on how division of labour informs behaviour in relation to AMR-related practice and in turn how professionals learn to change those behaviours given the division of labour and how it varies across the different roles. Once the context was mapped and tensions and contradictions were recognized (see section 8.3 – 8.4.4), I engaged with the voiced needs of the community of practice through data collection and analysis. This shaped how I, as a researcher engaged with the community in the next phase of co-design with the view to address the learning related tensions within the scope of the study. It is here, in this mapping of tensions that a community of practice such as the one at the research site can exercise their collective transformative agency, actively shifting from forms of activity that no longer serve the community toward “new concepts that may be used in other settings as frames for the design of locally appropriate new solutions” (Engestrom, 2011, p. 606). In this way, I argue that it becomes apparent how methodologically compatible DBR and CHAT are. Where CHAT frames an expansive view of the tensions and contradictions and creates a “shared problem space” (Akkerman & Bakker, 2011, p. 147). DBR provides the framework of engaging in the process of bringing the new solution about, that takes into account the theoretical and empirical findings and reduces the theory-praxis gap, such that the solution is locally appropriate. Below I outline the use of MMR within DBR design cycles.

6.6.1 Overview of DBR cycles

DBR is a context-specific, problem-focused, iterative design approach (Sandoval & Bell, 2004). It aims to address several issues, including the need to develop innovative approaches to improving educational outcomes by employing appropriate methods of data collection and analysis; qualitative and quantitative alike, in order to address context-specific questions about the application of theories of learning to the context. The contextual specificity that DBR affords researchers pushes research beyond narrow measures of learning to understand how the given ecology shapes and impacts learning. The
use of CHAT supports, the framing of learning ecologies and the resolution of the tension between the desire to generate “locally usable knowledge on the one hand and scientifically sound, generalizable knowledge on the other” (Sandoval & Bell, 2004, p. 199). CHAT contributes to the tension resolution by providing the framework to map historicised institutions, actors and the broader social histories. Through the mapping of institutions, one can find generalisability across institutions with for example similar histories. Activity theory allows researchers to colloquially speaking ‘keep their finger on the pulse’ within the wider setting to begin to consider multiple variables. In my case, this included consolidation of how the introduction of educational technology through DBR may impact an activity system as a whole, and in doing so, take an opportunity to see the disequilibrium and emergent practices at play (Engestrom, 2019). Thus, the initial phase of the study focused on conducting desk-based research on Kenya, including Kenyan culture and ethics, covered in the context and ethics chapters (see chapters 2 and 3). This enabled a broader view of sociocultural history. Following on from that, desk-based research focused on the research site and region before approaching the site to seek permission and engage with participants. Research on the site and its regional context site informed the research protocol and phase one of the DBR cycles. The process is reflected in figure 6.2, an upside-down triangle. The top is reflective of going from the broadest sociohistorical consideration to increased specificity in relation to the research site towards the bottom and narrower apex.

Figure 6.2 Approach to desk-based research in preparation of entering research site.

As discussed in the conceptual framework (see section 4.7), DBR is defined by iterative cycles. Within the cycles, there are three stages, namely, preparation, design, and teaching.
experiment then back to the preparation stage which can also form the retrospective analysis stage as the researcher analyses the cycles and preparers for the next one (Anderson and Shattuck, 2012). The goal was to study design in practice, with the view to move toward progressive refinement. This should be understood both in the broad sense of the design and its intentions and at a more granular level that considers elements of the design to understand how they interact to produce the integrated system that constitutes the design (Collins et al., 2004). Elucidating on these interactive elements, necessitates the formative approach to research that leverages best fit research methods, to combine QUAL and QUANT approaches. Theoretically, the use of CHAT strengthens the process of interrogating interactive elements by providing the frame and lens through which one can view these interacting elements (Engestrom, 2019). Wherein practice, the start and end of for example a tension, can be broadly nebulous. Having the frame and language to compartmentalise and track how a tension laden element has externalities that affect the system is useful. It elucidates on how tensions can impact how professionals learn to tackle AMR in a given environment (Engestrom, 2018). To this end, cycles are responsive and embedded within each are the opportunities to consider theory and design. The stages of the cycles are depicted below in Figure 6.3

![Diagram showing a DBR cycle.](image)

Stage one begins with theory or empirical findings from the field, followed by stage two, typically defined as the design stage where an artefact such an educational technology tool is designed. In stage three it is put in practice to be used in a naturalistic context. Findings from that stage feedback into the theory stage, where empirical findings are analysed to
form the base of the next cycle, where the design, practice cycle continue until one reaches an end point.

**Iteration 1**

**Iteration 2**

**Iteration 3**

**Figure 6.4 Guiding DBR research iterations**

Figure 6.4 depicts three cycles/iterations used to guide study design to the end point. Whilst this study had three iterations, within iteration 1 there were two phases that can be conceptualised as micro cycles in DBR, Pool and Laubscher, (2016) argue this to be appropriate for short term projects such as thesis. Figure 6.5 therefore displays the three iteration with detail of phases. This is further expounded on in Table 6.1 below. Where an overview of the iterations is provided.

**Figure 6.5 Study iterations**

The inclusion of iteration 0 covers the pilot study which was conducted with health professionals in Ghana across two facilities with similar pressures in resource constraints,
challenges in mapping the AMR burden and similarly working under a newly developed National Action Plan on AMR whose implementation was still unfolding across the country. As has been the case with Kenya as discussed in section 1.8. Data from Iteration 0 was coupled with desk-based research and broader literature specific to Kenya to design the scoping survey. The results from the scoping survey then informed the Knowledge and Practice (KAP) survey, preliminary analysis of both supported the development of interview instruments and the choice in mode of delivery. The KAP informed the design of the interview instruments for the next iteration and interview instrument. The interviews and test pilot mhealth formed another iteration where the design of the intervention subsequently went through further changes. The main intervention formed the final iteration and data collected from post-intervention interviews was subsequently used to inform final analysis and recommendations for next steps.

*Table: 6.1 Overview of iterations*

<table>
<thead>
<tr>
<th>Iteration</th>
<th>Task number</th>
<th>Title</th>
<th>Guiding Questions</th>
<th>Sample</th>
<th>Instruments</th>
<th>Analysis</th>
<th>Output from preliminary data analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Pilot Study</td>
<td>How do health professionals in sub-Saharan Africa learn to tackle AMR?</td>
<td>N=13</td>
<td>Interviews</td>
<td>Thematic analysis</td>
<td>Used to inform scoping survey</td>
</tr>
<tr>
<td>0.5</td>
<td>0</td>
<td>Stakeholder meetings</td>
<td>What barriers/facilitators do health professionals face in learning about AMR? Could mobile phones be a useful tool for AMR learning in the Kenyan context?</td>
<td>N=8</td>
<td>Informal discussions</td>
<td>Noting themes</td>
<td>Used to inform scoping survey</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Scoping Survey</td>
<td>How and what do health professionals in Kenya learn in continuous professional development? What socioeconomic factors may impact learning for health professionals?</td>
<td>N=43</td>
<td>Survey</td>
<td>Descriptive statistics + Thematic analysis</td>
<td>Used to inform KAP survey + Mode of delivery for mhealth platform</td>
</tr>
</tbody>
</table>
| No. | 2 | Knowledge and Practice Survey | What AMR-related knowledge do professionals possess?  
What are health professionals attitudes to learning/AMR learning?  
How do health professionals engage with recommended AMR stewardship in practice? | n=26 | Survey | Descriptive statistics | Used to inform mhealth platform + module choice |
|-----|---|--------------------------------|-------------------------------------------------------------------------------------------------|------|--------|-----------------------|------------------------------------------------|
| 2   | 3 | Test pilot mhealth platform + In-depth Interview + Observations of practice | How can the mhealth platform be improved for users?  
What are health professionals attitudes to learning/AMR learning?  
What challenges do health professionals have in engaging with recommended AMR stewardship in practice? | n=17 | Interview Pilot mhealth platform | Thematic analysis | Used to inform further develop mhealth platform module  
Used to map activity system |
| 3   | 4 | mhealth platform Intervention | How do health professionals engage in learning on a mobile platform?  
What can help improve learner engagement? | N=43 | WhatsApp support centre feedback | Thematic analysis | Used to inform post-intervention interview |
| 3   | 5 | Post intervention feedback | What are health workers experiences of engagement with an mhealth platform?  
What motivates health professionals to engage with learning /learning on an mhealth platform?  
What are health workers perceptions of various learning design elements? | N = 14 | WhatsApp feedback | Thematic analysis | Used to inform recommended next steps for further iteration |
6.6.2 Defining DBR cycles

The element of continuous refinement that defines design research has a notable impact on tracking change, analysis, and reporting on how research was carried out. Collins et al. (2004) suggest detailed documentation to major changes in design. Noting that it is the major changes in design that “mark the borders between phases” (Collins et al., 2004, p. 34). In the context of this study, phases were part of iterations, each phase was clearly defined by the tool through which participants were able to contribute to design. For example, through the survey participants provided data on the feasibility of using a tool that required internet connectivity. The first survey was one phase in iteration 1. The KAP facilitated gathering data on knowledge and content, marking another phase within the iteration. In these ways each phase contributed to specific aspects of design. This was in keeping with Collins et al. (2004, p. 34) who note that relevant data for addressing questions should be collected at each phase, with “the goal... [being] to characterize the design elements that are in place in each phase and the reasons for the transitions from each phase to the next” (Collins et al., 2004, p. 34). Wherein I adopt the use of phases within the iterations, it is to amplify the voices of the participants, maximising on their contribution to design. Figure 6.6 below expands on phases and iterations and demonstrates reasons for moving to the next phase by asking what remained unclear at each phase and references the iteration. Each phase shaping the stages within the DBR cycle in the next phase.

Customarily the DBR cycles are guided by flexibility and interactivity within an iterative refinement process (Anderson and Shattuck, 2012), that is driven by a hypothetical learning trajectory (HLT), which within retrospective analysis maybe viewed as an antecedent of emerging practices. Simon (1995, p. 136), describes the HLT as being

“made up of three components: the learning goal that defines the direction, the learning activities, and the hypothetical learning process a prediction of how the students’ thinking and understanding will evolve in the context of the learning activities”

The creation of the HLT is important in establishing a goal which serves as a rationale for design and decisions, equally important is its ongoing modification based on a symbiotic
relationship between the development of the HLT and learning activities. The processes of developing the HLT begins with a situational analysis of the topic of design, current difficulties within the topic and a reflection on what should be learnt. The following HLT was developed.

HLT: To deepen understanding of contextually viable learning approaches to prudent prescribing practices, collaborative and communicative work practices.

The HLT in this study was informed by the desk-based research, including AMR learning specific studies in Africa, such as Charitonos et al. (2019). It was also informed by the initial mapping of context using CHAT and the pilot study in Ghana that preceded this study as well as stakeholder engagement with the NGO that supported the study. I anticipated the simultaneous evolution of the HLT and mHealth platform design as they became tested within authentic practice. Anderson and Shattuck, (2012, p. 16) characterize the DBR refinement and iterative adjustment process as “research through mistakes” noting that perfect design and implementation in DBR is rare if at all possible. The advantage of which is the room for improvement in subsequent design and evaluation. As such, I employed multiple tools that focused not only on retrospective analysis but also continuous analysis, by beginning to analyse survey data as it came in and running a WhatsApp support group, this was used as a support centre for participants, enabling me to provide support whilst monitoring information related to usage through the messages (see section 8.5.1 for an example of support provided). Maxcy (2003, p. 59) asserts that “it is perfectly logical for researchers to select and use differing methods, selecting them as they see the need, applying their findings to a reality that is both plural and unknown”. This was the case in developing the design this study. Within each phase and across tasks, I considered how each phase and task one had contributed to the HLT and the research question. In doing so I was able to pose guiding questions as displayed in table 6.1. These were created in line with the research question, to help create data that addressed an aspect of how health professionals in Kenya learn to tackle AMR. Additionally, these questions were created in alignment with the HLT, in this way they were aimed at deepening the understanding of contextually viable learning approaches to prudent prescribing practices and developing collaborative and communicative work practices. Thus, at the end of each phase, I asked what within the
frame of the research question remained unclear. Below, figure 6.6 outlines overall study and highlights the conceptual links, and the guiding questions that guided the design.

Furthermore, in relation to selecting “differing methods” (Maxcy, 2003, p. 59), the initial goal was to collect data on-site, then online, however due to the global pandemic and closure I pivoted to collecting online for iteration 1. I then attempted to conduct iteration 2 online, however experienced difficulties in processing study related finances from the UK. This was at a time when there had been changes in COVID19 protocol in both in the UK and in Kenya. As a result, increased COVID19 vaccination rates and changes in epidemiology countries had begun to open up their borders allowing travel. I was once again able to pivot, adding an amendment to HRECs with the subsequent changes. After I received favourable opinions from respective HREC bodies to work on site, I was able to conduct observations and interviews in iteration 2 onsite (see table 6.1). In this way, I leveraged thinking from the interactive, systems approach based on Maxwell and Loomis (2003) as discussed earlier in this chapter and reconfigured the design to fit with the timing based on institution and the broader context of the global pandemic (Creswell and Plano Clark, 2018).
Iteration 0/0.5 – Pilot Study / Stakeholder Meetings
Provided data on the challenges to learning in resource constraint settings and the potential use of mobile phones
Provided useful data on variations in barriers and facilitators across research sites and settings

What remained unclear: In what ways do health professionals in Kenya engage in learning? What are demographic-specific barriers and facilitators to connectivity and digital platform use?

Iteration 1: Scoping Survey
Provided useful data on learning requirements and previous online learning experiences
Provided useful data on demographics, job roles, and basic AMR awareness

What remained unclear: What are health professionals’ attitudes to AMR-related practice/AMR learning? What aspects of AMR knowledge and awareness are

Iteration 1: Knowledge and Practice Survey
Provided useful data on knowledge and awareness for choosing the delivery mode as mHealth platform
Provided useful data on attitudes to learning and AMR-related practice

What remained unclear: What are health professionals’ attitudes to mHealth platform suitability to context? What are tensions and contradictions in the activity system impact learning? What challenges do health professionals have in engaging with recommended AMR stewardship in practice?

Iteration 2 – Test pilot mHealth platform + In-depth Interview + Observations
Provided feedback on mHealth platform accessibility
Provided in-depth data on the activity system and its tensions and contradictions (including socioeconomic factors) and challenges in practicing AMR stewardship

What remained unclear: How do health professionals engage in learning on an mHealth platform? What are the barriers and facilitators to learning on an mHealth platform?

Iteration 3: mHealth platform implementation
Provided data on context-specific barriers to engagement
Provided data on technical barriers and facilitators to learning using mHealth
Additionally, the design shifted from what I would consider static to become an increasingly dynamic design in terms of data collection. Wherein the initial design had required all participants to, for example take part in survey 1 before I could roll out survey 2, I could adopt a more dynamic design and move towards granting access to survey 2 as and when participants were ready. This approach was also adopted in signing up for the module on the mhealth platform. By adopting this way of conducting research, the design became more naturalistic in moving in accordance to variations that naturally existed. Taking on a similar mode of interaction with users that was more naturalistic in that users engage with online learning such as traditional MOOCs depending on their own timetables and motivations. This asynchronistic aspect is also touted as one the affordances of microlearning, “allowing the learner to control the place, method, and time of access to information” (De Gagne et al., 2019, p. 2; Milligan and Littlejohn, 2016). I therefore adopted a degree of flexibility in how I allowed the data generated by participants to guide the study, adding a more continuous mode of analysis in addition to the discrete points that had been built into the design in line with DBR (Anderson and Shattuck, 2012). This was in keeping with the aim of developing a participatory principled design (see section 2.8). Whilst I maintained flexibility in how that data informed the next stage, the flow of documents that worked in tandem with the design was sustained. Thus, participants received the same documents lest participants opted out as the study remained voluntary throughout, of which some participants dropped out, see variation sample in table 6.1, it is representative
of retention across the cycles. The document and event flow is detailed below in figure 6.7. In the subsequent section, I provide further detail on the event and documents flow that participant experienced.

Figure 6.7 An overview of document and event flow

The survey in iteration 1 focused on generating data about internet availability, participant experiences of mobile learning, learning opportunities provided by the health facility and opportunities related to AMR learning. Analysed data from survey 1 was used to inform survey two which focused on Knowledge, attitudes and practice (KAP) this was developed in line with other AMR-related KAP surveys (Ashiru-Oredope et al., 2019; Beovic et al., 2019; Di Gennaro et al., 2020; Garcia et al., 2011; Genga et al., 2017). Post intervention, after having taken part in the module, participants provided feedback on the module through WhatsApp.
6.7 Data selection, pre-processing, and main study premise

This section provides a brief overview of data sets generated in each iteration. Beginning with iteration 0 and 0.5, the latter constituted of stakeholder engagement, this expounded on in section 6.3.2. A brief description of each the data sets, pre-processing and rationale for data generation and use are provided. Subsequent section provides justification of each method employed with reference to underpinning process drivers.

6.7.1 Iteration 0

As described in previous section, iteration 0 data were derived from the pilot study. This study took place across two health facilities in Ghana. The aim of the pilot was to explore contextually appropriate educational approaches and the potential to fuse AMR-related workplace learning of in-service healthcare professionals with educational technology. The pilot took place over a two-week period in July 2019 and included two tertiary level health facilities; Sites A and B, involving 13 participants; 6 from Site A and 7 from Site B.

A quasi-ethnographic methodological approach was adopted for data collection (Murtagh, 2007). Data were gathered from interviews with health professionals and observations of practice in hospital wards and labs from which fieldnotes that would be part of the data analysis were taken. Research focused on the professional practice of a wide range of individuals with a variety of skills within the hospital setting, namely, pharmacists, a hospital director, nurses, laboratory professionals and doctors. Participant profiles are displayed in Table 6.2.

Table 6.2 Pilot Study participant profiles

<table>
<thead>
<tr>
<th>Role</th>
<th>Site</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacist</td>
<td>A</td>
<td>M</td>
</tr>
<tr>
<td>Doctor</td>
<td>A</td>
<td>M</td>
</tr>
<tr>
<td>Lab technician</td>
<td>B</td>
<td>F</td>
</tr>
<tr>
<td>Profession</td>
<td>Gender</td>
<td>Age</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>Nurse</td>
<td>B</td>
<td>F</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>B</td>
<td>M</td>
</tr>
<tr>
<td>Lab technician</td>
<td>B</td>
<td>M</td>
</tr>
<tr>
<td>Nurse</td>
<td>A</td>
<td>F</td>
</tr>
<tr>
<td>Nurse</td>
<td>A</td>
<td>F</td>
</tr>
<tr>
<td>Doctor</td>
<td>A</td>
<td>M</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>A</td>
<td>F</td>
</tr>
<tr>
<td>Nurse</td>
<td>B</td>
<td>M</td>
</tr>
<tr>
<td>Doctor</td>
<td>B</td>
<td>M</td>
</tr>
<tr>
<td>Hospital Director</td>
<td>B</td>
<td>M</td>
</tr>
</tbody>
</table>

The OU Human Research Ethics Committee granted the ethical clearance for the pilot study to be conducted (HREC/3302/Tegama). Interviews varied between 10 and 30 minutes, depending on participant availability. Interviews were transcribed and analysed along with fieldnotes and were the basis of the understanding of processes and procedures on both sites. The findings of this iteration are not provided in great detail because the focus of the main study was in Kenya, however the findings formed part the premise on which the main study was based thus, this section provides a brief introduction of how iteration 0, influenced the thinking and framing of iteration of 0.5.

### 6.7.2 Iteration 0.5

Having analysed data from the pilot I was aware of the challenges to learning that health professionals were facing in AMR-related practice and accessing learning in the Ghanaian context. Further contextual understanding of the challenges in practice were provided by Charitonos et al., (2019) whose work focused on capacity building in the Ghanaian context.
through the use of MOOCs. This provided useful thinking in terms of cross cutting factors that were broadly be applicable in the African health care context in reference to practice, resource constraints and epidemiology (Gitaka et al., 2019; Gyansa-Lutterodt, 2013). For example, the theme of money/cost was prevalent across both sites. This theme was anticipated to be relevant to other resource constraint settings thus it provided useful thinking in terms of educational tools and the challenges in accessing internet data to access a MOOC. Whilst these findings influenced my thinking and approach to looking for an educational technology tool that would be appropriate, I remained aware that ultimately there would be geographical and national variances, including governing rules. I therefore expected that these variations in socio-historical and cultural aspects of health settings in Kenya and Ghana would bring about some points of diversion in practice and approaches to AMR data collection based on the implementation of the respective AMR National Action Plans across the two countries (GovGhana, 2017; GovKenya, 2017). In keeping with the use of activity theory, and ethical approach to the study, I sought to increase contextual specificity and continue to move toward producing evermore ethically sound work that would be useful and locally applicable to Kenyan context by approaching various stakeholders to refine and understand the applicability of ideas borrowed the pilot Study to the main study.

6.7.2.1 Approaching stakeholders
Iteration 0.5 was focused on a needs analysis based on multiple stakeholders. Given the adopted use of CHAT and DBR with the goal of centralising of those who work in the given context. It was important to involve stakeholders from the beginning of the study. The sample size in iteration 0.5 was 8 (n=8). This sample included stakeholders from civil society and the health sector, for profiles see table 6.3 where identifiers used in this section are linked to stakeholders’ roles and workplaces. To engage with stakeholders who were on the forefront of AMR work in Kenya, I turned to participant OUFPM who was a project managing the development of a global AMR curriculum. This was because the donor funded AMR project from which I had been granted use of AMR modules was a largescale programme, working across both Africa and Asia. Constituting a large network of professionals working on different aspects of AMR. As a result, the project manager (participant OUFPM) had access to a large network of various actors working across health and with governments to
help countries roll their National Action Plans for AMR. Thus, the project manager was key to my gaining access to other gatekeepers. These made up the diverse pool of health and programme management professionals that would constitute the stakeholders with whom I would discuss the study with and gain their unique perspectives based on their professional experiences in Kenya. I would also leverage their understanding of the National AMR landscape and the challenges in implementing stewardship programs across health settings.

The stakeholders and profiles are listed in table 6.3, in order of contact. Participant 3 through to 8 were contacted using a snowballing technique, following initial contact with the project manager (participant OUFPM) (Bryman, 2001). The initial introduction by the project manager (participant OUFPM) to another stakeholder who was to the lead specialist for health systems, participant FFFLS. Each time I was introduced to a new stakeholder, I explained the project, the merits of the research and potential impact. It was in that communication that stakeholders could either qualify or disqualify the idea which would in turn determine whether they would introduce me to the next stakeholder. At the same time, it was also during these meetings and email exchanges, that stakeholders were able to offer their insight into the field. Each one leverages their expertise in offering advice on project design including in terms of geographical location. These meetings offered key information from those who have been involved on the ground programmatically and in practice, influencing my thinking and contributing to the design by shaping the premise of the study. These interactions were particularly important because over the course of stakeholder meetings and email exchanges it became apparent that there was a gap in knowledge that this study could fill. Where mobile phones had been employed in health as an edtech tool, it had been so as an informal tool for community health workers and had scarcely made its way into professional learning for in-service professionals and where it has been used there was a lack data beyond usage and uptake (Winters et al., 2019). This strengthened the justification of the use of DBR in the study as DBR was in part conceived to move research beyond static technology and understanding current use and effectiveness of pre-existing technology at a discrete point in time without understanding how to evolve the technology to meet evolving needs. Reeves, (2000, p. 12) asserts that “the overall goal of development research is to solve real problems while at the same time constructing design principles that can inform future decisions”. Thus, the use of DBR moves researchers onto
the question of how technology maybe designed, modified or transformed to increase the function that supports learning whilst also developing principles for future decisions.

Additionally, the exchanges with stakeholders strengthened the case for using activity theory. Given that some of the stakeholders were working across countries, they were able to highlight the role of culture and rules including the laws that govern pharmacovigilance and the state capacity to enforce the rules. This therefore centralised the role of context in influencing how professionals learn to tackle AMR. It also highlighted the importance of practitioners’ and stakeholders’ voices as central to effective and impactful interventions. This was consistent with the underpinning ethical drivers of the study. In the next section I turn to the sampling strategy in the subsequent section.

Table 6.3: Iteration 0.5 Participant profiles

<table>
<thead>
<tr>
<th>Role</th>
<th>Site/Workplace description</th>
<th>Gender</th>
<th>Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project manager</td>
<td>University</td>
<td>F</td>
<td>OUFPMM</td>
</tr>
<tr>
<td>Lead Specialist, Health systems and service delivery</td>
<td>AMR focused NGO</td>
<td>F</td>
<td>FFFLS</td>
</tr>
<tr>
<td>Global Technical Lead</td>
<td>AMR focused NGO</td>
<td>M</td>
<td>FFMGTLM</td>
</tr>
<tr>
<td>Regional coordinator for East and Southern Africa on AMR and One Health programmes</td>
<td>AMR focused NGO</td>
<td>M</td>
<td>FFMRC</td>
</tr>
<tr>
<td>Head of AMR and medical doctor</td>
<td>Large referral hospital</td>
<td>F</td>
<td>KNFHAD</td>
</tr>
</tbody>
</table>
6.7.3 mhealth platform & course content

The study used the AMREF’s Leap platform (AMREF, 2021) and adapted modules developed for a Fleming Funded project entitled *Introducing a One Health approach to AMR* (Fleming Fund, 2021) developed at The Open University. Materials were originally developed for delivery in the form of MOOCs that were designed to take up to 6 hours to complete for use in LMICs. The course structure was a mix of information, videos, and quizzes. Whilst the course was broadly applicable, it lacked culturally specific relevance to the research context. The course content therefore required tailoring to both the Kenyan context. It also needed amends to the formatting in order to leverage the affordances of microlearning and to adapt the content to the Leap platform. This is discussed in greater detail in subsequent section 6.7.3.1.

6.7.3.1 Contextualising course content

Given the arguments for the need for contextually-relevant approaches to AMR that have been made throughout the thesis (see for example chapter 2), it was important that learning materials were adapted to the Kenyan context. A consulting microbiologist from Kenya who worked within the field of AMR was hired to help with the decision making on the course choice for the module, the Fleming Fund’s map of available courses below (see figure 6.8) was used to guide decision making. In figure 6.8 module titles are listed horizontally and the different health professional job roles are listed vertically. Green and blue boxes are used to map job roles and corresponding courses. Green boxes reflected
course that were available, and blue boxes reflected courses that were at the time still in production.

Requirements for each pathway

![Map of AMR courses available for different health professionals](image)

**Figure 6.8 Map of AMR courses available for different health professionals (Fleming Fund, 2021, p.18)**

The consultant microbiologist and researcher collaboratively chose three modules, namely ‘AMR surveillance and you’, ‘The problem of AMR’ and ‘Introducing a One Health approach to AMR’ that were deemed most relevant, based on data from the scoping and KAP surveys. For example, through the KAP survey participants reported relatively lower levels of One Health knowledge and over half of the sample were unaware of AMR studies in Kenya (see section 7.3.2). In addition, the microbiologist was able to bring relevant knowledge to the decision-making process, based on their being an insider with awareness of the AMR-related challenges on the ground. A combination of these factors, as well as an assessment of module content and structure of the Fleming Fund modules, contributed to choosing the module that was eventually rolled out to the participants. For example, in the decision-making process, the option to use the Leap platform placed a limitation on media such as videos, as these could not be added to the platform. Whilst video can be an effective learning tool, Hurtubise et al (2013) note the importance for instructors to take into account pedagogical and technical considerations. We assessed the video content on the modules
and deemed them to lack in cultural appropriateness. Resnicow et al (1999) highlight the importance of cultural tailoring, which can be understood as the adaptation of materials to specific populations and developing culturally based materials that “combine culture, history and core values as a medium to motivate behaviour change” (Resnicow et al., 1999, p.11). These concepts relate to ethical principles of cultural sensitivity and appropriateness. Foronda (2008) defines cultural sensitivity as a combination of possessing cultural knowledge, giving consideration and careful thought and deliberation into for example, background, language, and belief systems and as a result tailoring content and interactions. Cultural sensitivity extends to understanding and respecting different cultures. Resnicow and colleagues (1999) assert that there are two dimensions of cultural sensitivity, namely, *surface structure* and *deep structure*.

*Surface structure* may involve matching intervention materials and messages to observable characteristics of the target population. In videos, surface structure may involve using places, language, locations, and people familiar to the target audience (Resnicow et al., 1999). For example, in the videos available on shortlisted module *the problem of antimicrobial resistance* (Open Learn Create, 2021a), we found lacked in surface structure, featuring predominantly Anglo-American presenters and being therefore culturally inappropriate. Surface structure according to Resnicow and colleagues (1999) can arguably be viewed as analogous to face validity (see section 6.7 for a broader discussion on validity). Similar to face validity, surface structure can be achieved though expert review and member checking. In consultation with the consulting microbiologist, it was decided the specific visual materials would require a great deal of adaptation to be deemed appropriate. We decided to use module materials from a module that had no videos, namely those from an *introducing a One Health approach to AMR* (Open Learn Create, 2021b). However, these still needed adaptation.

The consultant and I needed to extend our approach to what Resnicow et al., (1999) consider the second aspect of cultural sensitivity, known as *deep structure*. It is concerned with core cultural values, social, environmental, and historical factors that may influence behaviours. To understand how the target population perceive the given cause, module adaptation was guided by two factors. The first, cultural and contextual relevance and the second, practical implications. Module adaptation factored in practical challenges with time.
and availability known to be experienced by the target audience. As such the consultant and researcher reduced content from six to four hours, limiting the time demand on constrained workers (see section 5.7). Thus, the microbiologist systematically worked through materials, stripping away what was deemed contextually-inappropriate content, and highlighting relevant AMR examples and studies. These were chosen with the view to revisit and balance content between having a global outlook and awareness of One Health approaches across the world with those from Kenya and its neighbours in the East African and across the broader SSA region.

6.7.3.2 Translating the content onto the Leap platform
Once content was developed, I adapted material to conform to a format that was appropriate for Leap and leveraged techniques for designing and creating effective digital-based microlearning environments discussed in this section (Hug, 2005). In the first instance I checked content to ensure language was accessible and where technical language was used explanations were clear and concise. Secondly, in keeping with approaches to microlearning I sought to ensure that content was divided into bitesize information, with each unit lasting up to a maximum of 4 mins to complete. Image 6.1 shows an example of a short extract delivered through sms with a link to call a toll free number to activate audio component of the module.

Image 6.1 Example of welcome message sent to participants using the Amref’s Leap platform.

Thirdly, short segments were followed by low-stakes quizzes that corresponded to learning content and checked for understanding and provided instant feedback (Alqurashi, 2017). Fourth, some of the content was translated to audio recording as mini lectures adhering to the four-minute mark. Fifth, participants were routinely given the opportunity to
communicate with peers by posting text messages to the group, these would be specific a
learning segment for example, participants were posed with a questions such as:

‘Of the drivers of AMR in people that you have just learnt about. Which of them do
you think currently affect or have an impact on the local population in County X? To
discuss with other people on this course, type DISCUSS then your answer. Typing the
word DISCUSS before a text will allow you to speak to your peers throughout the
course.’

Participants would in this way be able to communicate and share knowledge. For example,
Image 6.2 below is an example of a response to the above discussion question that was sent
to the whole group for further discussion.

Image 6.2 Example of participant response to a discussion question for wider group discussion
(redacted to maintain confidentiality of County X)

At the end of the module participants were presented with an end of module quiz. All
content module was adapted using an excel spreadsheet to before being uploaded to the
mhealth platform and being made accessible to the participants where they would receive a
welcome text (as displayed in image 6.1) and begin the module.

6.8 Study Setting

This mixed-methods study took place at X Teaching and Referral County Hospital (XTRCH)
which was chosen on the basis of being a larger facility providing and tertiary care, thus
offering the broadest set of service provision, including paediatric care, obstetrics,
gynaecology, general medicine, and surgery (see section 2.2). XTRCH therefore served a big population at county level. With a diverse mix of health professionals, working across different wards, this would facilitate data collection across different cadres. Additionally, the hospital is a resource-constrained setting, thus it was chosen with the view that data gathered would be relevant to understanding AMR-related practice and learning in resource-constrained settings. According to the Global Antimicrobial Resistance and Use Surveillance System (GLASS) approach to AMR surveillance, which is driven by practitioner engagement in AMR surveillance and focused on LMICs like Kenya. GLASS recommends strategic incorporation of tertiary facilities into the AMR national surveillance first and progressively, adding in primary and secondary care. Therefore, the choice to work within a county facility in a country that was at the time of the study in the infantile stages of implementing its NAP on AMR was in keeping with GLASS recommendations on the establishment of good practice at tertiary level in the initial steps to establishing surveillance systems of a good standard across the country (Fleming Fund, 2016; GovKenya, 2017). Geographically and demographically, this facilitated data exploration in relation to the analysis of socio-cultural underpinnings that impact usage and learning. Providing key data on where tensions and contradictions arise in practice and the extent to which contextual factors impacted AMR-related learning.

6.9 Participants and sampling strategy

Participants were individuals who work across the health facility who responded to the questionnaires and opted to receive further information about the study. Inclusion criteria: personnel who work at XCTR, as nurses, doctors, lab personnel and pharmacists, nurses, including NGO supported staff. Exclusion criteria: county staff who work outside the facility, staff from private hospitals such as lab personnel from private labs that the hospital outsources to as they would be under different requirements for continuous professional development. Data from the pilot phase of the study indicated the importance of including participants across the different roles and conducting in-depth interviews to gain meaningful data that elucidated on the socio-theoretical underpinnings of the communities of practice. Participants were approached through departmental supervisors and managers. The initial introduction to the managers and supervisors was facilitated through
relationships established working on adjacent programmes. Participants who registered an interest were contacted via email or WhatsApp – subject to their preference. A leaflet (see appendix A) was distributed through email or WhatsApp. Recruitment adopted a snowball technique. The leaflets invited participants to take part in the study, with researcher’s details so they could contact the researcher if they wished to take part. The researcher disseminated web links to the survey, information sheets and consent forms via email/WhatsApp, participants were able to sign these digitally. Surveys were administered using Qualtrics, a web-based platform. Once participants agreed to take part in iteration 3. They were contacted through their phones by text message using the health platform.

6.10 Methods of data collection and analysis

As previously discussed, DBR centralises the goal to study design in practice, with the view to move toward progressive refinement (Anderson and Shattuck, 2012). In keeping with MMR, DBR conventionally involves qualitative and quantitative methods of data collection and analysis. DBR researchers commonly leverage what is the most appropriate method in moving toward reaching the most comprehensive answer they can ascertain (Collins et al., 2004; Creswell & Plano Clark, 2018). This is because design experiments occur in natural learning environments, which introduces a multiplicity of variables to consider, this is true of the professional learning context in which this study took place. Thus, careful consideration of the various elements at play in the given context and how they interacted to shape professional learning, I borrowed useful thinking applicable to broader landscape of educational designs. Rogoff’s (1995) conceptualisation of multi-layered analysis of learning as pertaining to three layers, namely, the personal, interpersonal and community. For a more granular analysis useful thinking was borrowed from Collins et al., (2004) to conduct analysis across the five levels: the cognitive level, the interpersonal level, group level, resource level and the institutional level (Collin et al., 2004). The use of these layers facilitated greater insight into understanding how health professionals learn to tackle AMR in Kenya. As such these multi-layered considerations were built into the instrument designs for surveys and interviews and guided observations, and data selection for quantitative analysis.
Where prior research (iteration 0) and drafting in the stakeholder and practitioner voices (iteration 0.5) were used to baseline the basis of the study and by extension design. Careful listening, consideration, and interrogation of the interacting elements in design required the use of different tools and instruments in order to optimise design, as well as to capture varying elements of the activity system. Engestrom, (2001) notes that activity systems are multi-voiced formations, that is to say systems, which comprise of many individual voices, experiences, and perceptions. In pursuance of capturing a range of voices as well and optimising design the study used several methods, namely: survey questionnaires, interviews, observations, and field notes. All of these were used to approach the questions what works, what may work, what doesn’t and why and to varying degrees. These were considered through multiple lens, namely, the cognitive, interpersonal, group, resource, institution on reference to learning. Where DBR is commonly criticised for generating large datasets that are unworkable, the approach to the study centralised research questions to increase the likelihood of generating data that was relevant to the research questions (Dede, 2004). This section provides an overview of the methods used with further detail provided in subsequent chapters in reference to the research cycles and analysis.

6.10.1 Observations

The study used participant observations, as a method to sensitise the researcher to the environment and collection of data for mapping the activity system (Bryman, 2001). Activity theory integrates materiality in the subject/object relationship, affording a degree centrality to how tools mediate the relationship between the subject, object and a given outcome. For example, the practitioner and the patient can be mediated by tools, this relationship is underpinned by as in figure 6.9 below. This is underpinned by other components such as culture and rules (Engestrom, 2018).

The idea of materiality and tools is articulated elsewhere in literature, for example Tilley (in Atkinson et al., 2001) revisits structuralist Levi Strauss’ appropriation of Saussurian linguistic theory. What is useful for this study is the idea of viewing language both synchronically - at a given point in time and diachronically - as it changes over time (Joseph, 2012) to expand the language of materiality/things. I limit my exploration of the language of materiality/things to the idea of synchronicity and diachronicity, as this provides useful
thinking for mapping the practitioners and their tools in their workspace, and how those tools can in resource-constrained settings take on a different use than their intended use. This idea is compatible with activity theory’s conceptions of tensions and contradictions that arise in practice due to change in how practitioners engage with their work (Engestrom, 2019). Within medical practice, scholars have noted how observations can provide important insight into the decision-making processes of health professionals, for example highlighting ward rounds as local and joint endeavours where decisions are marked by clinical talk and the varying elements that can characterise clinical reasoning such as confidence, dogma and a lack of certainty (Denzin et al., 2000). In this way prior literature within the field including works specific to activity theory (Engestrom, 2018), provided methodological grounding, leading to the use of observational methods within this study. These, alike the aforementioned literature, yielded insight into practice. Specifically, practitioner-to-practitioner interaction as well as practitioner-to-tool interaction, both in the singular and plural as joint endeavours during clinical rounds.

Observations were recorded in two ways. Firstly, across all research cycles. These were recorded as field notes, continuously collected within each cycle as well as reflections and at the end of research cycles once cycles were complete. Secondly, in keeping with the study’s quasi-ethnographic approach to mapping the activity system through conducting observations at the research site. Observations at the facility were carried out in 10 days across a three-week period and were conducted in the hospital within the in-patient wards, out-patient department, the pharmacy and administrative block including the medical records block. Observations were recorded as handwritten fieldnotes on an electronic tablet and each entry was accorded a code for example FN0905 meaning field notes for 9th May, these codes are used to reference field notes where necessary. Observations sought to understand several coexisting components. These included the journey of a patient from arrival, treatment to discharge or mortality. The interaction of practitioners and their tools with patients, and how they make treatment decisions, especially the decision to prescribe antibiotics (Engestrom, 2018) For output see patient journeys section 8.4.3.

Observations were made across several categories including the social and contextual variables and cognitive, referencing for example opportunities to learn. Observation notes were also made in reference to factors shaping practice, such as the interpersonal group
dynamics, resource availability or lack thereof and institutional culture (Collins et al., 2004). Categories were amalgamated in note taking and then later in analysis separated, thematically analysed, and triangulated with other data sources to build a comprehensive picture (Creswell and Plano-Clark, 2018). On the wards, I often sat in the nurse/doctor station, so as to minimise drawing attention or interrupting practice (Oliver, 2022). This was because the stations often had other workers in them, and it would seem more ordinary for a person to be sat in that position. I was also aware that practitioners were used to having people sat in the station and that this would reduce reactive effects – the idea that people would behave less naturally if they know they are being observed (Bryman, 2001).

Prior to beginning observations, I introduced myself to participants, explained the study then sat in the nurse/doctor station. Depending on the ward set up, nurse/doctor stations were to be found either in the centre of the room as for example on the female surgical ward. This allowed full view of the ward, patients and the practitioners with the exception of those who would be on a break or requiring handwashing as this was typically located behind the station. On other wards, stations were located on one end of the room, with limited view of other areas for example, this was the case on the paediatric ward. In these cases, I remained primarily located at the doctors/nurses station to minimise obtrusiveness and maintain sensitivity toward patients and the health professionals who in some cases were dealing with difficult situations. Where possible I moved to other positions on the ward.

Observations were conducted during the day and night shifts, in order to get a broad picture of the hospital function and clinical practice. This included clinical rounds. In the periods specific to clinical rounds, which typically lasted an hour, I stood at some distance from the patients and practitioners. Whilst patients were assessed and practitioners engaged in clinical talk to discuss next steps, I took notes on practitioner interactions. Ensuring that I highlighted what was unclear or misunderstood or required further clarification for the accurate recording of observations. In some cases where antibiotics were prescribed, I would note the case and revisit the case with the practitioner later to ask for example how they reached the decision to switch antibiotics or why/if they suspected resistance.
On the medical records and administrative blocks observations were conducted from different positions, based on minimising obtrusiveness as much as pragmatically possible. I would consult with practitioners for confirmation of best placing before I located myself wherever was considered best in terms of not hindering practitioners from executing their duties fully. Though endeavouring to minimise interactions during observations, I maintained varying degrees of interaction. For example, if I did not understand what was going on or wanted to understand why something was being done a certain a way. This was the case on a specific day where I arrived on the ward to find that though scheduled there were no consultants on the ward. On inquiring why this was the case, I would find out that there had been issues in delayed staff salaries and this information in turn contribute to the mapping of the activity system and its tensions and contradictions and the impact of that on how practitioners learn to tackle AMR (FN0905). This evidence the importance of balancing minimising obtrusiveness with interacting to increase clarity of researcher understanding and accuracy of observations (Bryman, 2001).

Analysis was done in varying stages, the first was preliminary, on-going, and broadly reflexive whilst in the field. I would reflect back on the observations during or at the end of the workday, for example reflecting on a ward round and decisions to prescribe that were made. Reflecting back on my notes and sometimes adding to the notes or clarifying the shorthand for future reference (Braun and Clarke, 2022). The observations sensitised me to the nuances of the research site and the challenges of working on site. This had an impact on how I approached participants for interviews and how I handled the interviews, for example (see section 6.6.3) and the decision to opt for latent coding over semantic codes—that is to say, I focused on the deeper and implicit meanings rather than limiting it to surface (Braun and Clarke, 2022). This was in keeping with my understanding of the cultural factors pertaining to language within the context. For example, on explaining the importance of preserving the local language in an interaction in the field, a young man from the region explained that the local way of speaking was involved parables, proverbs and embellishing that added to the richness of language and interactions (FF1305).

As a result of maintaining interaction during the observations some of the observational notes were reflective of the interactions and conversations with participants during the observations including verbatim notes. For example, FN0905 – I noted “go slow” – in
reference to absent consultants during for morning meeting and ward rounds. Referencing the build up to strike action, due to delayed salary payments, it was the use of language in interactions such as this that affirmed the decision to use latent coding (Braun & Clarke, 2022). A data-driven, inductive approach was adopted to generating code labels. Through use of a reflexive approach, codes evolved over the process of analysis. (Braun & Clarke, 2022). These data were used to build a picture of the activity system. Braun and Clarke, (2002) note the importance of existent theory and concepts in providing useful lens for data interpretation and sense making. Thus, in the process of sense making and contextualising health facility, I mapped the activity system, using a deductive approach where observational data were categorised based on the components that constitute the activity system; subject, object tool relationship underpinned by the culture, rules, division of labour, these are presented as findings in see section 8.2 (Engestrom 2018). Observations provided rich data, that facilitated a detailed mapping of the activity system. They sensitised me to the challenges of working at the facility, and the language and culture of the community. Through observations I was able to begin to map barriers and facilitators to learning, relevant to research question 3. Importantly observations enabled me to produce a descriptive map of the activity system, including patient journeys and the use of instruments/tools. It also facilitated developing an understanding of diachronicity of tools in practice, highlighting for example, when tools where they take on a different use than originally intended based on circumstances. Sections 8.2 – 8.4 present observation-based findings.

6.10.2 Surveys

Surveys are a useful tool for acquiring information about the characteristics, behaviours, and attitudes of a population (Clifford et al., 2016). I use questionnaires as a survey tool. Questionnaires can facilitate the standardisation of questions and responses in a way that is useful for drawing inferences and making comparisons (Gillham, 2008). Such as in the context of this study where two questionnaires were used. The first questionnaire was used to explore demographics, participant access to internet and affordability and access to learning opportunities. Questionnaires was targeted at health professionals who interact or play a part in the prescription, dispensation, and the administering of antibiotics. Using questionnaires in the context was valuable in providing data including data on practitioner
behaviour, attitude towards antibiotics and learning through the KAP survey. Two questionnaires were employed.

The first questionnaire focused on demographic characteristics, baselining experience of previous AMR learning and the modes of delivery for continuous professional development. Through a combination of multiple questions and open text answers (Appendix D). The option for text sought to gather data with increasing accuracy and leverage additional information for design. This was used in to inform the next phase of design, concerning for example access to internet and affordability. It provided clarification of what tools would be both accessible and affordable and pragmatic for learning for health professionals.

The second questionnaire built on the first questionnaire, with a primary focus on knowledge, attitude, and practice. Of which, these could be categorised in the same manner as the observations with questions pertaining to the cognitive, interpersonal, group, resource and institutional (see section 6.6.1) (Collins et al., 2004). This was in keeping with broader approaches to understanding antibiotic stewardship and how health professionals learn to tackle AMR and was devised using both the data from the previous survey and other KAP surveys used in literature (Ashiru-Oredope et al., 2019; Beovic et al., 2019; Di Gennaro et al., 2020; Garcia et al., 2011).

A Likert scale approach was adopted in the second questionnaire. Likert methodology is commonly across all fields of research, particularly so within allied health, medicine, and medical education (Sullivan and Artino, 2013). As such, items on the Likert scale were arranged in logical sequence and where items were closely interrelated, items still provided some independent information, for example ‘AMR is a worldwide problem’ was a listed item followed by ‘AMR is a problem in Kenya.’ Though related, the proceeding item provided additional information specific to the context. Additionally, the scale was designed to maintain coherence between responses, with aim to ensure that items individually measured elements that were clearly relevant to issue in question (Joshi et al., 2015). Participants were asked to rate statements on a scale ranging from strongly disagree to strongly agree. This method was employed elsewhere in literature on antibiotic resistance, this in turn influenced the approach to designing the questionnaire (Garcia et al., 2011; Ashiru-Oredope et al., 2019). Survey tools from papers were reviewed and demonstrated
continuity across the KAP survey tools, for example tools measured domains such as capability, opportunity, motivation, and behaviour.

The questions that were included in the instrument were developed with these domains in mind and to prompt data that would help to answer the research question. Capability questions focused on assessing AMR knowledge and practitioners’ understanding of AMR both locally and international awareness including resource availability (see section 7.3.2). Questions on opportunity focused on the opportunity to learn, including access to information and the structure of learning in practice for example individual versus collaborative, extending to enjoyment (see section 7.3.5). Behavioural questions focused on practice for example handing resource to patients and perception of antibiotic usage in the hospital (see section 7.3.4).

The instruments were developed iteratively, by asking stakeholders to evaluate the perceived relevance of questions subsequently amendments were made based on feedback, this informed face validity and is discussed greater detail section 6.7 (Daud et al., 2018). The final surveys were distributed online to health professionals at the research site. The surveys were voluntary and participants were given the option to provide their email or WhatsApp number for further information about the study or to take part in the second survey/study.

Data was anonymised, to replace phone numbers with unique identifiers. A strength of using questionnaires is the potential use of statistical tests that can facilitate the assessment of validity (Somekh and Lewin, 2005). There are however disadvantages to questionnaires, similar to interviews they are reliant on self-reported data. This can be unreliable in terms of misconception, biases and dishonesty. Unlike interviews there is limited if any rapport established between the respondent and researcher (Bryman, 2001). It was therefore useful to triangulate data in later analysis at the end of all data collection cycles, triangulation facilitated another form of checking for validity by converging information from different sources, this is discussed in greater detail in section 6.7 (Creswell and Miller, 2010).

Preliminary data analysis, at the end of each data collection phase informed design of research instruments for the next phase, such that survey data for example, highlighted points for possible follow up in interviews see section 7.1.1.1. Descriptive statistics were
used to analyse data and text-based responses were analysed thematically, data analysis strategies are described in greater in subsequent sections, (see section 6.9). The next section on interview instruments. This is followed by a brief discussion of validity and reliability of instruments.

6.10.3 Interviews

Interviews were conducted at two different points in the research. The first interviews were conducted, following the two questionnaires and initial observations. Towards the end of the first interview participants were introduced to the mobile learning platform, offered an explanation of how it works, then handed a phone to interact with the platform provide feedback on the platform, i.e. if they thought it was contextually appropriate whether it would fit for use of health workers and the challenges on they may face in rolling out and encouraging use of the platform amongst health workers at the facility. The second interview was post intervention, following participant engagement with the mobile learning platform. Participants could provide feedback on WhatsApp using voice notes, texting or through a phone conversation depending on availability and convenience for participant. Feedback interviews, voice notes and/or texts used prompts from the same interview Instrument as the first interviews were used. Focusing gathering data on experience of using the mhealth platform. Both sets of interviews were semi-structured, to allow participants to expand on ideas within the remit of the predetermined areas of inquiry as well as the room to broach into areas of inquiry that may have been missed in research design for lack of not being an insider within the hospital (Bryman, 2001). The interview instrument was developed based on data from previous iterations and the literature review. Once in the field, adjustments were made for several reasons, including time, if participants were in a rush or were called back to work due to an emergency then the interview was cut short. During in-person and phone interviews, as well as texts and voice note prompts, the semi-structured interview format facilitated probing into ideas expressed during interviews based on building rapport and the art of conversation (Denzin & Linconln, 2018). Interviews were audio recorded, transcribed, and supplemented by additional field notes, WhatsApp message were extracted and analysed (Bryman, 2001). Instruments for interviews are appended (Appendix E -J).
6.11 Validity and Reliability

There are multiple ways of approaching questions of validity and reliability. Validity checks in QUAL are routinely marked by methods such as member checking, triangulation, and external audits (Creswell and Miller, 2010). QUANT researchers employ statistical analysis to check for validity and reliability. In the next section I discuss validity and reliability in reference to study instruments.

6.11.1 Content Validity

Content validity and face validity are concerned with the degree to which an instrument has the capacity to gather data that is relevant to meeting study objectives. Specifically, content and face validity centres on questions such as whether an instrument is representative of what it aims to measure and whether the content appears to be suitable to the aims (Daud et al., 2018). Typically, face and content validity are based on expert/researcher assessment of instruments, using expertise and prior experience to determine appropriateness of instrument with reference to objectives, scope of the instrument and the data to be collected (Daud et al., 2018). In this way, content and face validity are commonly dependent on researcher judgements, research teams or on the supply side of a service, in the context of this study this would be the author and doctoral research team (Creswell and Miller, 2010). Cornell et al., (2018) suggest that this is a limitation based on variance in researcher and participant perception. To contribute to remedying or shrinking perception variation, between researcher and participant Cornell et al., (2018) suggests the active input from participants in pooling items and informing item selection. Therefore, in addition to face and content validity from the researcher and the broader research team - the doctoral supervisors - active participation was sought from the consulting microbiologist, a participant who worked on research site such that all the instruments were designed iteratively. Instruments were constructed and shared with the team for input on appropriateness of questions in context. Thus, instruments were in this way co-designed, this included the decision to for example measure five variables pertaining to knowledge, attitude, and practice within the questionnaires. High validity in this context is concurrent to the degree to which an instrument’s measurements are consistent with the objective. The validity is therefore correspondent to specific use, for a specific group and I would argue by
extension at a specific time, because as epidemiology changes it has an impact on professional learning in healthcare (Daud *et al*., 2018). For example, the questions in the construct ‘scope of knowledge’ (S) were at the time of the study relevant to the group however changes in epidemiology may shift how health professionals maybe expected to learn to tackle AMR in Kenya. Thus, at a different point in time it may not be valid in another place at another time based on the degree of specificity to the Kenyan context at the time of the study. For reliability, constructs for the KAP survey were subsequently tested using statistical methods in keeping with QUANT data analysis. In contrast, interview instruments for QUAL data cannot be analysed using scores, instruments, instead rely on “the views of people who conduct, participate in, or read and review a study.” (Creswell and Miller, 2019, p.125). I leveraged theories and methods from different investigators such as Charitonos *et al*., 2019 who investigated AMR-related capacity building in Ghana, this was done as a validity procedure. I engaged in researcher reflexivity, revisiting the instruments over and over again to check if questions made sense and whether they would facilitate data gathering. Altheide and Johnson (1994, p.489) refer to interactivity between the researcher, topic, and the process of sense-making “validity-as-reflexive-accounting”. In addition to this, I consulted with the research team, the consulting microbiologist and a participant who worked on the research site.

6.11.2 Reliability and validity of research instruments

Reliability looks at whether an instrument can be interpreted consistently across different situations (Sullivan, 2011). Reliability determines consistency and stability of research instruments. In the context of this study, the KAP survey used Likert scales, to gather data. Survey was structured to ask subject specific questions; these can be understood as constructs. The constructs were created based on study design, the study objectives to address the research question, broader literature, the theoretical framework, and in consultation with stakeholders to ensure applicability to local context (Ashiru-Oredope *et al*., 2019; Di Gennaro *et al*., 2020; Engestrom, 2019). Constructs were made by way of grouping multiple statements such that statements pertaining to specific subject would be grouped to create the construct which would then be represented as a variable to measure for example, communication. Statements pertaining to communication were grouped together to create the variable communication abbreviated as C. All statements were
grouped into new variables, to create 5 variables namely the aforementioned communication as well as Learning at Work (LW), Acceptability and appropriateness of guidelines and actions (AC) referred to as acceptability, One Health knowledge (O) referred to as One Health and Scope and Awareness of AMR (S). Once constructed the new variables were tested for face validity in collaboration with the research team and previously mentioned stakeholders, constructs were also tested for reliability statistically. Construct validity refers to the degree to which a test assesses the underlying theoretical construct it is supposed to measure, this is not merely a question of measuring an attribute but the rather measures whether test score interpretations conform to a nomological network comprising theoretical and observational terms that is to say whether the degree to which predictions in a theoretical network are confirmed within the construct (Cronbach & Meehl, 1955; Hagger et al., 2017). To test for construct validity, the Cronbach alpha was used on the data set, this was not piloted instead, adopting systems thinking, the survey was rolled with the contingency plan to treat it as a pilot on the occasion that the Cronbach Alpha was found to be too low and deemed unacceptable, see section 7.3 for Cronbach results.

6.12 Data Analysis

In this section I discuss adopted approaches to data analysis for both QUANT and QUAL stands. I briefly discuss QUANT data analysis and then thematic analysis.

6.12.1 Quantitative data analysis

In the data processing and analysis used excel Qualtrics software and SPSS software. Surveys 1 and 2 followed the same process of analysis. Over the period during which the survey was live and available to participants for completion initial data analyses were conducted on the Qualtrics platform. The facilitated sense making and data familiarisation. At the end of the data collection phase, data were imported from Qualtrics into an excel spreadsheet where data was cleaned. Analysis was restricted to complete surveys, thus complete surveys were imported into SPSS. Survey one analyses focused descriptive statistics, frequencies and percentages. Text-based responses were analysed thematically, where responses required an answer to evidence a claim such as having to name previously attended courses on AMR,
these data were counted i.e. the number of participants who reported having attended an antibiotic stewardship course. See section 7.1.1. Survey 2 data followed a similar process of cleaning and importing data into SPSS. Once in SPSS, data were explored for familiarisation and sense making. To accurately analyse Likert scale data and present meaningful findings including mean, reverse coding was adopted in line with broad approaches to Likert scale analysis (Jozsa & Morgan, 2017). Items were then grouped based on constructs and new variables were computed. Variables were analysed for validity and reliability using the Cronbach Alpha. Descriptive statistics were then computed, analysing mean and standard deviation. Single item analysis was also carried out, this provided useful information representing the average of each of the items, this facilitated an exploration of the most frequently chosen answer. Standard deviation expounded on data dispersion in relation to the mean. Data facilitated a better understanding of items individually and as constructed categories (see section 7.3.1 ) (Ashiru-Oredope et al., 2019, p.21).

6.12.2 Qualitative data analysis

Nvivo software was used for storing QUAL data, coding and theme development (Creswell & Plano Clark, 2018). Latent coding was used, this deemed most appropriate based on the previously discussed cultural factors such as the local way of speaking was involving parables and proverbs (see section 6.6.1). As well as other confounding factors that are usually present when conducting interviews such as social desirability, dishonesty, and the accuracy of respondents’ memories (Bryman, 2001). Therefore, making the job of the researcher to interpret the interview and in the second instance use member checking by going back to the participants with data and interpretations to confirm the credibility of information and the adopted narrative account (Creswell and Miller, 2010). Analysis happened over a period of phases beginning with data anonymisation. Table 6.4 below lists all participants from interviews and WhatsApp feedback in iterations 2 and 3.
Table 6.4: Interview/WhatsApp feedback participants

<table>
<thead>
<tr>
<th>Participant identifier</th>
<th>Role</th>
<th>Sex</th>
<th>Ward/Workspace</th>
<th>MoH/NGO</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBMA01</td>
<td>Lab manager</td>
<td>M</td>
<td>Lab A</td>
<td>MoH</td>
</tr>
<tr>
<td>HDMS02</td>
<td>Hospital Director</td>
<td>M</td>
<td>Admin Block</td>
<td>MoH</td>
</tr>
<tr>
<td>LTMB03</td>
<td>Lab Technician</td>
<td>M</td>
<td>Lab B</td>
<td>NGO</td>
</tr>
<tr>
<td>LBFB04</td>
<td>Lab Manager</td>
<td>F</td>
<td>Lab B</td>
<td>NGO</td>
</tr>
<tr>
<td>COMFS5</td>
<td>Clinical Officer Intern</td>
<td>M</td>
<td>Female Surgical Ward</td>
<td>MoH</td>
</tr>
<tr>
<td>COFFS6</td>
<td>Clinical Officer Intern</td>
<td>F</td>
<td>Female Surgical Ward</td>
<td>MoH</td>
</tr>
<tr>
<td>COMFM7</td>
<td>Clinical Officer</td>
<td>M</td>
<td>Female Medical Ward</td>
<td>NGO</td>
</tr>
<tr>
<td>COMMM8</td>
<td>Clinical Officer</td>
<td>M</td>
<td>Male Medical Ward</td>
<td>NGO</td>
</tr>
<tr>
<td>COFTB9</td>
<td>Clinical Offer</td>
<td>F</td>
<td>TB/COVID19 Ward</td>
<td>NGO</td>
</tr>
<tr>
<td>COMM10</td>
<td>Clinical Officer</td>
<td>M</td>
<td>Male Medical Ward</td>
<td>NGO</td>
</tr>
<tr>
<td>DAFS11</td>
<td>Doctor - Anaesthetist</td>
<td>F</td>
<td>Surgery</td>
<td>MOH</td>
</tr>
<tr>
<td>NMOD12</td>
<td>Nurse</td>
<td>M</td>
<td>Outpatients Department</td>
<td>MOH</td>
</tr>
<tr>
<td>PCMP13</td>
<td>Paediatric Consultant</td>
<td>M</td>
<td>Paediatric Ward</td>
<td>MOH</td>
</tr>
<tr>
<td>PDFP14</td>
<td>Paediatric Doctor</td>
<td>F</td>
<td>Paediatric Ward</td>
<td>MOH</td>
</tr>
<tr>
<td>HRFA15</td>
<td>Head of HR</td>
<td>F</td>
<td>Admin Block</td>
<td>MOH</td>
</tr>
<tr>
<td>COFTB16</td>
<td>Clinical Officer</td>
<td>F</td>
<td>Respiratory Ward</td>
<td>NGO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MDR TB Ward</td>
<td>NGO</td>
</tr>
</tbody>
</table>
The next phase was data exploration and memo writing and progressing towards refining and mapping the activity system with the view to triangulate interview data with observational data presented in section 8.4.

6.12.3 Thematic Analysis

Thematic Analysis (TA) enables systematic identification, analysis, and interpretation of patterns across qualitative datasets through the process of coding and systematic development of codes into themes (Braun & Clarke, 2022; Denscombe, 2010). It enables the organisation of data and in identifying themes and moves beyond counting specific words or phrases to focus on identifying and describing both implicit and explicit ideas (Namey et al., 2008). This was particularly important, in the context of this study where culturally, the use of proverbs and parables in daily language was a common part of local culture. To that end, latent coding was deemed most appropriate for analysis. Codes were developed inductively and applied to raw data as summary markers for later analysis. This was an iterative data-driven process whereby I engaged in careful reading and reading, identifying keywords, trends, and ideas in the data. I coupled the data driven approach with a theory-driven approach that was guided by activity theory categories, involving close reading and with the activity system in mind (Namey et al., 2008).

This was useful in the context of exploring and analysing the activity system and the potential for embedding technological tools into professional learning for AMR. I adopted reflexive approach to TA, this was in keeping the broader philosophical approach my research project as reflexivity requires researcher engagement in critical reflection to
consider my research practice and process. I therefore used Braun & Clarke’s (2022) six phase analytic process, namely; 1. dataset familiarisation 2. data coding 3. initial theme generation 4. theme development and review 5. theme refining, defining, and naming and 6. the write up. Amongst the assumptions of reflexive TA is researcher subjectivity as a primary tool that views knowledge generation as both subjected and situated. Thus, I sought not to get rid of my subjectivity but to understand it and how it influences my thinking and analysis across the six TA phases. I engaged in reflexivity on multiple levels, this is made apparent in the methodology and reflections on my underpinning philosophical approach and situating my personal philosophy in relation to that of the Bantu and Nilotic Kenyan communities and their shared ethics, in chapter 3. Therefore, over the data analysis process, I engaged in personal, functional and disciplinary reflexivity. On a personal level, I continuously considered how my ethics and values would shape my research, I also engaged in functional reflexivity, to consider how the methods and the various aspects of design shaped the research and knowledge produced. Lastly, I engaged in disciplinary reflexivity, considering how the disciplines that my disciplinary work exists within shape knowledge production (Wilkinson, 1988). I sought to develop strong interpretation of the data that is insightful and as rich and nuanced as the human interactions that were embedded within the research site. As such I thematically analysed my observation field notes, qualitative survey and interviews and went back to participants for member checking.

The interview process included note taking and reflecting on the interview and initial coding. Braun and Clarke, (2022) note that coding to be an evolving and open process where insights develop through analytic engagement. The coding process can be “a loop-like pattern of multiple rounds of revisiting the data as additional questions emerge [and] new connections are unearthed.” (Berkowitz, cited in Srivastava and Hopwood (2009, p. 77). I therefore adopted this loop like nature. Where themes were noted as requiring further attention, amendments were made to the instrument. Additionally, the mhealth tool was originally designed to be trialled as an intervention across the whole group as an iteration. However, there were technical challenges with the tool on the backend that required the intervention of the software developers. As a result, the tool was piloted on a small group, that were the interviewees. Where questions were in the instrument were initially designed to ask about a hypothetical mhealth tool, they asked about the pilot version of the tool.
Towards the end of the interview participants were handed a phone where could access the mhealth tool, they were asked to use the tool and provide feedback on the tool with respect to professional learning, contextually relevant factors that may affect usage and uptake.

6.9.3.1 Phase 1: Dataset Familiarisation
Data familiarisation is both a process of immersing oneself in the data to develop an intimate knowledge of the data alongside critical engagement. This requires the researcher to step out of the immersive process, and actively create some distance between data and themselves so that one can critically engage with the dataset (Braun & Clarke, 2022). Across the different iterations, data familiarisation varied slightly, for example, in iteration one, it meant reading and re-reading survey responses. Where the focus was on the open-ended questions, it was useful to familiarise myself with the entire survey, and the individuals responding to the survey and their role and demographics to understand the story they were telling across the quantitatively analysed responses and qualitative responses. In iteration two and three, data familiarisation was conducted by listening to transcripts and transcribing interviews, as well as reading and rereading field notes. This enabled me to begin to gain some insight into the data items and across the dataset. Once I had data across all iterations I conducted another familiarisation phase, in order to find continuation and points of convergence in codes across all phases, earmarking data segments that provided partial information, and looking across other iterations for continuation and required clarity. In this way I triangulated the data (Cresswell and Miller, 2010).

6.9.3.2 Phase 2: Data coding
Data were imported into qualitative software package Nvivo 12 which facilitated data sorting and management. Coding was done initially at the end of each iteration; preliminary analysis was used to inform next iteration. Then once all data had been gathered, Alhojailan, (2012) notes multi-phase analysis to be compatible with thematic analysis. Once all iterations were complete, I worked systematically through the data, reading each transcript and observation entry in the field notes closely, this included reading through my reflections that I noted whilst I was in the field. During readthroughs I got a broad sense of some of the key elements of the dataset. During the coding, I systematically worked to identify data segments that seemed interesting, relevant, and meaningful for the research question (Alhojailan, 2012; Braun and Clarke, 2022). This included elements of responses that were
that were both closely and loosely related to professional learning and AMR practice. I recorded memos alongside the coding process, this for example enabled me to keep a log of loosely related elements, that had some relevance or seemed interesting and potentially relevant. I would revisit these and explore links to other elements across the dataset, themes generated are discussed in chapter 8.

Below is an example of the table used to capture fieldnotes. This included short form field notes taken on the wards during observation sessions as well as extended field notes taken at the end of session. The tables below (tables 6.5 and 6.6) show highlighted text, that is exemplary of the initial coding as applied to observation notes as well as to interview transcripts. Highlighted sections correspond to codes by colour.

Table 6.5: Extract of coded Ward Observations

<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.05.22</td>
<td>FSMOH WARD</td>
<td>08:00</td>
<td>3 hours</td>
</tr>
</tbody>
</table>

Notes: Health professionals gathered around the table (10 at present). The sister (leading nurse) who I met yesterday introduced me to the team. I chose ward rounds observations based on the day each ward is supposed to have big rounds with the consultants so I could map relationships across entire teams. At the beginning of the round, the team seemed to be waiting for the consultants – I asked a clinical officer who confirmed they were waiting for consultants. The team spoke among themselves in waiting. The handover started with going through the night report, night duty nurses reflecting on how the patients were overnight and then a caseload discussion for each patient. At the end of the handover the lead nurses said remember, “If I read, I remember, if I remember” and in chorus practitioners say “I do”. With that she reminds nurses that all caseloads must be read and instructs nurses to remember to
have conversations with patients about physio and nutrition and reminds the team “if they can swallow, they should swallow for infection control”

Ward round – led by 2 Clinical Officer Interns (COI) and nurses

COIs moved around in 2s, they reviewed cases, asked patients how they were feeling, examining patients, reflecting back on the notes and that should be run, in some cases asked if certain test results were back. Examining COI asked for details of test results, or which tests have been run and on what date. One patient appeared to be a difficult case, not showing enough improvement. From what I could gather the patient had been on different antibiotics for more than a month, the infection was showing little signs of subsiding, and she was oozing with puss post-surgery. After rounds I followed up with participant COFFS6, an intern Clinical Officer who explained that the case was indeed difficult, the patient had “several repeats” of antibiotics, but was not reacting in the way one would expect. When I asked whether they had done cultures for the patient. She said no cultures have been done then references reliability of the lab and how “you can request and they tell you something was wrong with the sample, you pull sample three times and have nothing at the end” COFFS6 also noted, “if they can’t run the test here, it will go outside but we have low positive rates and you have”

Codes: Absentism, go-slow, communication, learning, Right route, lab reliability, blind empirical diagnosis, outsourcing Collaborative practice
Table 6.6 Extract of coded interview transcript

<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.05.22</td>
<td>ODMOH</td>
<td>20:30</td>
<td>23:52</td>
</tr>
</tbody>
</table>

| Participant ID: | NMOD12 |

Legend: P = participant  R= researcher

<table>
<thead>
<tr>
<th>Codes</th>
</tr>
</thead>
</table>
| R: During strikes when there is no doctor. Can nurses prescribe?  
P: Yes  
R: What about in a normal situation, can nurses prescribe?  
P: Well after 5 years they can apply to be nurse practitioners through but specialisation courses can shorten the period but that depends on the level of facility. For example, at the dispensary and health centres, nurses prescribe and dispense drugs. Also, in special clinics like psychiatry, palliative care and renal unit.  
R: What about when there are doctors present?  
P:No when there are doctors, doctors do the prescriptions. Nurses only do prescription of analgesics and again only nurses trained in advance pain management and palliative care.  
R: |
|-------|
| Circumstantially permitted prescribing  
Legally authorised prescribing  
Nurse Prescriber |
6.9.3.3 Phase 3 & 4: Initial theme generation, development & review

The research was guided by research questions on what and how practitioners learnt at the time of the study, the sociocultural factors that influenced learning including economic factors and the facilitators, barriers, and opportunities for learning. These research questions guided analysis, for example, I categorised codes based on the three research questions to understand how these interacting factors affected a health professional, see figure 6.9 below for diagrammatic representation.

![Diagram of factors affecting learning](image)

**Figure 6.9 Factors that affect how a (subject) health professional in a Kenyan facility learns to tackle AMR**

In the initial theme generation, I adopted an inductive approach, then looked to understand what the evidence offered by categorising themes based on the research questions, see for example figure 6.10 mapped themes relevant to research question 2. Relevant categories are depicted in figure 6.9 as having a mutual relationship with the subject, that is to say current CPD, sociocultural factors and barriers and facilitators impact the subject. Conversely, by subjects exercising their urgency, they for example shape sociocultural factors, because culture isn’t static, but is ever evolving and thus makes activity systems virtual disturbance producing machines (Engstrom, 2005). Figures 6.10 and 6.11 are examples categorised themes with reference to respective research questions attached above, categorising themes helped to comprehensively answer the research questions in
the discussion in chapter 8. Themes were then reviewed, to check themes made sense in relation to coded extracts and in the context of the full dataset. This involved reviewing iteration 1, to begin to understand how themes in iteration 2 fitted with QUANT data, this is in keeping with approaches to triangulation (Creswell and Miller, 2010).

RQ2: What socioeconomic factors impact learning for health professionals?

RQ3: What are the barriers and facilitators to learning about and practicing AMR stewardship?

Figure 6.10 Initial coding categorification for socioeconomic and sociocultural factors

Figure 6.11 Initial coding categorification for barriers and facilitators to learning
Initial data presented in figures 6.10 and 6.11 were then refined in the next phase. This included managing cooccurring themes, where necessary collapsing two themes into a single theme as well as managing the connections between themes within and across the theme maps resulting in more refined themes that included subthemes presented in chapter 8.

6.9.3.4 Phase 5 & 6: theme refining, defining, naming and writing up
The data were once again reviewed, to engage in an iterative process of noting patterns and cross cutting themes (Braun and Clarke, 2022). Once common themes started reoccurring across interviews, I concluded that I had reached data saturation had been achieved due to the as little new information relating to the main research question was discovered. I therefore engaged in the process of theme refining, defining, and naming. Moving to writing and returning to refinement as when necessary, over the write up phase where data was presented. See chapters 7 and 8 for data presentation.

The final contribution of the analysis approach used in this thesis also relates to the validity of the results by considering whether the results were credible in the eyes of participants (Nowell et al., 2017). As described by Yin (2014), construct validity relates to whether the results achieved are actually representative of the phenomenon studied, in the context of this study, the narrative and interpretation of data was important to understand whether participants had been represented in the data. Member checking was therefore employed, Lincoln and Guba (1985) describe member checks as “the most crucial technique for establishing credibility” (p. 314) in a study. It constitutes presenting data and interpretations to study participants to confirm credibility of information and narrative account. Participants were presented with results through WhatsApp, where I would communicate with participants and check for narrative and account. This was done iteratively, for example in analysis when a term required clarity or I was doubtful of meaning, I reverted to WhatsApp to ask for clarity.

6.13 Conclusion
In this chapter I expanded on my methodological decision making. I built on decolonial arguments from previous chapters to demonstrate the methodological implications of decolonial thinking and the opportunities that exist within mixed methods thinking for
boundary crossing to accommodate decolonial scholarship. I argued that employing decolonial thinking has important implications for capturing what may be evolving on the ground, within communities of memory and practice. Where what is happening or what has happened on the ground is not necessarily reflected in academic spaces, and in literature. Thus, the chapter exemplified the methodological process of negotiating how to bridge that gap, in order to reflect what is happening on the ground within academic literature (Hoppers, 2000). It demonstrated how a focus on capturing the story that is evolving on the ground, coupled with the commitment to centering collective voices of the people on the ground can be leveraged to guide and justify methodological decisions. Such that one can for example, embed degrees of amenability in the research design in order to foster an openness that is not only in keeping with decolonial scholarship but presents an opportunity to contribute to the development of new typologies of mixed methods research that may prove to be more fitting for certain research contexts such as in public health education in Africa. The chapter also presented the research design, effectively demonstrating the affordances of triangulating DBR and CHAT for decolonial thinkers. Later parts of the chapter focused on methods for data collection and analysis including approaches to checking for validity and reliability. The chapter draws to an end with examples of thematic analysis and an invitation to explore chapters 7 and 8 for data presentation.
Chapter 7: Iteration 1 findings

7.1 Introduction

The conceptual framework details the triangulation of activity theory and design-based research (DBR) (See chapter 4). The methodology chapter demonstrated the application of the conceptual framework and ethics to the decision-making process in relation to methods. Providing justification for choosing methods for data collection that would provide data best positioned to answer the main research question. This chapter presents findings from across the first iteration and phases one and two, to present quantitative and qualitative data. Iterations 2 and 3 are presented in chapter 8. This chapter frames findings and preliminary discussion for iteration one within the context of activity theory and DBR. The iterations were based on the central focus of the thesis - how do health professionals in a Kenyan health facility learn to tackle AMR? Sub-research questions detailed below were used to guide thinking and navigating data capture across all iterations.

RQ1. To what extent and through what methods do health professionals engage with continuous professional development?
RQ2. What socioeconomic factors impact learning for health professionals?
RQ3. What are the barriers and facilitators to learning about and practicing AMR stewardship?

Figure 7.1 Representation of study findings (The vibrant part of the figure displays the findings presented in this chapter, greyed out section are findings are presented in chapter 8.)
7.2 Iteration 1

The design of iteration 1 was based on iterations 0 and 0.5 – these formed background and context of study and settings. Iteration 1, Survey 1 was designed to provide data that would facilitate the mapping of the activity system and inform the design of the technological intervention in line with DBR (Engestrom, 2018). As such questions were framed in reference to approaches to Technology Acceptance and Usability Surveys (TAUS). These typically seek to establish the extent to which environment is primed for absorbing a new technology and the likelihood of acceptance (Lynch et al., 2022). Data are then used to inform the design and implementation of new technologies. The survey therefore gathered data relevant to technology acceptance and usage and the mapping of the activity system, such as demographic data, participant roles in line with framing division of labour within activity theory and previous exposure to technology for learning at work. Subsequent sections present the findings.

7.2.1 Respondent Demographics

Respondents were aged between 18 and 60. Over half of the respondents (55.8%) were aged between 31 and 40, with a slightly higher response rate from women at 51.2%.

Table 7.1: Respondents’ age and gender (n=43)

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 25</td>
<td>5 (11.6)</td>
</tr>
<tr>
<td>26 – 30</td>
<td>9 (20.9)</td>
</tr>
<tr>
<td>31 – 40</td>
<td>24 (55.8)</td>
</tr>
<tr>
<td>41 – 50</td>
<td>4 (9.3)</td>
</tr>
<tr>
<td>51 – 60</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td>60+</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>21 (48.8)</td>
</tr>
<tr>
<td>Female</td>
<td>22 (51.2)</td>
</tr>
</tbody>
</table>
The respondents were from various job roles, namely, clinical officers, doctors, nurses, and lab technicians. All of the roles are involved in the antibiotic recommendation to dispensation pipeline within a hospital setting.

Table 7.2: Respondents’ role and number of years in practice in their profession (n=43)

<table>
<thead>
<tr>
<th>Job Role</th>
<th>Number of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Officer</td>
<td>14 (32.6)</td>
</tr>
<tr>
<td>Doctor</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Nurse</td>
<td>9 (20.9)</td>
</tr>
<tr>
<td>Lab Technician</td>
<td>17 (39.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years of Experience</th>
<th>Number of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1</td>
<td>10 (23.3)</td>
</tr>
<tr>
<td>2 - 4</td>
<td>4 (9.3)</td>
</tr>
<tr>
<td>5 – 7</td>
<td>10 (23.3)</td>
</tr>
<tr>
<td>8 – 9</td>
<td>14 (32.6)</td>
</tr>
<tr>
<td>10+</td>
<td>5 (11.6)</td>
</tr>
</tbody>
</table>
Table 7.3: Respondents’ antibiotic interaction in role (n=43)

<table>
<thead>
<tr>
<th>Antibiotic interaction</th>
<th>Number of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommend</td>
<td>23 (53.5)</td>
</tr>
<tr>
<td>Prescribe</td>
<td>18 (41.9)</td>
</tr>
<tr>
<td>Dispense</td>
<td>8 (18.6)</td>
</tr>
<tr>
<td>Other</td>
<td>7 (16.3)</td>
</tr>
</tbody>
</table>

7.2.1.1 Respondents perceptions of dealing with antibiotics
Respondents were asked about **recommending, prescribing, and dispensing** of antibiotics in their roles.

**Recommending** can be understood as suggesting the antibiotic with the highest propensity to be effective in treating an infection. This is done in one or two ways. The first uses tests from the laboratory, whereby bodily fluids are drawn from the human body and put through tests known as cultures that test to find bacteria or fungus causing an infection. A sensitivity test checks for the medicine that has the highest chance of effectively treating the infection (Bayot & Bragg, 2022). As such it was anticipated that lab technicians would opt for the category ‘recommend’ in the survey. The second way of recommending is done in lieu of lab tests, whereby a practitioner assesses a patient and makes a recommendation of treatment based on how the patient is presenting, for symptoms such as a fever, this is known as empirical diagnosis. As such it was anticipated that clinical officers, doctors, and advanced nurse practitioners would also opt for the category ‘recommend’.

A **prescriber** is someone who has legal authority to issue a prescription for pharmaceutical drugs. The process of prescribing can be understood as the issuing of a formal communication from prescriber to other registered health-care professional, such as a pharmacist, to authorize the issuing of a specific drug for a specific patient (Health and Care Professions Council, 2019). In this case, it would be anticipated that roles that have the legal authority to prescribe would deem that their roles include recommending and prescribing,
these roles include clinical officers, doctors and in some cases nurses who have acquired further training to become advanced nurse practitioners (ANP).

*Dispensing* is the process of preparing and giving a specific medicine to a specific person on the basis of the prescription. Dispensing is typically understood as the pharmacists’ role and can include the nurses within hospital wards where patients may be admitted (GovKenya, 2017).

When asked whether they ‘prescribe’, ‘recommend’, or ‘dispense’, with the option to tick all relevant, 53.5% of all survey respondents said their role involved recommending antibiotics and 41.9% of all survey respondents said their role involved prescribing antibiotics. Given that clinical officers and doctors who are the more common prescribers made up 39.6% of the respondents’ data reflected the possibility of one individual who may have been an ANP. Data were revisited to locate the job role and it was noted that a nurse had reported that prescribing was a part of their role, which was initially inferred to imply they may have been an ANP. I revisited the data to build a more comprehensive picture of the particular participant. When asked about years of experience, the participant had selected 2-4 years as their response, which disqualified the possibilities of the ANP narrative, because ANPs require a minimum of 5 years’ experience. This flagged the need to follow up and pay greater attention to prescribing practices (see section 7.2.1).

18.6% of the total number participants said their roles involved dispensing, with 16.3% of total respondents reporting they neither recommended, prescribed nordispensed and opting for ‘other’. All participants who opted for ‘other’ were lab technicians. Lab technicians would be expected to opt for ‘recommend’ as their role typically involved looking at cultures for sensitivity to antibiotics. This was also noted for further exploration in observations and prompted the need to explore how respondents in each job role had responded with granularity. Therefore, crosstabulation analysis were conducted for each of the variables. Table 7.4 below provides a summary of the contingency tables that were run to show frequencies of how participants responded to the question on their role in interacting with antibiotics in practice. For example, table 7.4 shows consensus on antibiotic interaction amongst doctors and clinical officers. 100% of doctors and Clinical Officers responded that their role involved prescribing.
Table 7.4: Respondents’ reported antibiotic interaction by job role

<table>
<thead>
<tr>
<th>Job Role</th>
<th>Recommend (%)</th>
<th>Prescribe (%)</th>
<th>Dispense (%)</th>
<th>Other (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Officer</td>
<td>7 (50)</td>
<td>14 (100)</td>
<td>1 (7.1)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Doctor</td>
<td>1 (33.3)</td>
<td>3 (100)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Lab Technician</td>
<td>10 (58.8)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>7 (41.2)</td>
</tr>
<tr>
<td>Nurses</td>
<td>5 (55.5)</td>
<td>1 (11.1)</td>
<td>7 (77.7)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Some divergence within roles is noted across all other categories, for example 50% of clinical officers said they recommend antibiotics whilst 7.1% said they dispensed. 33.3% of the doctors said that they recommended. Of the lab technicians 58.58% said they recommended whilst 41.2% said their role was other. Some speculation on the causes of divergence in answers could be made, based on previous experience in the pilot in iteration 0. One could, for example, speculate that divergence was based on the number of years in practice. For example, a lab technician with less experience on the job would not be in position to recommend (East et al., 2014). These speculations were followed up both in observations and interviews in iteration 2 for further clarity where in an interview with participant LTMB03, they were able confirm that in their setting the lab technician’s role includes recommending. However, LTMB03 speculated that perhaps the term ‘recommend’ had not been understood.

7.2.2 Professional learning in practice

In the initial survey, participants were asked a series of questions specific to professional practice. These were a combination of multiple choice and text-based responses. Multiple choice questions were analysed quantitatively, the summaries of which are presented using descriptive statistics (Creswell & Plano Clark, 2018). Text-based responses provided limited data and were used to as evidence to substantiate a claim to knowledge. That is to say, if a participant for example answered that they understood the meaning of AMR, the
subsequent question requiring a text-based response asked for an explanation of what AMR is. Qualitative and quantitative data were analysed and are presented in the subsequent paragraphs.

When asked about their continued professional development (CPD), 90.7% of the participants from across all roles (n=43) said that CPD was a formal requirement of their role. One might have expected 100% of response for this question, given that all health professionals are required to undertake regular CPD (GovKenya, 2014). However, I came to appreciate that this is broadly known in the context as Continuous Medical Education (CMEs), and the change and terminology may have had an impact on their responses. Additionally, the hospital is a teaching hospital, and some of participants may have still been in training to qualify for their roles and may subsequently perceived CPD as a requirement for in-service roles. The 90.7% of participants who had answered yes to ‘CPD’, were then asked how much CPD was required over the course of the year. A text-based response was sought. Participant responses varied, see below,

“earn 20 points equivalent to 10 courses” – Nurse

“not specified” - Clinical Officer

Some answers were more specific and reflected the number of hours i.e.

“52 hours” – Nurse

Some responses seemed particularly high, such as the 52 hour requirement. Data were therefore analysed thematically to find some synthesis. Across the responses it appeared that the variation in hours was dependent on how long it took to complete a course, for example in relation to online courses. When followed up in iteration 2, COMFM7 supported this synthesis. When asked about CPD COMFM7 responded

“It depends, we do it in points” - COMFM7

COMFM7 explained the point system, explaining that he tries to do 1-2 hours a week, this would in this way support responses such as 52 hours per annum. A broader discussion CPD can be found in section 8.5.2
All participants were then asked how long ago they took part in professional learning activity, including online or in person activities. Most participants, at 53.5% had taken part in CPD activity in the previous 0-3 months. Table 7.5 details responses in relation to their time since the last course.

Table 7.5: Time since last course (n=43)

<table>
<thead>
<tr>
<th>Time in months</th>
<th>Number of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>23 (53.5)</td>
</tr>
<tr>
<td>4-6</td>
<td>3 (7.0)</td>
</tr>
<tr>
<td>7-9</td>
<td>7 (16.3)</td>
</tr>
<tr>
<td>10-11</td>
<td>7 (16.3)</td>
</tr>
<tr>
<td>12+</td>
<td>3 (7.0)</td>
</tr>
</tbody>
</table>

When asked whether they had taken part in any course or other professional learning activities on AMR, 86% of the participants said they had not. Of the 14% who had taken part in a course, they were asked to provide further information on the courses they had attended. Responses are displayed below with the number of respondents.

“antibiotic stewardship” (n=2)

“antibiotic resistance” (n=2)

“the use of ceftriaxone” (n=1)

“one week on the OJT (interpreted as on-the-job-training) on the laboratory role in fighting AMR” (n=1)

Cross tabulation was run, table 7.6 below shows previous access to AMR courses by job role.
Table 7.6: Previous experience with experience to AMR by job role

<table>
<thead>
<tr>
<th>What is your job role?</th>
<th>Have you taken any courses or other professional learning activities on antimicrobial resistance?</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Officer</td>
<td></td>
<td>12</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Doctor</td>
<td></td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Lab Technician</td>
<td></td>
<td>14</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Nurse</td>
<td></td>
<td>8</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>37</td>
<td>6</td>
<td>43</td>
</tr>
</tbody>
</table>

Participants were asked further questions requiring text-based responses. These were analysed in Nvivo and summative themes were generated. When asked ‘What types of professional learning or continuous medical education opportunities are there for you to develop new skills and knowledge in your workplace?’ In text-based generated responses participants said they had taken part in lectures – online and offline, seminars, workshops. These had also taken part in Continuous Medical Education (CMEs) online from various websites. Other responses included on the job training and individualised consultations with senior/teaching members of staff.

7.2.3 Accessibility

Participants were asked questions pertaining to the pragmatics of undertaking a course online and/or the use of mobile devices in course content delivery. This set of questions were focused on technology and usability, looking specifically for data on infrastructure and participant access, including factors such as affordability and regularity of access. This in keeping with the typical framing of TAUS to determine potential acceptance and usability of a technological intervention (Lynch et al., 2022). Data were therefore gathered with the view to inform design decisions pertaining to the mode of delivery for the AMR course that would be used in the context of this study, the results of which are presented in this section.
On the question of affordability, participants were presented a choice of three words; ‘cheap’, ‘affordable’, ‘expensive’ to describe internet affordability for them. The results are presented below and are divided based on job description.

*Table 7.7 Internet Affordability across job roles*

<table>
<thead>
<tr>
<th></th>
<th>Clinical Officer</th>
<th>Doctor</th>
<th>Lab Technician</th>
<th>Nurse</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Which word best describes internet affordability for you?</strong></td>
<td>Affordable</td>
<td>10</td>
<td>3</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Expensive</td>
<td>4</td>
<td>0</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>14</td>
<td>3</td>
<td>17</td>
<td>9</td>
</tr>
</tbody>
</table>

None of the participants n=0, opted for ‘cheap’. This is in keeping with broader trends on affordability. In terms of affordability, Africa ranks lower than the global average, where the global average is an aggregated score of 54.8. Africa ranks at 38.8 and is the region with the least affordable internet (for more on connectivity see section 5). Kenya’s affordability based on average salary remains relatively low (GSMA, 2023; Alliance for Affordable Internet, 2021; Ngila, 2021). This was therefore in keeping with participants reporting internet as ‘affordable’ or ‘expensive’. These data were then cross tabulated to expand on whether the job role, which can be used as a proxy for income based on national pay scales for medical staff, had an impact on participants’ reported affordability (GovKenya, 2021). This is in keeping with global measures of calculating internet affordability based on income (Alliance for Affordable Internet, 2021). Across the four roles, doctors typically out earn the other roles, 100% of the doctors (n=3) opted for ‘affordable’. Across the rest of the roles, responses were divergent. Most of the clinical officers 71.4% (n=10), who based on their pay scales become the second highest earning group, opted for ‘affordable’. Only 33.3% (n=3) of nurses opted for ‘affordable’, whilst 52.9% (n=9) of the lab technicians found the internet ‘affordable’. It is here worth noting whilst number of years in service has impact on salary in the Kenyan public sector, salary is also impacted by the specialist courses a practitioner may take. Therefore, number of years alone would be inadequate in determining pay, given that participants were not asked questions on specialisms.
Participants were then asked about access to internet. Most participants 74.4% (n=32) said they had regular access to the internet. When asked how/where they access the internet, whether on mobile phones, at home on a laptop/desktop or at work on laptop/desktop or alternatively elsewhere such as at an internet café. 95.3% (n=41) had internet access on their mobile phones. Only 23.3% (n=10), had access to the internet on a desktop or laptop at home, this number grew slightly to 25.6% (n=11), when it came to access to internet at work on a laptop/desktop. Only 4.7% (n=2) used internet cafes for access. Whist the majority of participants had access to the internet, more than 25% did not have regular access and would have been left behind in learning platforms that required internet access.

Additionally, access was not commensurate with finding the internet affordable, reflecting the need to explore learning platforms away from the internet to ensure that learning solutions would be equitable, accessible, and affordable for the target population.

7.2.4 Previous learning experience

Participants were asked questions related to their previous learning experiences, with particular reference to accessing learning online or via mobile apps or mobile platforms. 69.8% (n=30) of the participants had previously taken part in an online course, whilst 74.4% (n=32) of participants had used a mobile platform for learning before. See tables 7.8 and 7.9 below.

Table 7.8 Previous mlearning experience

<table>
<thead>
<tr>
<th>Have you used a mobile app or mobile platform for learning before?</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>11</td>
<td>25.6</td>
<td>25.6</td>
<td>25.6</td>
</tr>
<tr>
<td>Yes</td>
<td>32</td>
<td>74.4</td>
<td>74.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
Table 7.9 Previous online learning experience

<table>
<thead>
<tr>
<th>Have you taken part in an online course before?</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>30.2</td>
<td>30.2</td>
<td>30.2</td>
</tr>
<tr>
<td>Yes</td>
<td>30</td>
<td>69.8</td>
<td>69.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Participants were subsequently asked to expand on the courses they had previously taken online. This question required a text-based response. Responses were thematically analysed, inductively. Resulting in the grouping responses into six themes, namely:

- clinical or lab practice
- COVID19
- HIV
- Management
- Non-communicable disease
- Infections

Across all themes some of the courses were marked as required CMEs (see appendix J).

7.2.5 AMR Knowledge

Participants were asked about their knowledge of AMR. The first question asked participants if they understood the term antimicrobial resistance. Of which 97.7% (n=42) of the participants said they understood the term. Participants were then asked to expand on their understanding of the term AMR, requiring a text-based response. These were analysed and against the WHO, (2021a) definition of AMR noted below,

“Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to medicines making infections harder to treat and increasing the risk of disease spread, severe illness and death” (WHO, 2021a, n.np)

Answers were subsequently grouped based on definitions offered. These were grouped into three categories; correct understanding, incorrect understanding, semi-correct but inadequately explained. For example, the response,
“Having an bacterial infections that is resistant to various antibiotics”

from a lab technician in Survey 1, (scoping survey) was classed as semi-correct but inadequately explained. Most responses 67% (n=29) were classed as correct, 27.9% (n=12) were classed as semi-correct however not adequately explained and 4.7% (n=2) were classed as incorrect, (see appendix J).

7.3 Iteration 1, Phase 1 Discussion

As discussed, the aims of iteration 1, phase 1 - the scoping survey, were to provide key demographical data and begin to map the activity system in relation to socioeconomic factors, consider barriers and facilitators to learning, the current undertaking of CPD, as well as expound on technology acceptance and usability in keeping with addressing the research questions. The preceding section presented this survey data.

This section offers a preliminarily discussion of the data, in order to begin to understand key elements in the activity system (Engestrom, 2018). A more comprehensive discussion is offered in chapter 9, where synthesis is drawn across all three iterations. Respondents were aged between 18 and 60, and from various job roles with most (39.5%) coming from the laboratory. This may have been partly due to the in-country, onsite project coordinator being a lab professional. The second group were clinical officers at 32.6%, followed by nurses at 20.9% and doctors making up only 7% of the sample. It is worth noting that clinical officers in Kenya, whilst not synonymous with doctors, have overlap in their roles. Clinical officers and doctors have different training programmes. However, the roles of clinical officers include medical and surgical procedures that are ordinarily carried out by doctors including diagnosis and prescription. Clinical officers are more commonly present in developing countries because of the perceived benefits when compared to traditional medical training such as reduced training and employment costs, such that in rural areas such as the research site, it is commonplace to have a higher number of clinical officers than doctors. This was the case on site (Wilson et al., 2011). Whilst the sample is not representative of the clinical officer to doctor ratios on site, the larger proportion of clinical officers than doctors is in keeping with expected distribution (see section 2.6 for county level data).
7.3.1 Antibiotic Interaction

How employees in each job role interact with antibiotics, and whether their tasks include antibiotic recommendation, prescribing or dispensing pipeline, is central to understanding how health professionals learn to tackle AMR. Thus, participants were asked how they interact with antibiotics in their role, (see table 7.4). Based on previous understanding of the roles, including the pilot iteration 0 and literature from MoH, Kenya, (2020). The anticipated interaction is as detailed in figure 7.2 below.

*Figure 7.2: Anticipated antibiotic interaction by job role*

The data were different from these expected interactions within job roles. The unexpected interactions are highlighted as the stars in figure 7.3. The survey did not give room for participants to expand on their roles beyond the multiple-choice options provided. The question of why, for example, nurses were recommending, or prescribing was approached in two ways. First through literature such as East *et al.*, (2014) that showed that Advanced Nurse Practitioner had the capacity to prescribe. In some ways assuming a similar role to clinical officers in being able to perform tasks that are traditionally designated for the doctor such as diagnosis and prescription of in less complex, more commonly presented disease cases (Wilson *et al.*, 2011). Secondly, at a later stage in observations and interviews, (see section) in iteration 2, (see to section 8.7). Another anomaly, though a less concerning one, were the clinical officers dispensing. Finally, a relatively low percentage of the sample of lab technicians, 41.2% (n=7) opted out of the recommending, to dispensing pipeline opting for ‘other’. This also required follow up in iteration 2. Interaction data contributed to the process of beginning to map the activity system and how community engages in in antibiotic related activity.
7.3.2 Professional learning in Practice

Engestrom, (2018) in his work on Activity Theory’s role in expansive learning in medical work elucidates on enculturation approach to developing expertise, asserting that “the enculturation approach to expertise sees thinking and knowledge as embedded in social situations, practices and cultures.” (Engestrom, 2018; 6). I would argue this approach extends to cultures developed around learning and the continuous development of expertise in practice, such that in the context of this study the culture of learning becomes central to answering the question of how professionals learn to tackle AMR in two important ways. In one way, addressing the first part of the research question, this places emphasis on the already existent culture of learning in Kenya, and more specifically at the research site. In a second way, placing emphasis on the latter part of the question, how they learn to tackle AMR, this sees the culture of learning as a novel issue requiring change in practice. Data showed that across all roles, most participants (90.7%) indicated that they were ordinarily required to undertake CPD courses. Therefore, a culture of continuous professional learning was anticipated. It was important to understand how it was ordinarily accessed; the methods and modes of delivery, its regularity and quantity over given periods as key to answering the overarching research question. Subsequently this emerging understanding guided RQ1 to focus on examining the extent and methods that health professionals engage with continuous professional development. In this way, data would
facilitate broader mapping of the culture of learning to contribute to mapping the activity system (for a diagrammatic representation of an activity system see section 4.4).

The element of rules in an activity system, in the context of this study can be understood as the governing rules at the research site, including the rules that govern CPD (Engestrom, 2018). Survey data showed a culture of CPD and variation in modes of delivery to include online/in-person seminars and lectures. Previous experience with online learning was further explored by asking participants whether they had previously done an online course. 69.8% reported having previously taken part in online learning, which subsequently rose to 74.4% when asked if they had used a mobile platform or app for learning. Approaches to gauging the potential acceptance and usability include considering whether participants had previous experience with specific technologies, as familiarity with technologies can increase the likelihood of uptake of the planned intervention (Lynch et al., 2022). Data on prior exposure therefore contributed to the decision to use an mhealth platform, as evidence of reported previous learning suggested that the use of an mhealth platform for AMR would be transitional rather than radical. It was anticipated that prior experience would ease the transition into learning delivered through an mhealth platform to participants from across the organisation (Dierkes et al., 2007).

7.3.3 Accessibility

In the pilot study conducted in iteration 0, socioeconomic dynamics influenced accessibility in relation to modes of delivering learning, with internet access and affordability highlighted as principle issues. Thus, RQ2 centred on socioeconomic factors impacting learning for health professionals, with the view to understand demographics and online and mobile app usage. Survey questions were designed to seek data on accessibility in the broad sense of whether learning could be made accessible across the various socio-demographics within the hospital. Within the scope of activity theory, this can be understood as across members of the community based on division of labour (Engestrom, 2018). Division of labour has an impact on income, affordability and in turn access to the internet. Cross tabulated data in section 7.1.3 showed consistency with expected outcomes of perceptions of internet affordability across job roles based on medical staff pay scales. That is to say the highest earning job role – doctors - perceived internet costs as affordable. However, there were
considerable disparities in reported affordability for remainder of the roles. This was indicative of the need to consider offsetting cost at the point of access, including internet costs in order to maximise accessibility based on affordability data. In this way data on affordability contributed to framing thinking to include pursuing research on pedagogically sound mhealth platforms that would be free at the point of access. In addition, the question of where and how participants access the internet was considered. Most participants (95.3%) accessed the internet on their mobile phones, coupled with previously data on mobile apps and mobile platforms for learning mobile platforms were seemingly contextually favourable.

7.3.4 AMR Knowledge

Whilst most participants (97.7%) in the survey considered themselves to understand the definition of AMR, when asked to expand on defining AMR by way of text-based responses, that were analysed against the World Health Organisation’s (2021,n. pn) definition of AMR as:

“Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to medicines making infections harder to treat and increasing the risk of disease spread, severe illness and death. As a result of drug resistance, antibiotics and other antimicrobial medicines become ineffective and infections become increasingly difficult or impossible to treat.”

The percentage of responses classed as correct was 67%. Comprehension of AMR is central to understanding and adopting approaches to effectively tackling AMR. As such a subsequent survey with a focus on Knowledge, Attitude and Practice was developed using data from the initial survey and broader KAP survey design literature (Gracia et al., 2011; Ashiru-Oredope et al., 2019). These formed the basis of phase 2 within this iteration.

7.4 Iteration 1, Phase 2 – Knowledge, Attitude, Practice Survey

In line with the common use of a Likert methodology across all fields of research, but particularly so within allied health and medical education, the KAP survey was designed to inform professional learning within health (Sullivan and Artino, 2013). This section discusses
approaches that informed the development of the KAP study, expands on the approach to analysing validity of constructs within the KAP and presents descriptive statistics of KAP survey specific study findings.

7.4.1 Approaches to developing the KAP survey content

The design of the KAP survey was informed by global health literature on AMR (de Vries, 1994). It was designed in line with procedural and stewardship guidelines (Dryden et al., 2011) and co-designed with a Kenyan microbiology consultant. In this way, the study adopted both a local and global approach. This was particularly important because whilst literature on AMR continues to grow, there is limited literature and country specific data at local level. As a result, where texts from the wider global health context were used to inform the KAP survey design, the consultant’s role included checking to ensure that the framing of statements were in line with and applicable to the Kenyan healthcare context. This aligned with the ethical approach to the study, ensuring that the local context was reflected.

How this approach ensured the design was locally specific can be exemplified:

- One statement read ‘Multi-drug resistant non-typfi Salmonella in Kenyan hospital and community settings rose from 31% in 1993 to 42% in 2003’ (Akullian et al., 2018).
- Other statements borrowed from national legislature as well as the broader global health AMR stewardship landscape including literature on the correct dispensation of antibiotics and educating the patient on dosage and adherence (de Vries, 1994; Dryden et al., 2011; GovKenya, 2020).
- The KAP survey framed questions in line with guidance to include for example, questions on giving out leaflets, pamphlets or advice on prudent antibiotic use or management (WHO, 2018).

Additionally, other AMR studies that used KAPs were used to inform KAP survey design as well as analysis (Garcia, 2011; Genaro et al., 2020; Genga et al., 2017).

7.4.2 KAP Construct validity
To test for construct validity, the Cronbach alpha was used. The Cronbach alpha across the constructs varied between >.6 and <.8. The communication subscale consisted of 5 items (α = .708), the acceptability subscale consisted of 13 items (α = .736), and the One Health subscale consisted of 12 items (α = .723). The learning at work subscale consisted of 5 items (α = .683), the scope and awareness subscale consisted of 9 items (α = .612). Literature, such as George and Mallery (2003), whose guidance on interpretation is as follows “> .9 – Excellent, > .8 – Good, > .7 – Acceptable, > .6 – Questionable, > .5 – Poor, and < .5 – Unacceptable” (p. 231) was used. This is supported in other literature where a Cronbach alpha of >.6 is acceptable (Tavakol & Dennick, 2011).

Table 7.10: Cronbach alpha measuring construct validity of variables

<table>
<thead>
<tr>
<th>Scale</th>
<th>Number of Items</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication (C)</td>
<td>5</td>
<td>.708</td>
</tr>
<tr>
<td>Learning at work (LW)</td>
<td>5</td>
<td>.683</td>
</tr>
<tr>
<td>Acceptability (AC)</td>
<td>13</td>
<td>.736</td>
</tr>
<tr>
<td>One Health Knowledge (O)</td>
<td>12</td>
<td>.723</td>
</tr>
<tr>
<td>Scope &amp; awareness (S)</td>
<td>9</td>
<td>.612</td>
</tr>
</tbody>
</table>

Amongst the challenges of using the Cronbach alpha is the debate on minimal value required for acceptability and reliability, for example where some scholars such as Cronbach & Shapiro, (1982) note that the minimal value should be .7, literature elsewhere (Tavakol & Dennick, 2011) suggests that minimal value should be .6 given that limitations such as the influence of sample size and number of items. Cronbach alpha for all subscales produced internal consistencies that met the minimal value of .6 required for acceptability and reliability, this is in line with the use of the Cronbach by other scholars such as Raharjanti et al., (2022).

An additional source of feedback about the quality of the questionnaire was gained through administrating the survey. It is here worth noting that once I had introduced myself onsite,
participants who had taken part in the online survey were increasingly open to speaking to me. Some participants approached me to express a lack of confidence around certain terms on the questionnaire, either reiterating their choices and explaining how they for example, used ‘neutral’ when they were unsure or lacked confidence regarding a term. In addition to this one participant said they had started but not finish the survey because they did not know what a word in one of the items meant. The participant displayed some apprehension to getting things wrong (FN2804). In this case the participant was encouraged to use ‘neutral’ if they had no understanding or opinion that would fit within agree/disagree or strongly agree/strongly disagree. The participant (NMFS20) was also offered reassurance that it was not a test, and a reminder that it was still voluntary and they had the option to carry on or drop out at any point. This was in keeping with the ethical approach to the study and the ethics approval. Where on site this only happened in two instances, given that the questionnaire was administered online for most participants, the researcher takes this into consideration. This is in keeping with Przybylski’s, (2021) assertion on the need to adopt multiple lenses of analysis in hybrid research, which I return to in the next section.

7.4.3 Descriptive analysis

This section presents descriptive statistics on each of the constructs as well as on single variables. Where scholars such as Carifio and Perla, (2008) note that adopting an analytics strategy that looks at single Likert items as a practice should occur only very rarely, this is one such occasion. Single item analysis of Likert scaled items is in line with the evidenced analytic strategies adopted by other scholars working on AMR specific KAP surveys (e.g. Garcia et al., 2011; Genga et al., 2017; Ashiru-Oredope et al., 2019). Analysis of each variable, as responded to by participants, offers a greater degree of granularity than constructed variables presented in 7.9. This approach is appropriate because AMR is an emerging field and exposure to AMR learning and knowledge remains varied across and within institutions. Therefore, where the Likert scale items were arranged in logical sequence and where items were closely interrelated, items were structured to provide information independent of preceding items. For example, ‘Scope and Awareness’ questions were posed to participants with interrelated items. ‘Antimicrobial resistance (AMR) is a worldwide problem’, had a mean score of 4.73, ‘Antimicrobial Resistance (AMR) is not a problem in Kenya’ had a mean score of 4.69 and ‘AMR is a problem in my daily practice’ had
a mean score of 4.42 as presented in Table 7.11. The mean provides useful information for data familiarisation representing the average of all responses to single items, and the general positive/negative trend in answering i.e. participants generally leaning towards strongly agree or strongly disagree.

The dispersion in data captured in the standard deviation provides further detail that is useful in appreciating the spread of data relative to the mean (Ashiru-Oredope et al., 2019;21). Therefore, item means and standard deviations are presented alongside response percentages in data visualisations such as figure 7.4. It is here worth noting that, to accurately analyse the Likert scale data and present meaningful findings including means, reverse coding is often adopted, in relation to negatively coded items. This is in keeping with broad approaches to Likert scale analysis (Jozsa and Morgan, 2017) and was adopted here.

Picking up on the issues raised in 7.3.2 about lenses needed on analysis, there was a need to learn the language of research sites including the insider vocabulary, context specific taboos in communication and shorthand references to digital platforms. This is in keeping with ethnographic study. This means that it is important to understand platform-specific codes and how they translate across the same group of participants with whom one is encountering both in a physical and digital space. As a result, observations and interactions with participants provided another lens for looking at the online data. For example, when looking at the individual means of items, some attention needed to be paid to means around 3, that reflect the use of ‘neutral’. Greater attention was then accorded to the items, by looking at the percentages, to consider the possibilities of implied difficulty of concepts and implied lack of confidence to respond noted earlier. Table 7.11, below displays means of around 3 on the questions specific to two studies. For example, the following statements had means of 3.62 and 3.58 respectively, ‘Resistance to the first-line treatment for P. falciparum malaria (artemisinin-based combination therapy) has been confirmed in five counties of the Greater Mekong sub-region’ and ‘Multi-drug resistant non-typhi Salmonella in Kenyan hospital and community settings rose from 31% in 1993 to 42% in 2003’. A closer look at the data, by item showed high percentages of ‘neutral’ responses (see figure 7.5). This was for example, different to the responses for the statement “Studies in Kenya have found that common life-threatening pathogens resistance to common first-line drugs such as ampicillin and cotrimoxazole” that had a mean of 4.12.
Data from iteration 2 showed that this might have been in part due to synthesis based on experiences. Knowledge of resistance to cotrimoxazole, may for example be more prominent amongst the health workers because it is a broad-spectrum antibiotic. Participants were more likely to have experienced cases of resistance to cotrimoxazole in practice. This is evidenced within the interviews at a later stage where participants were asked if they had seen cases of resistance in practice, amongst responses, participant COFTB9 specifically mentioned cotrimoxazole. It is typically used to treat respiratory tract infections such as bronchitis, COFTB9 worked on the TB/COVID19 respiratory ward. Additionally, resistance to both drugs is mentioned in the national action plan on AMR. Data from this phase were then used to inform the other phases, including module choice for the intervention. This was taken into account during the module development stage for the module in iteration 3 to include several studies as examples. In order to strengthen evidence-based practice by showing the association between practice and resistance.

7.4.4 Awareness and scope about AMR

On awareness within the context of the global, national, and local, 73.1% strongly agreed that AMR was a worldwide problem, whilst the remaining 25.9% agreed. The majority of participants strongly agreed at 80.8% that AMR was a problem in Kenya whilst 15.4% agreed, with 3.8% disagreeing, this would represent 1 (n=1) out the 26 participants. In the context of daily practice, 42.3% of participants strongly agreed that AMR was a problem in their daily practice whilst 57.7% of participants agreed. Reflecting general awareness of the problem of AMR.

![Figure 7.4](image)

*Figure 7.4: Awareness about scope of AMR as surveyed among 26 participants. Data represent percentages.*
Figure 7.5: Awareness about scope of AMR-specific to studies as surveyed among 26 participants.

Data represent percentages.
Whilst awareness of the problem of AMR at global, national, and local level was very high, in keeping with other literature conducted in other settings, both in Kenya and abroad (Garcia

<table>
<thead>
<tr>
<th>Items</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimicrobial resistance (AMR) is a worldwide problem</td>
<td>26</td>
<td>4</td>
<td>5</td>
<td>4.73</td>
<td>.452</td>
</tr>
<tr>
<td>Antimicrobial Resistance (AMR) is not a problem in Kenya</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>4.69</td>
<td>.838</td>
</tr>
<tr>
<td>AMR is a problem in my daily practice</td>
<td>26</td>
<td>4</td>
<td>5</td>
<td>4.42</td>
<td>.504</td>
</tr>
<tr>
<td>AMR/ Super bugs can be a cause of death</td>
<td>26</td>
<td>3</td>
<td>5</td>
<td>4.58</td>
<td>.643</td>
</tr>
<tr>
<td>Every person treated with antibiotics is at an increased risk of antibiotic resistant infection</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>3.88</td>
<td>1.071</td>
</tr>
<tr>
<td>Antimicrobials are overused in our hospitals</td>
<td>26</td>
<td>4</td>
<td>5</td>
<td>4.73</td>
<td>.452</td>
</tr>
<tr>
<td>Studies in Kenya have found that common life-threatening pathogens resistance to common first-line drugs such as ampicillin and cotrimoxazole</td>
<td>26</td>
<td>3</td>
<td>5</td>
<td>4.12</td>
<td>.431</td>
</tr>
<tr>
<td>Resistance to the first-line treatment for P. falciparum malaria (artemisinin-based combination therapy) has been confirmed in five counties of the Greater Mekong sub-region</td>
<td>26</td>
<td>3</td>
<td>5</td>
<td>3.62</td>
<td>.571</td>
</tr>
<tr>
<td>Multi-drug resistant non-typhi Salmonella in Kenyan hospital and community settings rose from 31% in 1993 to 42% in 2003</td>
<td>26</td>
<td>3</td>
<td>5</td>
<td>3.58</td>
<td>.758</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
et al., 2011; Genga et al., 2017). Literature has shown that awareness of scope of the AMR problem is not synonymous with understanding the problem of AMR (Genga et al., 2017). It was therefore no surprise that in a hospital in Kenya the majority of participants reported a high degree of awareness of the issue of AMR (Garcia et al., 2011; Genga et al., 2017). Yet, the same sample of participants, whose roles involved recommending, prescribing, or dispensing antimicrobials, largely perceived antimicrobials to be overused within the hospital setting. 73.1% strongly agreed that antibiotics were overused in the hospital setting, whilst the remaining 26.9% agreed. Highlighting a mismatch between awareness and practice. This finding in keeping with trends cited elsewhere, Garcia & colleagues (2011) found disparities between awareness and practice, that is to say whilst aware of the problem of AMR, practitioners do not consistently recognise how AMR translates to daily practice. For example, when asked whether participants understand how their AMR-related practice impacted resistance rates across the hospital, responses did not consistently mirror the reported understanding of scope. For example, whilst 100% of participants either agreed or strongly agreed that AMR was a problem in daily practice, this number dropped to 80.8% when presented with the statement on whether they understood how AMR-related practice impacted resistance rates across the hospital (See figure 7.4). Findings in subsequent sections were in keeping with Garcia and colleagues’ (2011) findings in a Peruvian hospital setting, in which the survey sought to elucidate on various aspects of knowledge, attitude and practice. These items were designed to strengthen the understanding of how to shape the intervention for learning to tackle AMR within this study. Participants were presented with statements specific to general understanding of AMR with particular reference to implications of antibiotic use (see figure 7.6).

![Figure 7.6 Knowledge of implications of antibiotic use & AMR as surveyed among 26 participants. Data represent percentages.](image)
The majority of participant responses to the statements ‘AMR/ Super bugs can be a cause of death’ and ‘Every person treated with antibiotics is at an increased risk of antibiotic resistant infection’ could be classed as having been correct. A slight increase in incorrect participant responses was observed, these were a minor divergence from the levels of awareness as captured in figure 7.4. This may have in part been to the increased awareness campaigns of AMR across the globe, including in Kenya, where the Ministry of Health Kenya runs annual World Antimicrobial Awareness Week Events (One Health Trust, 2015). The publicising and marketing of these events has increased awareness of the problem of AMR, and subsequent awareness campaign materials have been distributed (The Global Antibiotic Research & Development Partnership, 2020). In addition, the conversation on AMR has garnered national attention and researchers at Kenya Medical Research Institute (KEMRI) created an initiative between journalists and researchers known as Kenya’s AMR Media Network (The Global Antibiotic Research & Development Partnership, 2020). Its goals are to improve the media’s health reporting capacities and highlight the danger that antimicrobial resistance (AMR) poses to human health.

A combination of events, materials and media outlets appeared to have raised awareness, with campaigns being run in MoH hospitals. Key messaging of campaigns can vary in the range of information they present when highlighting the criticality of AMR. Researchers have previously found that though criticality is communicated, it can be without presenting the rigorous scientific evidence and the context specificities that effectively communicate the need for practitioner to engage in tackling AMR through their practice (Huttner et al., 2019). The following statements were presented in the Likert questionnaire; ‘Resistance to the first-line treatment for P. falciparum malaria (artemisinin-based combination therapy) has been confirmed in five counties of the Greater Mekong sub-region’ and ‘Multi-drug resistant non-typhi Salmonella in Kenyan hospital and community settings rose from 31% in 1993 to 42% in 2003’. The means for these statements were 3.62 and 3.58 respectively. Though referenced often in AMR literature with specific reference to Malaria, the Greater Mekong sub-region is located outside Kenya (Smith Gueye et al., 2014). The latter reference to the 1993 – 2003 study is specific to a point in time, where most participants, were not in practice. Data on years of practice in survey one shows that only 11.5% of participants had more than 10+ years of experience, with no data captured as to whether any participants
were in practice 19 years ago. Whilst such data is used both in education and campaigns to highlight criticality, it is worth noting that the survey in phase 1 showed that most participants (86%) had not taken part in AMR specific learning before. Several studies were used as examples in iteration 3 in the module that participants took part, this was done with the goal to strengthen understanding of how practice has implications for AMR levels in the hospital and across the locality, the national epidemiological landscape and indeed globally. Given the previously discussed question of confidence, the mean scores of around 3, which translates to ‘neutral’ can be viewed through the lens that looks at confidence based on field interactions (FN2804). In this way it can be explored as a slight shift in group confidence where knowledge of studies is concerned. Studies can be useful in improving practitioners’ understanding of the implications of antibiotic use in practice. This highlights the need to gain a better understanding of what participants know as well as identifying the opportunities to present practitioners with studies in iteration 3.

7.4.5 One Health Knowledge Capabilities

Table 7.12 below displays the individual items, means and standard deviations for statements specific to One Health knowledge. Looking at the means in the One Health Knowledge Category, there is decline of responses leaning toward agreeing and strongly agreeing in comparison to the preceding Scope and Awareness questions. It is here worth reiterating that in analysis, negatively worded responses were reverse coded to read positively.

Table 7.12: One Health Knowledge

<table>
<thead>
<tr>
<th>Items</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use and disposal of antibiotics in other sectors such as food, agriculture and the environment impacts human health</td>
<td>26</td>
<td>3</td>
<td>5</td>
<td>4.81</td>
<td>.491</td>
</tr>
<tr>
<td>Statement</td>
<td>N</td>
<td>Mean</td>
<td>Std. Dev.</td>
<td>Column Mean</td>
<td>Std. Error</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
<td>------</td>
<td>-----------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>One Health is a multisectoral approach</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>3.92</td>
<td>1.093</td>
</tr>
<tr>
<td>I can explain what One Health is</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>3.69</td>
<td>1.011</td>
</tr>
<tr>
<td>I can discuss the importance of a One Health approach in addressing AMR</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>3.27</td>
<td>1.002</td>
</tr>
<tr>
<td>I can describe an example of a One Health AMR problem</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>3.27</td>
<td>1.002</td>
</tr>
<tr>
<td>I can give examples of measures that can be implemented by different sectors in a One Health approach to controlling an AMR problem</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>3.42</td>
<td>1.137</td>
</tr>
<tr>
<td>I can define what antimicrobial residues are</td>
<td>26</td>
<td>2</td>
<td>5</td>
<td>3.27</td>
<td>.962</td>
</tr>
<tr>
<td>I know about the nonclinical/environmental routes for the spread of antibiotic resistance genes (ARGs)</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>3.54</td>
<td>1.067</td>
</tr>
<tr>
<td>I am familiar with the Global Antimicrobial Resistance and Use Surveillance System (GLASS)</td>
<td>26</td>
<td>1</td>
<td>4</td>
<td>2.69</td>
<td>1.011</td>
</tr>
<tr>
<td>I know about the critically important list of antimicrobials specified by the World Health Organization (WHO)</td>
<td>26</td>
<td>2</td>
<td>5</td>
<td>3.73</td>
<td>.724</td>
</tr>
<tr>
<td>Drug resistance in another part of Kenya will potentially impact drug resistance in hospital and community</td>
<td>26</td>
<td>3</td>
<td>5</td>
<td>4.50</td>
<td>.583</td>
</tr>
<tr>
<td>I am aware of studies in Kenya about drug resistance</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>2.65</td>
<td>1.263</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Of the displayed means in table 7.12, only 2 out of a possible 12 have means ≥4, indicating either an increase in neutral or negative responses; that is responses that disagree or strongly disagree. As well as a possible increased shift from strongly agree to agree which would impact the mean, the questions in the category had an increased degree of specificity. More questions placed greater emphasis on practitioners’ understanding of One Health specific knowledge, as a move away from the topic of AMR, which had been routinely publicised during for example, Antimicrobial Awareness Week and in campaigns. This shift is in line with Huttner et al’s (2019) findings that highlighted the need to base messages more rigorously on scientific evidence and context specificities. That is to say, practitioners were better versed in the knowledge of an existing problem of AMR, showed good awareness of One Health however showed a decreased understanding of a One Health approach. This is reflected in the increased neutral and negative responses, (see Figure 7.7).

For example, 84.6% and 11.5% of participants strongly agreed and agreed respectively with the statement ‘The use and disposal of antibiotics in other sectors such as food, agriculture and the environment impact human health’ with the remaining 3.8% opting for ‘neutral’. Within the cluster of One Health items, the aforementioned item garnered the largest ‘strongly agree’ response. When presented with the item ‘One Health is a multisectoral approach’ 30.8% strongly agreed, and 46.2% agreed, with the subsequent 15.4% choosing neutral and the remaining 7.7% strongly disagreeing. Interestingly, only 19.2% of participants strongly agreed with the statement ‘I can explain what One Health is’, falling to 3.8% when presented with the statement ‘I can discuss the importance of a One Health approach in addressing AMR’. All four items are presented in a Figure 7.7 below.
The data in Figure 7.7 shows that, whilst most participants (96.1%) were aware of the interplay between food, agriculture, environment and human health that centres on the use of antibiotics in the individual sectors, understanding of how that translated into tackling AMR through a One Health approach was lower. 15.4% and 7.7% opting for neutral and strongly disagree respectively, when presented with the statement ‘One Health is a multisectoral approach’. Yet another rise in the rate of neutral responses was observed, rising from 23.1% and subsequent 3.8% of participants opting for ‘strongly disagree’ when presented with the statement ‘I can explain what One Health is.’ A subsequent decrease is observed in the percentage of participants who reported that they could discuss why a One Health approach is important to tackling AMR. These data are in line with Ashiru-Oredope and colleagues’ (2019) findings in the large-scale survey for the European Centre for Disease Prevention and Control where variation was observed in One Health capability questions. These showed fragmented knowledge in aspects of One Health, with participants for example reporting stronger agreement with associating animal health factors as contributory to antibiotic resistance in bacteria for humans versus factors in the environment. This provides important data as it indicates that, amongst the challenges of addressing how health professionals learn to tackle AMR, is the challenge of increasing knowledge and understanding of One Health amongst professionals. This ought to include not only the definition of One Health but also help for professionals to develop fluency in
discussing its multisectoral approach and the importance of One Health in relation to individual practice.

Figure 7.8 - Knowledge of One Health approaches – Technical (part 2) as surveyed among 26 participants. Data represent percentages.

The above figure (7.8), displays data from capabilities questions. Only 30.7% agreed or strongly agreed that they were aware of studies in Kenya about drug resistance. This was a surprising figure given that 96.2% of participants had either agreed or strongly agreed that ‘Studies in Kenya have found that common life-threatening pathogens resistance to common first-line drugs such as ampicillin and cotrimoxazole’ (see figure 7.5). This provides further evidence to support the analysis offered for results displayed in figure 7.5, triangulated with interview notes that participants may have deduced their answer based on experiencing cases of drug resistance. Participants showed understanding of the interdependent effect of resistance transmission between the hospital and community, with 53.8% strongly agreeing and 42.3% agreeing that ‘Drug resistance in another part of Kenya will potentially impact drug resistance in hospital and community’. However, on the technical capability questions, decreasing percentages of participants were able to define antimicrobial residues nor give examples of measures that can be implemented across sectors to control AMR. This is in keeping with data from survey one, that reflected that 84% had not taken part in AMR specific modules, as this would form the basis of an introduction to One Health module such as the one offered by Fleming Fund, (2021). In this way, the data contributed to decision-making to inform iteration 3, such that the module offered within the intervention was in
keeping with the learning needs of the group of participants to, for example, present technical components of approaches to One Health.

7.4.6 One Health Knowledge - Guidelines

Enacting positive behaviours in line with recommended practice is underpinned by an understanding of guidelines (Charani et al., 2016). The KAP survey therefore asked participants about awareness of and access to guidelines. Below figure 7.9 displays the results on awareness of two international guidelines.

![Figure 7.9 - Knowledge of One Health approaches – Guidelines (part 3) as surveyed among 26 participants. Data represent percentages.](image)

A high percentage (73.1%) of participants were familiar with the WHO’s list of critically important antimicrobials. Whilst awareness was high, participants were not asked specific questions such as naming antimicrobials on the WHO’s list. Therefore, while broader awareness is high, this is not synonymous with an understanding and capacity to engage with and enact positive behaviours on the basis of engagement. For example, in iteration 2 participants COFTB9 and PCMP13 mentioned overuse of some of the antibiotics on the WHO’s list of critically important antibiotics as well as cases of suspected resistance to antibiotics on the WHO’s watch and reserve lists. In relation to the Global Antimicrobial Resistance and Use Surveillance System (GLASS) only 30.8% of participants were aware of GLASS(WHO, 2019c). This maybe in part because having been enacted in 2016, GLASS is comparatively new in comparison to the list of critically important antimicrobials first workshoped in 2003 (WHO, 2018). The enactment of positive behaviours that are in keeping with recommended prescriptive practices require practitioners to be familiar with prescribing and behavioural guidelines.
7.4.7 Acceptability & Appropriateness of guidelines and interventions

As well practitioners having an understanding of how guidelines translate to practice (Charani et al., 2016; Dryden et al., 2011) within the scope of this study it was important to understand accessibility to guideline materials and resistance data that have the potential to impact practice. For example, prescribing practices should ideally be guided by local data. Though not the only factor, these should be a part of the decision-making process. For example, if diagnosing empirically, it would help for practitioners to know levels of resistance to particular drugs amongst a population. The lack of these data mean that practitioners are conducting what participant PCMP13 termed “blind empirical diagnosis” deeming it an inefficient way to diagnose (see section 8.5.4 for a fuller discussion).

In addition, questions in this section of the KAP survey looked at the appropriateness of interventions (Garcia et al., 2011). Table 7.13 below, displays data on guidelines and interventions with reference to practice. The means for access to AMR data varied, between 2.19 and 2.85, where 2 is synonymous with disagree, indicating limited access to data. This finding is in line with challenges across sub-Saharan Africa in AMR data collection as discussed in section 5.3.1 (Kariuku, et al., 2018). The data on access are displayed below in Figure 7.10 and discussed in subsequent sections along with other aspects of acceptability and appropriateness of guidelines and interventions. Table 7.13 shows confidence in guidelines had a mean of 3.85, where confidence in practice was slightly lower at 3.58.

Table 7.13: Acceptability & Appropriateness of guidelines and interventions

<table>
<thead>
<tr>
<th>Items</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotic guidelines and antibiotic committee (If present) are an obstacle more than a help to clinical care.</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>3.69</td>
<td>1.050</td>
</tr>
<tr>
<td>I have easy access to the materials I need to give advice on prudent antibiotic use and antibiotic resistance</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>2.85</td>
<td>1.120</td>
</tr>
<tr>
<td>I have access to local resistance data</td>
<td>26</td>
<td>1</td>
<td>4</td>
<td>2.19</td>
<td>.981</td>
</tr>
<tr>
<td>I have access to national resistance data</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>2.65</td>
<td>1.294</td>
</tr>
<tr>
<td>Statement</td>
<td>N</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neutral</td>
<td>Disagree</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>----</td>
<td>----------------</td>
<td>-------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>I am confident that my practice uses antibiotics optimally</td>
<td>26</td>
<td>19.2</td>
<td>34.6</td>
<td>15.4</td>
<td>15.4</td>
</tr>
<tr>
<td>I have confidence in the antibiotic guidelines available to me</td>
<td>26</td>
<td>15.4</td>
<td>19.2</td>
<td>42.3</td>
<td>15.4</td>
</tr>
<tr>
<td>The AMR trainings that I receive are often useful and improve my practice</td>
<td>26</td>
<td>15.4</td>
<td>11.5</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>There is a need for the AMR stewardship programs in my hospital.</td>
<td>26</td>
<td>19.2</td>
<td>46.2</td>
<td>26.9</td>
<td>7.7</td>
</tr>
<tr>
<td>I use the national antimicrobial stewardship guidelines for healthcare settings in Kenya to guide my practice</td>
<td>26</td>
<td>15.4</td>
<td>11.5</td>
<td>34.6</td>
<td>34.6</td>
</tr>
<tr>
<td>I give out leaflets, pamphlets or advice on prudent antibiotic use or management as often as I prescribe, dispense or administer antibiotics</td>
<td>26</td>
<td>15.4</td>
<td>11.5</td>
<td>34.6</td>
<td>34.6</td>
</tr>
<tr>
<td>In my role I guide people on the proper use of antibiotics</td>
<td>26</td>
<td>15.4</td>
<td>11.5</td>
<td>34.6</td>
<td>34.6</td>
</tr>
<tr>
<td>I understand how my AMR-related practice impacts AMR resistance rates across the hospital</td>
<td>26</td>
<td>15.4</td>
<td>11.5</td>
<td>34.6</td>
<td>34.6</td>
</tr>
<tr>
<td>I have a key role in helping control antibiotic resistance</td>
<td>26</td>
<td>15.4</td>
<td>11.5</td>
<td>34.6</td>
<td>34.6</td>
</tr>
</tbody>
</table>

Valid N (listwise) 26
Figure 7.10 Acceptability and Appropriateness of guidelines and interventions (part 1) as surveyed among 26 participants. Data represent percentages.

Figure 5.9 displays responses to questions on guidelines and resistance data. As noted, access to national and local data was relatively low, this is largely because there are infrastructural shortcomings in surveillance systems across Sub-Saharan Africa, in this way Kenya is no exception (Kariuku, et al., 2018). 50% of participants reported use of national guidelines to guide their antibiotic practice. The percentage of participants who used national guidelines (50%) was lower than those who expressed confidence in available guidelines at 76.9% (see figure 7.11). It is worth reiterating that the role of guidelines is to guide practice towards optimal practice. Therefore, one would expect those who expressed confidence in guidelines to use guidelines in practice (Charani et al., 2010).

84.6% of participants perceived AMR trainings they received as useful in improving their practice. One may have expected this to be mirrored in confidence in personal practice, but when asked about personal practice only 61.6% of participants reported being confident about their own antibiotic practice (see Figure 7.11). The awareness of the importance of
AMR training, coupled with access to training may in turn have had an impact on the reported confidence in practice.

7.4.8 Learning at work

The central tenet of stewardship programmes has tended to be policy and guidelines heavy, where both are important, the enactment of rules and guidelines alone is not synonymous with effecting change and optimal practice (Leadingham et al., 2019). Charani and colleagues (2016) posit that best practice requires an environment that is readily geared for positive reinforcement such that the environment can both support as well facilitate best practice where prescriptions are concerned. This can be understood as a whole systems approach. However, I am aware that best practice is a contentious term in learning literature. There remains a debate on the use of good ideas rather than best practice and evidencing what works of which some of the practice that works that can then be transferred (Biesta, 2007; Peters and Heron, 1993). This is in line with my thinking and what I conceptualise as best-in situation-practice, which in medical environments can be adjusted subject to changes in the working environment. This is in line with systems thinking and the importance that Charani and colleagues’ (2016) place on the working environment. It is therefore important to understand two critical aspects of the working environment, the first learning at work and attitude towards learning at work and the latter communication and attitudes towards communication. Both are discussed in this and the following section. The questions in both sections of the KAP survey focused on current learning practice as well as attitudes to learning and communication. Specific to learning at work, observed means as displayed in table 7.15 show means that are above 4.5 indicating broadly positive attitudes towards collaborative learning. Figure 7.14 provides detailed response percentages across the strongly disagree/strongly agree continuum.
Table 7.14: Learning at work

<table>
<thead>
<tr>
<th>Items</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>During training sessions, I learn with healthcare professionals from other disciplines. i.e. laboratory professionals learn with doctors</td>
<td>26</td>
<td>3</td>
<td>5</td>
<td>4.54</td>
<td>.582</td>
</tr>
<tr>
<td>Learning with professionals from other healthcare professions would be more beneficial to improving my teamwork skills than learning only with my peers</td>
<td>26</td>
<td>4</td>
<td>5</td>
<td>4.92</td>
<td>.272</td>
</tr>
<tr>
<td>I learn at work through others e.g. peer support or conversations and discussions with other practitioners</td>
<td>26</td>
<td>4</td>
<td>5</td>
<td>4.58</td>
<td>.504</td>
</tr>
<tr>
<td>Learning collaboratively with other healthcare professionals would help us to work more efficiently across the hospital</td>
<td>26</td>
<td>4</td>
<td>5</td>
<td>4.96</td>
<td>.196</td>
</tr>
<tr>
<td>I would enjoy the opportunity to learn with professionals from other healthcare professions</td>
<td>26</td>
<td>4</td>
<td>5</td>
<td>4.88</td>
<td>.326</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 7.12 Learning at work as surveyed among 26 participants. Data represent percentages.

Figure 7.12 shows that across all five variables, responses largely varied between agreeing and strongly agreeing. 100% of participants reported that they would enjoy learning with professionals from other health professions. This would for example include mixing lab workers with doctors in CPD sessions, to offer opportunities for interprofessional learning. The benefits of this are explored elsewhere in literature and accorded further attention in the discussion in chapter 9 (Bridges et al., 2011; D’amour et al., 2005; Schot et al., 2021). 96.2% responded in the survey to indicate that they already learnt with professionals from other disciplines, which was confirmed during field visits (see section 8.4.2).

Interprofessional learning depended on the course on offer and relevance to various cadres (FF1005). 100% of the participants believed that collaborative learning would increase efficiency across the hospital. 100% of participants said they learnt through others in the workplace through discussion and peer support. However, responses to questions about communication indicated that there may be challenges in communication across professions in practice. This mismatch and the challenges posed by silos to communication are evidenced elsewhere in literature. For example, Schott and colleagues (2020) in their systematic review of interprofessional collaboration discuss the challenges of facilitating collaboration. They note that this requires organisational arrangements, such as clear common rules across the professions and open information structures across professions, to facilitate professionals getting to know one another in a way whereby discussion can be
initiated across the group should issues arise. The subsequent section looks at reported communication amongst the participants.

7.4.9 Communication

Efficient collaborative work is underpinned by effective communication mechanisms. Within activity theory exploration of communication patterns can be facilitated by exploring the rules element, to understand the underpinning rules that guide the community in communication. Workplace culture therefore fits in within the scope of exploring the rules and community aspects of the activity theory triangle (Engestrom, 2018). In this way, respondent data from the Likert scale contributed to mapping the activity system. Table 7.15 below displays means for communication-related items.

Table 7.15: Communication

<table>
<thead>
<tr>
<th>Items</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The line of communication between all members of the healthcare professions is open.</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>2.62</td>
<td>1.203</td>
</tr>
<tr>
<td>It is easy to communicate openly with people from other healthcare disciplines</td>
<td>26</td>
<td>2</td>
<td>5</td>
<td>3.27</td>
<td>1.002</td>
</tr>
<tr>
<td>There isn’t a status hierarchy in healthcare that affects relationships between professionals</td>
<td>26</td>
<td>1</td>
<td>4</td>
<td>2.12</td>
<td>.993</td>
</tr>
<tr>
<td>Different healthcare professionals are always cooperative with one another</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>2.77</td>
<td>1.243</td>
</tr>
</tbody>
</table>

Valid N (listwise) | 26
Where the learning at work responses were largely positive with the lowest mean across all items at 4.54, communication items had means ranging between 2.12 and 3.27, indicating perceptions of challenges with communication in practice. To better understand the dynamics of communication, the analysis of each question was conducted in order to expand on where participants sit on the strongly agree/strongly disagree continuum across each variable Figure 7.13 shows the communication responses.

Figure 7.13. Communication as surveyed among 26 participants. Data represent percentages.

When asked whether different professionals are always cooperative with one another, the majority of participants at 53.9% either disagreed or strongly disagreed, with a further 3.8% opting for neutral. When asked whether there is a status and hierarchy that affects relationship between professionals, the majority of professionals, at 76.9% reported that there was a hierarchy that affected relationships between participants. When asked about the line of communication, the majority at 53.8% of participant perceived lines communication as not being always open, with further 15.4% opting for neutral. Some scholars have explored the importance of open and receptive professional culture as well as the willingness to cooperate and communicating openly (e.g. D’Amour et al., 2005; Schot et al., 2020). Where data showed that participants were willing to communicate, such models are framed as a challenge for healthcare managers to promote and facilitate the necessary conditions (Bronstein, 2003; Valentijn et al., 2013). Communication in practice was further explored in iteration 2, see section 8.5.7.
7.5 Conclusion

This chapter presented findings from iteration 1 across phases 1 and 2. Data presented were from the scoping survey and KAP survey. The scoping survey provided key information on group demographics and sought to scope technology acceptance and usability at health facility X. Data gathered included accessibility data, AMR knowledge data and previous learning with a brief discussion of findings. KAP survey data presented in the chapter focused on One Health knowledge, awareness, and scope of the AMR problem, learning at work and communication. Data on AMR practice at health facility X showed some divergence from the WHO’s recommendations and practice guidelines from Kenya’s NAP on AMR. This was indicative of possible tensions between what was feasible on the ground and recommend best practice. For example, nursing staff reported prescribing, this was indicative of need to have a broader and more comprehensive understanding of practice in the given context. The next chapter presents data from Iteration 2. This focused on context and facilitated an understanding of tensions that arise between western medical practice, cultural practices, and socioeconomic challenges in the Western region of Kenya that have an impact on AMR stewardship.
Chapter 8: Iteration 2 and 3 Findings

8.1 Introduction

This chapter presents a summary of the activity system and findings from data collected in observations and interviews during iterations 2 and 3. It builds on the conceptual framework presented in chapter 4 to contextualise this study in reference to Cultural Historical Activity Theory (CHAT). In the first instance, highlighting the usefulness of CHAT in analysing goal orientated interactions between an actor and their environment. Then through CHAT maps a deconstruction of the workplace and surrounding environments into units in order to analyse the units and explore underpinning interacting elements i.e. rules and division of labour (Engestrom, 2018). Section 8.2 maps the visual context of the study and section 8.3 maps the hospital structure and patient journeys and treatment pathways based on observation and interview data. In sections 8.4 and 8.5 I present the thematic analysis from interview data.

8.2 CHAT in context

Mapping the varying components that constitute an activity system in context can facilitate analysis of tensions, contradictions, and emerging social norms within the system (Engestrom, 2018). This includes the mapping of processes of institutionalisation – how a subjects’ goal orientated activities become institutionalised. For example, how a subject’s (read individual health professional’s) engagement in goal-oriented activity can shape the rules of the community and, by extension, shape how a team interacts (Park et al., 2013). Teams exist within complex and dynamic systems that are ever evolving and interlocked by activities, which can be mapped within the activity system model. Teams are important in the context of this study, this therefore necessitates increased fluency in how the theoretical framework applies to the workplace in focus and the practitioners who work there. Below, in Figure 8.1, I adapt the use of Paine’s (2017) visualisation and breakdown the of mapping the activity theory terrain by asking key questions. Figure 8.2 summarises the evidence that contributes to map the terrain in context.
Mapping the terrain in the context of this study was a combination of desk-based research and observation data triangulated with interview data. Reviewed policy documents, legal structures, and researched relevant academic papers and grey literature, including literature presented in chapter 5 provided key data on legality and practice, ethics, regulation and evolving capabilities in line with Global Antimicrobial Resistance and Use Surveillance System (GLASS) a stepwise approach to developing AMR surveillance (Fleming Fund, 2016; GovKenya2017; Revathi and Mailu, 2016; WHO, 2018). Findings from desk-based research were indicative of existent limitations in practice. Evidencing that, whilst divisions of the Kenyan government and healthcare system were progressively engaging in implementing GLASS in line with the National Action Plan on AMR (NAP on AMR), there were shortcomings (GovKenya, 2020). These included challenges highlighted in the NAP on AMR and gaps in AMR-related to data and surveillance infrastructure at national level (GovKenya, 2017). Data through surveys, observations and interview data across the three iterations of this study were triangulated with desk-based research in analysis. Enabling me to engage in meaning making, sense making and data interpretation to broaden the initial map of the

Figure 8.1: Mapping the Activity System terrain (Paine, 2017, n. np)
activity system. Figure 8.2 schematically presents the findings that offer answers to the questions set in figure 8.1, using an activity theory framework.

![Diagram of activity system](image)

**Figure 8.2: Activity System Mapping the Terrain in context (Adapted from Engestrom 2018; p14; Paine, 2017; np)**

8.2.1 Descriptively mapping the activity system

In this section I provide a summary of the activity system based on desk-based research, surveys, observations, and interviews. This will be largely descriptive, with brief incepts of discussion within this chapter, where it is deemed most fitting. Detailed discussion of findings is offered in chapter 9.

8.2.2 Mapping Visual Social Context

As discussed in chapter 2, hospital X located in the Western region of Kenya is a referral site for the county and within the region and has the only specialist Multidrug resistant tuberculosis (TB) (MDR TB) ward. It is therefore a regional referral facility for MDR TB. That
is to say patients from surrounding counties in the Western Kenya send MDR TB patients to Hospital X. Amongst the bordering counties is County Y, home to a larger city and larger county hospital with greater availability of more advanced technologies than County X. Patients are routinely sent from the Hospital X to the city hospital in County Y for services that are unavailable at Hospital X (FN1005).

On arrival into the Western region of Kenya for fieldwork, I began capturing images, though I had not planned to take photographs. Once in the field, it became apparent that images would be helpful in understanding the relationships that exist between the environment, animals, and humans, in the region. I extended taking photographs to the neighbouring county because of the boundary transcending nature of AMR in relation to spatial boundaries, and the patient interchange between the two facilities. Though the images did not form part of the core data collection, collecting imagery became a useful observational tool to provide context and help to frame thinking in analysis and within the discussion chapter. In both the analytical and discussion phases, I revisited the images to consider what a cultural and holistic approach to health professionals tackling AMR within the context of the research facility may look like.

The images below in section 8.3 were captured during the data collection period and exemplify the communal nature of space between peoples and animals. All of the spaces captured were readily accessible and a part of daily communal lives. No images of persons nor government property were captured, neither of which I had permission to photograph. In these images, animal presence is highlighted in red circles. These images are discussed to help illustrate the importance of the connection between humans, animals, and land as an important part of understanding the context for AMR in this setting. This is in keeping with CHAT, in relation to the community and rules within the CHAT model. These images, contribute to the understanding of the broader community and culture and the rules that govern community and culture.

8.2.3 Understanding the connection between humans, animals, and land

In relation to AMR, the shared environment between humans and animals was immediately noticeable on arriving in the Western Kenyan region. This is important because AMR
transmits between humans, animals, and land (see section 1.7.1). Figure 8.3 illustrates the relationship between animals, humans and the environment.

Figure 8.3: Illustration of AMR transmission (Djordjevic and Morgan, 2019, p. 74).

Across the region, in counties X and Y, a variety of farm animals were on the streets and on highways, grazing near homes in residential areas, (see image 8.1) in marketplaces (see images 8.2 and 8.3) and within walking distance of the hospital entrance (see image 8.5). These included donkeys, goats, cows, and chickens. Image 8.4 shows an up-close photograph of the waterways that animals were drinking from. It is here worth noting that waterways are amongst the routes through which AMR is transmitted and studies (Kairigo et al., 2020; Karimi et al., 2022) have pointed environmental contamination with antibiotics as a challenge in Kenya.
Image 8.1: Goats grazing near a home in a residential area

Image 8.2: Goat grazing around a rubbish dump near a fish market

Image 8.3: Goat grazing near a fish market
Images 8:1 to 8:5, I argue, display a frictious transition or a clash between agrarian, nomadic traditions and the modern present that require communities to now strategically rise to meet the challenge of integrating modernity’s tools and technologies (including modern western medicines) with traditional African ways of being. In order to facilitate a smoother transition or integration of modernity’s tools, to circumvent health challenges that may arise out of the clash. For example, image 8.3 above displays animals grazing at a fish market that is heavily polluted by plastics and other general waste and poor sanitation, this
is effectively an aetiology\(^5\) for multiple disease such as cholera and specific to this study, AMR transmission.

In this section I provided a descriptive map of the activity system and provided visual imagery to map the social context. These are discussed more broadly in the discussion chapter (section 9.3) where I offer a broad analysis of the sociohistorical context and how AMR stewardship may be grafted into these communities so as to not clash, but rather transition. In the next section I apply CHAT to the study context.

8.3 Applying CHAT to the study context

In this section, I discuss the hospital structures based on observations and interviews.

8.3.1 Mapping Hospital structures

Hospital X has nine wards and two laboratories. The administration of the wards is managed by two bodies, one of which is a non-governmental organisation (NGO) and the other, the Ministry of Health (MoH) at county level. Of the nine wards, three are supported by the non-governmental organisation that provides staff, equipment and oversees the wards and lab’s administration. The remaining six wards are run by the local county government (see section 2.2). The NGO works to support MOH, by relieving them of some of their duties and taking ownership of running specific, negotiated wards. The wards are negotiated based on resources and patterns of mortality rates. The NGO has historically taken ownership of the wards with the highest mortality rates.

The NGO’s objectives are to improve practice across certain wards to effect change in mortality rates by taking charge of the wards’ administration, including hiring and training of staff. The NGO aims to improve patient outcomes. Once the NGO deems the ward to have sufficiently improved and where the MoH has the resources and capacity to maintain or improve standards, the NGO gives the ward back to MoH, who then takeover its running (FN1005). The NGO then diverts resources to another ward, with the aim of improving standards until the hospital system is strengthened. Whilst, historically, the NGO has been able to switch certain wards, i.e., hand back one ward and adopt a new ward, participant

\(^5\) the cause, set of causes, or manner of causation of a disease or condition.
LBFB04 noted that, in recent times, they had maintained the same three wards. They elaborated that this may have been due to several factors, including a continued strain on resources on the part of MoH and an increased complexity in cases of MDR TB.

At the time of data collection (FN0405), the NGO was charge of the:

- Respiratory (TB/COVD19) ward
- Male Medical ward
- Female Medical ward
- Outpatient Department (where they maintained some presence)

The MOH was in charge of running the:

- Female Surgical ward
- Paediatrics ward
- Maternity ward
- Gynaecology ward
- Male surgical ward
- Outpatient Department

This two-stream administrative management structure materialised into differences in workflow and practice, including practice-based training and CPD. For example, this observation in part explains the variations in responses in data collected in iteration one, where participants reported varying levels of required CPD. This reflected a lack of uniformity across the required CPD (see section 7.1.2). On a broader level, the two-stream management structure had implications for work culture, producing observable differences on the respective NGO and MoH wards. In the section below I present information relevant to differences, interaction and collaboration across both streams and conceptualise these within the CHAT model.

8.3.2 Two stream management

Whilst both NGO and MoH streams were governed by the same legal structure, the communities, rules and culture that guided both streams differed. Though the two streams
intersected at varying points working collaboratively, the differences in administration created divergent ways of working. This created observable differences in practice and culture on respective wards and labs. For example, LTMB03, who worked on the NGO ward as a senior lab technician, noted that on the occasions that the NGO lab experienced shortages in reagents – a substance that is required in order to test whether samples are resistant to antibiotics. The lab technicians from the NGO lab would call the lab manager or walk over to the MoH lab to negotiate borrowing reagents with the lab manager, with the promise to give the MoH lab reagents once theirs were delivered on a given date. Alternatively, they would negotiate running the required tests in that lab. Where the NGO was more likely to able to provide accurate data on the date on which borrowed reagents would be returned, this was not the case for MoH. The MoH lab routinely ran out of reagents and regularly had supply chain issues pertaining to timely delivery, with no recourse to electronic systems to monitor progress on delivery (FF2804). When the MoH lab experienced shortages, it would reserve borrowing or sending patient samples to the NGO’s Lab in acute emergencies. This was due to factors such as having a larger patient workload and therefore reserving borrowing as a way of prioritising.

The divergence in administration had an impact on ways of working and patient journeys. Below, I outline potential patient journeys based on observations (FF2804; FF0905) and interviews with participants PDFP14 and NMOD12.

8.3.3 Patient journeys

It was evidenced that a patient arrives at Hospital X for three reasons:

1. The hospital is the nearest treatment facility that the patient perceives to have the capacity to deal with a given health issue they are experiencing. This can be understood as either self-initiated help seeking or in emergencies such as accidents where one maybe picked up by an ambulance. It is here worth noting that during observations in the out patients department, there were no cases of individuals brought in by ambulance in emergencies, observed emergencies were brought in by private cars.

2. Following a referral from a smaller facility.
3. As a transfer from another facility for specialised MDR TB care, these patients are likely to be brought in by NGO operated ambulances.

On arrival at hospital X, the primary determiner of where patients report is related to the aforementioned reason for visiting the facility. Their journeys subsequently are summarised in figure 8.4.

![Figure 8.4 Patient journeys at Hospital X](image)

Referral and self-initiated help seeking patients or emergency patients follow a similar trajectory. They arrive at the OPD department, where they register using a new electronic system, this includes earmarking whether or not they have been referred. At the time of data collection the electronic system was being trialled in the OPD. Transfer patients are typically MDR TB patients, that are notably complex cases, because they often have a comorbidity of HIV/AIDS and may be experiencing resistance in both TB and HIV/AIDS (COFTB16). These patients come under the care of the NGO and are straight away sent to the ward on arrival.

Patients are then triaged into three groups, using a traffic light system, that separates groups based on perceived urgency with which they should receive care. Patients are then attended to accordingly. Practitioners take patient history details and examine patients...
according to a protocol. Referred patients should have a patient record card that details their history, reasons for referral and any previous and/or current medications the patients may be on (PDFP14). However, NMOD12 and PDFP14 noted that patients often did not present with their medical record cards and, where they did, they sometimes did not have information on history including current medications. Accurately capturing patient history is important for AMR practice, because patient history is an opportunity to gather data on whether patients have been found resistant to certain antibiotics or can indicate resistance and whether patients had recently or were presently taking antibiotics. This information has implications for how practitioners act for example in recommending or prescribing antibiotics or ordering cultures for susceptibility. These information gaps can be understood as disturbances in the activity system (a broader discussion on the implications is offered in chapter 9). On examination, practitioners decided whether patients were treatable within OPD. That is to say practitioners decide if patients could be prescribed medication and discharged or if patients needed to be admitted to the hospital for further on-going care. Where practitioners decided to treat and discharge, this may have included the prescription of antibiotics. If practitioners recommended admission, patients would be admitted to a given ward based on the patient’s needs. This would in turn determine whether a patient was going to an MoH or NGO run ward. Once admitted to a ward, the patient history would then be taken once again. In both streams patient histories were taken manually by Clinical Officers (CO) or Clinical Officers Interns (COIs). This was a duplication of the initial contact in the OPD, where data was collected electronically. These data were not transferred to the ward. Manually recorded patient data on the ward were kept in a folder that moved with the patient within the ward hospital and, on discharge, would be retained in the medical records block where manual files were kept.

8.3.4 Patient treatments

After obtaining personal histories and examining patients, practitioners then determined the required next steps towards diagnosis and treatment. This may have included asking colleagues to engage in collaborative diagnostic practices, including colleagues who were specialists and on other wards. This was routine for complex cases (COFTB9). In the ‘treat’ phase, as displayed in figure 8.4 COs, doctors and consultants would need to make decisions about the best course of action and, subsequently, treatment for patients. Whilst the
structure of the decision-making process across both streams was similar, for example a CO, doctor or consultant considered a range of variables, i.e. symptoms, patient’s age, medical history, comorbidities etc in order to reach a clinical decision, there were some key differences in practice. Differences were resultant of the respective governing structures, finances, and resources.

MoH and the NGO had different administration structures with notable differences in resources on the ward. For example, the NGO had access to different Point of Care Tests (POCTs). These enabled practitioners to move from symptom-based prognosis, reducing presumptive treatment, which is “the treatment of clinically suspected cases without confirmatory laboratory tests” (Parkes-Ratanshi et al., 2019; p2 ). POCTs enable quick result generation and prompt treatment with the aim of improving outcomes. For example, Parkes-Ratanshi and colleagues (2019) argue that increasing POCTs for Malaria in endemic areas may be associated with better outcomes for Malaria, in decreasing overtreatment and slowing the emergence of AMR.

Additionally, the NGO operated a free at-the point of care policy, as the sole bearer of treatments costs, including lab tests for the patients admitted to their wards. On the other hand, patients on the MoH wards bore the cost of treatment. Some could be offset by a health insurance policy. However, these were broadly non-comprehensive, often resulting in patients having out-of-pocket expenses. This had broader implications on practice and, more specifically AMR-related practice, because clinical decisions on the MoH wards were influenced by the financial circumstances of the patient.

This decision-making and their implications can be exemplified in relation to the practice of taking and testing blood cultures that are used to determine which antibiotics a pathogen is susceptible or resistant to. For example, the best course of action for a patient may have been to run blood cultures. At the time of data collection, the cost of blood cultures was 5500 Kenyan Shillings (£36.50). If a patient required these tests but had less than the required amount of money or had the required amount but using the money for the tests would subsequently mean that the patient could not afford the medicine to treat the condition, the practitioner would in some cases forgo the test. They would therefore rely on symptomatic diagnoses to begin a course of presumptive treatment. In complex cases
where a patient on the MoH ward required test that they could not afford. If the doctor or clinical deemed the tests critical for rationale clinical decision making, they sometimes reached out to the NGO lab to request that the lab meets the costs of the test and carry out the test. In such cases, the NGO lab staff made decisions based on their caseloads and resources. It is also here worth noting that at the time of data collection, neither labs had the capacity to process blood cultures. Blood cultures were sent on a 2 hours+ journey to County Y, over 100km away, for processing period that would take 24 – 48 hours. Samples were therefore drawn at the facility and transported to a private facility in the neighbouring county. However, participants LBMA01, LTMB03, PCMP13, PDFP14 expressed concern about a pattern of unexpectedly high levels of low positivity rates from the cultures sent to the facility in County Y. Practitioners noted that this had caused them to suspect inaccuracy in tests. Practitioner concerns were linked to quality of samples, sample transportation and sample contamination. Participants PCMP13 and PDFP14, both in senior roles on the paediatric wards as consultant and doctor respectively, expressed concern about AMR practice, noting that the practitioners sometimes started patients on courses of antibiotics prior to drawing blood samples to be tested for susceptibility, this would in turn cause low positivity rates. In order to accurately run the tests, samples should be drawn before administering antibiotics. The concern was echoed by COFFS6. This is discussed in greater detail in the thematic analysis section.

8.3.5 Summary

This section mapped hospital structures using evidence from fieldwork. It provided an overview of Health facility X and expounded of the two-stream management structure that is run by MoH and an NGO. It offered a detailed description of patient journeys and treatment pathways including challenges in accessing blood cultures and susceptibility testing.

8.4 Presenting iteration 2 data

In this section I present data from iteration 2. This section presents participant profiles and thematically analysed data from interviews and observations.
8.4.1 Applying CHAT to the data through thematic analysis

Thematic analysis was conducted, this enabled data exploration in relation to all three research questions. Thematic analysis was a combination of inductively and deductively generated coding and theme generation from interview data triangulated with survey data from iteration 1. Table 8.1 displays interview participants, their roles and place of work within the hospital and whether the institution was NGO or MoH run, whilst this is often presented in the methodology chapter, due to the iterative design of data collection, for continuity and linking related data to the participants this is presented here. Table 8.1 below displays the themes, with accompanying descriptions of themes and examples of data.

Table 8.1 Themes and sub-themes from iteration 2

<table>
<thead>
<tr>
<th>Theme</th>
<th>Sub-Themes</th>
<th>Description</th>
<th>Example</th>
<th>Iteration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learning at Work</td>
<td>Learning Online</td>
<td>Continuous medical education</td>
<td>“we get on Job training, weekly PowerPoint presentations of different conditions”</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td>Technological literacy</td>
<td></td>
<td>“CPD Africa offers online courses with points awarded”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Point of care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. AMR data and learning</td>
<td>AMR course availability</td>
<td>AMR specific learning and data that informs practice</td>
<td>“Well we have had a few trainings like from ETAP which is emergency triage and training in paediatrics. So this tackles a bit of antibiotics but not in detail and also its not possible for everyone to attend so I guess it’s the funding for the training and it happens once like in 5 years”</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td>Access to data &amp; guidelines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>3. Self-directed learning</td>
<td>Learning outside required CMEs</td>
<td>“I did it myself, I found the University of Washington was offering a course on AMR online, so I did it that way”</td>
<td>1,2</td>
<td></td>
</tr>
<tr>
<td>4. 4Rs – Right Drug, right route, right Dose, right duration</td>
<td>Reference to the 4Rs, prescribing practice and clinical decision making</td>
<td>“there is no hospital antibiogram, so to me it is completely blind empirical therapy”</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5. Beyond Scope</td>
<td>Supply chains Drug quality Public behaviour Feeder health facilities</td>
<td>Beyond the practitioners’ reach, generally concerning matters that sit outside the hospital</td>
<td>Referring to patients acquiring medication “You don’t know if they will go to the market so even if you are administering medication from outside, you cannot be a 100% sure what you are giving”</td>
<td>2</td>
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<tr>
<td>6. Communication</td>
<td>Communication once patients are being treated at facility</td>
<td>Referring to accessing lab results “Email, yes. WhatsApp – social media yeah. We choose which mode is easier, phone call”</td>
<td>1,2</td>
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<tr>
<td>7. Lab capacity Offsite processing Reliability</td>
<td>Hospital lab capacity including outsourced lab tests</td>
<td>referring to capacity to carry out blood cultures “We don’t have but it is sent to [county 1] for culture”</td>
<td>2</td>
<td></td>
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</tbody>
</table>
8. Collaboration | Telemedicine | Collaborative working practices | “If the consultant is not around we have our HIV doctors here and in the TB that is complicated we sometimes post them to the telemedicine, for help then we discuss.” | 2

9. Site management | Strike action Absenteeism | Relating to management of the hospital | “They have not been paid. The patients have been sent home. You can see the critical ones left in some wards” | 2

10. Motivations | Reference to practitioners’ motivation or lack thereof | “It’s go slow now so many of them will not be willing to do the work and even as a manager, I can’t ask them” | 2

11. Universal Health Coverage | Free health provision and cost absorption | “In some cases, [the NGO] is able to do the tests for free, you explain the patient’s situation and condition and if they have the resources they will do the test” | 2

8.4.2 Theme 1: Learning at work

The theme ‘Learning at work’ was ascribed to data relating to compulsory continuous professional development (CPD) mandated by the respective administrative bodies of the hospital and the licensing medical bodies for medical professionals, i.e. the Kenya Medical Practitioners & Dentists Council who regulate training and renewing of professional licence
required for practice (GovKenya, 2014). In iteration 1 data showed participants were required to undertake CPD, routinely referenced as continuous medical education (CME). Data showed a variation in responses in terms of required amount of learning, as participants conceptualised it differently, either in terms of points or hours required (See section 7.1.2). Data in iteration 2, provided further clarification on the amount of CPD required, with one participant noting

“normally a CME is between 45 minutes and one hour long. So, it gives me 3 CPD points and the minimum they need is 50 points.” - COMMM8

At the time of the data collection, CMEs were delivered through a number of modes. Seminars and lectures were delivered either online or in-person. In person delivery, included presentations and seminars, these varied between cross cadre and role specific courses.

8.5.2.1 Subthemes - Learning online & Technological literacy

CME were also online. When delivered online, the use of zoom software was mentioned.

“so we attend via zoom. Someone shares the link. Invites us and we are able to attend”

Participants talked about online delivery, thus the sub-theme ‘learning online’ was generated, participants noted issues of accessibility, in relation to cost and challenges in network connection in terms of learning online. As noted by PDFP14 below.

“Yeah the network is also not good, the network sometimes is really bad so even when you have bundles you just can’t attend because well the network is off or is off and on, on and off and also not all the time people have bundles the biggest part is the network” -PDFP14

An additional challenge to accessing learning, was ‘technological literacy’ this was generated as a subtheme of ‘learning at work’. Participant PDFP14 noted that,

“ some people are not phone smart or computer smart or something”.
8.4.2.1 Subthemes - Point of care and time
Participants discussed learning through one-to-one consultation with senior members of staff and at the point of care. Within the ‘point of care’ sub-theme participants across all wards discussed point of care training in relation to ward rounds, as well as when junior staff shadow senior staff to observe practice. During observations of handover it was apparent that handovers were also used as opportunities to teach and to learn. The abstract below is from my field notes (FN0905). It evidences teaching and learning in practice.

The handover started with going through the night report, night duty nurses reflected on how the patients were overnight and then had a caseload discussion for each patient. At the end of the handover the lead nurses said remember,

“If I read, I remember, if I remember” [NFFS18]

and in chorus practitioners say

“I do” - all practitioners present at handover on surgical ward (FN0905).

With that she reminds nurses that all caseloads must be read and instructs nurses to remember to have conversations with patients about physio and nutrition and reminds the team

“If they can swallow, they should swallow for infection control” - [NFFS18]

Ward rounds were discussed as varying in terms who attends on the MoH side, citing circumstances such as strikes as having an impact on attendance. COMFSS noted these typically should involve all clinical staff and some non-clinical roles, for example on the surgery ward, expected roles at ward rounds were

“surgeons, medical doctors, physiotherapists, anaesthetists, nutritionists, social workers, students, interns, nurses, pharmacists, orthopaedic surgeons and specialist too” - COFFS6.

In the build up to strike action and during strike action, some of the roles would not be in attendance, particularly consultants, COFFS6 noted that

“If they are not paid, they go to their own clinics, even I have my own but I am still training” - COFFS6
The absence of consultants had an impact on practice given that consultants bring experience and expertise to the ward that doctors and clinical officers do not possess. This extends to experience and tacit knowledge they possess in relation to infection control and AMR, which is evermore important in a context where practitioners heavily rely on empirical diagnosis rather than the lab.

Fieldwork was conducted in the lead up to and during strike action. During that period the ward rounds that were observed had no senior consultants and senior medics present on the MoH wards. In some circumstances ward rounds were led by trainee clinical officers and supported by nurses, in senior and training positions (FF0905).

Data also showed that ‘learning at work’ was done through “death audits” (COFTB16).

“we have the death audit where we learn and review...we go through our audits and see where did we go wrong, what were we supposed to do that we didn’t do” - COFTB16

Participants (COFTB16; COFFS6) described death audits as a process whereby consultants lead case reviews of processes and actions of the team leading up to the death of patient in order to consider what if anything could have been differently with the view to learn how if anything can be done differently in the future. COFTB16, noted that reviews begin with initial triage on arrival up until time of death is announced. Death audits were noted as mandatory and routinely done on all NGO wards, however this was not the case for all MoH wards, were some wards conducted audits, wards such as the surgery wards did not conduct death audits, except in new-born unit cases. Reasons for variation remained unclear.

Specific to the learning platform, technological literacy was a sub-theme of learning at work. During interviews participants were introduced to the mobile learning platform, offered an explanation of how it works, then handed a phone to provide feedback on the platform, i.e. if they thought it was contextually appropriate whether it would be fit for use of health workers and the challenges one may face in rolling out such a platform. Most participants in the first instance raised the issue of accessibility in financial terms in relation to data bundles and cost, favouring platforms that would be free at the point of access, of which
they were ensured that the mobile platform in question was free. Some participants (COFFS6; LBF804; COMFM7) referenced technological literacy.

“I think it’s good but again, it’s not accessible for everyone. Some people are not phone smart or computer smart or something, so sometimes, to relay information needs you to write it out you see. Put them in one room and say to their ears. Also, the schedule is very tight. The schedule is too tight, and we are few so we find few people are interested more than the others” - PDFP14

Participants also discussed the challenge of finding time to dedicate to learning at work citing workload burdens as an issue. ‘Time’ was therefore generated as a subtheme of learning at work. As a result, of initial feedback, learning content on the platform was refined to ensure it further leveraged the affordances of microlearning, to produce short and targeted learning. Giving the participants more opportunities to start, stop and save previous learning. Increasing ease of access as and when learners were available.

As a result of initial feedback highlighting the potential challenge of technological literacy amongst participants, WhatsApp was used as a support centre for participants. Where participants had been given the WhatsApp number to contact in case they had any further questions about the study, they were informed that they would be able to contact the researcher if they had any issues in accessing the module or needed further support in learning on the mobile platform. Over the course of the module, participants communicated via WhatsApp.

8.4.2.2 Summary of Learning at Work theme
This section discussed the theme of learning at work and corresponding subthemes of learning online, technological literacy, time and point of care. Data evidenced the different modes of learning and highlighted challenges to engaging in learning.

8.4.3 Theme 2: AMR data and learning

AMR specific learning was captured under a different theme, given the centrality of AMR to the study and participant responses that showed a marked difference in the way that AMR learning was accessed in comparison to CPD learning in general. The theme ‘AMR data and learning’ was ascribed to data expressing sentiments about AMR learning and access to
AMR specific data because AMR data typically influences AMR learning. That is to say data on the AMR burden can be used to influence practice, it serves a similar function to death audits, in that practitioners would be able to review usage and consider ways they can drive down usage. Additionally, it can shape learning materials such as induction courses for new practitioners or CPD for practitioners at the site, targeting prescription related behaviours. ‘AMR course availability’ and ‘access to data & guidelines’ were developed as subthemes of ‘AMR data and learning’. In reference to ‘AMR course availability’ 6 participants (LTMB03, LBFB04, COMFM7, COFTB9, PCMP13, PDFP14) said they had some experience with AMR learning. The degree to which they had engaged in learning varied, from a brief mention in training to having undertaken a certified course, that they paid for themselves. Some participants spoke passionately about the need for AMR learning, these participants included the director of the hospital director who discussed being aware of the challenge of AMR in daily practice, welcoming the study on the site as he deemed it necessary, and was particularly keen on understanding knowledge gaps amongst practitioners, highlighting the need for a more systematic approach to the challenge of AMR (HDMS02). Below, participants discuss their AMR-related learning and knowledge

“we have had a session on AMR in our weekly training [referring to NGO specific CPD sessions] but first, we have crossover, patients can move to MoH run wards so we need something for the whole hospital and even when we had, it was one session but we are seeing many cases” – COMFM7

COMFM7, who was a clinical officer on an NGO ward, spoke about the need for more AMR specific training and communicated a readiness to engage in further AMR specific learning, asking if I had access to AMR specific learning materials that are free at the point of access.

“I did it myself, I found the University of Washington was offering a course on AMR online, so I did it that way” – PCMP13

In reference to ‘access to data & guidelines’ there was a lack of data. Despite the lack of data, most participants reported having suspected or experienced cases of AMR. For example, in reference to suspected AMR cases in practice participant PDFP14 noted,

“Yes, we have a lot of cases. You know this is referral hospital.” – PDFP14
Yet there were no available data for AMR cases. PCMP13, noted that

“there is no hospital antibiogram” – PCMP13,

As previously introduced in section 1.7, an antibiogram is an overall institutional profile of antimicrobial susceptibility testing results of specific microorganism to antimicrobial drugs. It is an essential resource for tracking changes and trends in AMR to guide empirical antimicrobial therapy (Truong et al., 2021). Participants discussed AMR data issues at local facility level

“in this lab [NGO ward] we collect some data on these laptops but it’s not really used” – LTMB03

Of the collected data from interviews and observations, there was no clear institutional procedure in place for periodic analysis and presentation to practitioners to inform and guide data related practice.

“even what we collect, I don’t think we use it comprehensively, we have no continuity across the two labs or the data for the cultures we send to County X... for the ones we send we look at positivity rate, most of them have no growth because clinicians are possibly requesting the cultures after starting the antibiotic course” – LBFB04

This feedback loop of low positivity rate from samples that were transported to County X for processing was a form of data, that practitioners were privy to in the specific cases they dealt with and in the context of their community of practice. Whereby they had to weigh up the challenges the community of practice collectively encountered in terms of reliability of blood cultures against the profiles of their patients, including the patients’ financial standing.

“Clinicians have to make these decisions daily, they are [blood cultures] 6000 KES and the majority of patients who need blood cultures can’t afford this, they can barely afford to come to the hospital so many patients will go to pharmacies for drugs before they come and this maybe also explains the low positivity rates” – LBFB04
Issues in the paucity of data and challenges in lab resources, patient finances and public behaviour created a rather complex web of issues relating to AMR.

8.4.3.1 Summary
This section discussed AMR-related learning and data. It presented data specific to practitioners’ previous participation in AMR-related learning, access to AMR guidelines and challenges in access to data, specifically the absence of a hospital antibiogram.

8.4.4 Theme 3: Self-directed learning

Beyond compulsory learning, participants also engaged in ‘self-directed’ learning. The theme of self-directed learning in this context is being used to refer to the learning outside required CMEs. Participants had varying reasons for engaging in learning, including advancing practice with the view to work within private practice, for example COMFM7 looked to advance his practice with the view to offer services in his own clinic. A small number of participants discussed self-directed learning that they undertook online, accessing both free and paid for courses. In reference to having any experience with AMR learning, PCMP13 was the only participant to have engaged in AMR specific self-directed learning. He noted having had to pay for the course. It is worth noting of the participants who referenced accessing courses that required paying for, were more senior staff members (PDFP14, DAFS11, PCMP13).

8.4.5 Theme 4: 4Rs – Right drug, right route, right dose, right duration

The 4Rs refers to prudent prescribing practice (see section 1.7), that notes that antibiotics should be given on the basis of the 4Rs, ensuring patients are given the right drug, through the right route, at the right dose for the right duration of time. Drug audits discussed above included the collective evaluation of prescribed and administered medicines, such as antibiotics, to critically explore whether drugs were administered in line with the “4Rs”. Adhering to the 4Rs in context was challenging due to multiple interacting factors such as challenges in supply chains and drug availability. Thus, practitioners sometimes prescribed based on circumstances in supply chains as opposed to recommended prudent practice guidelines.
8.4.5.1 Subtheme – Challenges to the ‘right’ route

Prudent prescribing could in the context of Hospital X be undermined by external factors such as challenges to obtaining medications for the right route based on rational clinical decision making. Right route in the context refers to the form in which the drug is administered for example, oral pills, or intravenous treatment whereby a plastic catheter inserted is into the vein to administer drugs directly to the bloodstream (Great Ormond Street Hospital, 2020). Data showed that sometimes drugs were administered in a form that was not the prescribed choice.

For example, if participant PDFP14 noted,

“you can send for IV and they bring back oral so now you have to use because there is no money”

These issues were echoed elsewhere, especially in paediatrics where route is ever more important

“Well if I want a syrup but someone is getting tablets so then we can’t dispense the tablets because the tablets usually a small child won’t be able to take or the milligrams are too high and also wrong formulation, wrong sometimes we have the wrong active component if I sent someone for paracetamol for example and they are told oh we only have ibuprofen you see because according to the pharmacist or whoever they met all of them will solve fever but the thing is you can’t give it in all patients and then others come with generics which won’t benefit the patient. Some drugs are good the right formulation, the right active ingredient but stored wrongly, when its been stored in a very hot place when it was supposed to be in the cooler so it won’t work” -PDFP14

8.4.5.2 Subtheme – Challenges to right drug, right time, and right duration

Meeting the right drug, right time and right duration criteria were subject to challenges in supply chain, that is in time lapse in relation to sourcing drugs that were out of stock and the dispensation of the wrong amount from pharmacists and sellers outside the hospital. Given the contextual challenges in adhering to prudent prescribing practice, it was no surprise that participants talked about often encountering what they suspected to be AMR,
due to patients not reacting to certain medicines as one may expect. Some participants such as PCMP13 expressed some concern around the frequency with which cases were encountered. During fieldwork, ward rounds I experienced one such unconfirmed but clinically signalling AMR case. Below is an excerpt from my fieldnotes

“One patient appeared to be a difficult case, not showing enough improvement. From what I could gather the patient had been on different antibiotics for more than a month, the infection was showing little signs of subsiding, and she was oozing with puss post-surgery. After rounds I followed up with participants COFFS6 and COMFS5 who were the intern Clinical Officers who explained that the case was indeed difficult, the patient had ‘several repeats’ of antibiotics but was not reacting in the way one would expect – COFFS6.

When I asked whether they had done cultures for the patient. She said no cultures had been done then referenced the reliability of the lab (FN0905).

The statements below were made by COFFS6, to expound on lab related challenges in practice, these were voiced in the context of the difficult case discussed above.

“you can request and when you go looking for results they tell you something was wrong with the sample, you pull the sample three times and have nothing at the end, you can go back all week” – COFFS6

“if they can’t run the test here, it will go outside but we have low positive rates and you have cost the patient money” – COFFS6

PCMP13, and PDFP14, who were the two most senior practitioners on paediatric wards, talked about the challenges of experiencing cases of AMR in children and the need to provide training on prudent prescribing with PDFP14, noting that the learning provision with specific reference to the paediatric context to be inadequate.

“Well, we have had a few trainings like from ETAP which is emergency triage and training in paediatrics. So, this tackles a bit of antibiotics but not in detail and also it’s not possible for everyone to attend so I guess it’s the funding for the training and it happens once like in 5 years” – PDFP14.
8.4.5.3 Subtheme – Challenges to empirical therapy
PCMP13, talked at length about the need for AMR training, noting that he perceived AMR to be a growing burden given the frequency with which he came across cases where he suspected AMR and the challenge of what he referred to as

“blind empirical therapy” – PCMP13

That is making therapy decisions in the absence of antimicrobial susceptibility tests. These tests check which antibiotics, specific organisms are susceptible to, that is to say it is a process of detecting the right drug that is most likely to be effective for a specific patient (Bayot & Bragg, 2022). In the absence of access to tests, these practitioners can use hospital data, this can be used to improve the quality if initial decision making, to help them arrive at a rational and informed clinical decision on prescribing antibiotics, however this was also a challenge for the facility, data paucity was more broadly discussed in section 8.5.2.

PCMP13, therefore discussed how this reliance on “blind empirical therapy” made for poor practice amongst his juniors and how the lack of institutional support structures made for missed opportunities to adjust and align practice with prudent prescribing practices of starting smart then focus (see section 1.7).

“you will find someone has given the antibiotics first then pulled the sample after but this should of course be the other way round and we have no antibiotic champions or committee to support especially junior staff and we are a training hospital” – PCMP13.

8.5.4.4 Summary
This section discussed the 4Rs and presented data that expounded on challenges in meeting adhering to the principles of right drug, right route, right dose, right duration within the context of the hospital. This section also present data relevant to challenges specific to empirical therapy.

8.4.6 Theme 5: Beyond Scope

The ‘beyond scope’ theme refers to challenges and concerns and issues that broadly sat outside the hospital, where there exists limits in terms of how practitioners in hospital X can
address those specific challenges. These challenges would be better addressed in public health, health promotion, the regulatory space or practices in feeder facilities. However these challenges are relevant to the activity system of the hospital and the ability of this thesis to make recommendations relevant to practitioner learning to tackle AMR in Kenya.

To capture the range of issues covered in the ‘beyond scope’ theme, I present them by sub-theme, namely, supply chains, drug quality, public behaviour and feeder facility practices. Of which, feeder facility practices have a bearing on health practitioners within the referral hospital setting. These are discussed in subsequent sections.

8.4.6.1 Subtheme – Supply chains
Inefficiency in supply chains was an issue for AMR practice, the hospital pharmacy routinely ran out of medicines, this was known as

“stock outs” – PHMP17

The pharmacist reported that drugs were sometimes not delivered on time, as a result they would sometimes run out of stock. This had implications for AMR practice in relation to prescription practices.

“You don’t know if they will go to the market so even if you are administering medication from outside, you cannot be a 100% sure what you are giving so you sometimes think better I give them what’s in our pharmacy” COMFM7

As noted by COMFM7, stock outs would sometimes cause practitioners to prescribe a second or third choice drug due to suspicion about drugs from outside, this is echoed in the latest WHO policy brief on AMR in Kenya (WHO, 2022) and elsewhere in literature where solutions such as emergency procurement procedures are offered as solutions to the challenge of stock outs (Godman et al., 2021).

8.4.6.2 Subthemes – Drug quality and public behaviour
This section presents the drug quality and public behaviour sub themes, of which the drug quality related challenges that health workers face in practice are interrelated with public access to lower quality drugs.
'Drug quality’, was ascribed to participant data (LBFB04, COMFM7, PCMP13 and PDFP14) referring to patient access to cheap drugs. For example, PCMP13 noted

“we also have to train the public, I tell the mothers if the price sounds too good to be true, it is too good to be true, we have had many issues with mothers accessing medication for meningitis very cheap and the child does not get well and we can have serious complications. So I have to also train my staff to educate the public” – PCMP13

The issue of drug quality was spoken about in two ways. Firstly, access to cheap, sub-standard drugs was common. Its underpinning drivers were both regulatory (lack of enforcement) and financial (inadequate patient finances to meet the cost of drugs). According to PCMP13, in some instances, patients’ carers would forego the hospital pharmacy to go and find cheaper drugs elsewhere including on market stalls outside the hospital. Secondly, drug quality was discussed as an issue that was particularly problematic in the context stock outs, whereby the hospital pharmacy it out of stock of certain medicines and practitioners actively send out patients/patients’ relatives and carers to source drugs from outside the hospital due to the stock outs.

‘Public behaviour’ was generated as a sub-theme of beyond scope, referring to actions taken by patients and members of the public that could undermine prescriptive practices. As noted by COMFM7 in the quote above, practitioners cannot be sure of what they are administering given the challenges in regulating access lower quality drugs and the choice to purchase lower quality, cheaper drugs that patients in difficult circumstances may make. Regulation related challenges include illegal pharmacies, access to antibiotics on open markets and access to antibiotics over the counter without prescriptions. These challenges are recognised in the NAP on AMR as contributing to misuse and overuse (GovKenya, 2017). When the public use informal routes to gain access to antibiotics over-the-counter from open markets, authorised or unauthorised pharmacies without prescriptions, this impacts practitioners’ capacity to make informed clinical decision, as sometimes they are not privy to the drug accessed prior to the patient presenting. For example, paediatric doctor PDFP14, in discussing the challenge of making informed clinical decisions noted that
“Some children come after two weeks of antibiotics, one week at home, one week in the facility then that’s when they come” – PDFP14

The challenge for the practitioner according PDFP14, was that parents may in some cases access later line drugs over the counter, they may not recall the administered antibiotics and may have accessed and administered lower quality drugs. This behaviour not only impacts the practitioner’s capacity to make an informed empirical decision but also impacts their capacity to rely on the bench as susceptibility testing should be done prior to antibiotic administration. Thus public/patient behaviour can in this way make the practitioner’s job ever more difficult.

8.4.6.3 Subtheme – Feeder facility

The same challenge of not knowing which medication a patient had taken already and whether they had already had a course of antibiotics, and how many, to make an informed clinical decision, was also exacerbated by feeder facilities that referred patients to Hospital X. As discussed in section 8.4.3, in reference to patient journeys, referral patients should on presentation to a referral facility provide the receiving facility with a medical record card with accurate information about the patient’s condition and any prescribed medications the patient may have taken. Whilst this is the case for transfer MDR TB patients who are transferred by ambulance. Participants discussed the challenge in communication as mostly being related to self-presenting patients and other referral patients presenting without a letter or card that summarised treatment and reasons for referral. In the following extracts PDFP14 elaborates on the AMR challenge in relation to feeder facilities.

“They are supposed to write a letter or a summary of what they have done but it is not guaranteed” – PDFP14

This posed a particularly acute challenge for AMR practice, in relation feeder facilities as discussed by PDFP14

“Oh, we need to do more continuous medical education, reaching all facilities. You see this is a referral, but we have level 4, level 3 so they need to understand – when do we use antibiotics, when do we not, if we are to refer the patient. Is it important for me to indicate that I gave something? Some don’t indicate, so you see, you have
a child not improving on the right treatment and yet you just don’t have the knowledge that they actually received treatment prior because it’s not undocumented. It’s very important and also to appreciate the lines in places you know first line, second line, third. We are also not appreciating those but I think its also because of lack of knowledge. Someone will have a simple cough and they are already on third line you see. So by the time they come to you, now you, the safer options are already gone”.

In the quote above PDFP14, discussed the challenge that is posed by the feeder facilities failing to provide patient data and importantly, indicates that the challenge lies beyond the scope of the practitioner and hospital and though affecting practice at the Hospital X, addressing the challenge requires engagement beyond the hospital, as the root of the issue in this case is in lower-level facilities within primary and secondary care.

8.4.6.4 Beyond Scope theme summary
This section presented data relevant to the theme beyond scope and its corresponding subthemes of supply chains, drug quality, public behaviour and feeder facilities. It highlighted challenges in practice that are imposed by external factors that broadly beyond the scope of the individual practitioner’s role and in some cases the hospital’s scope.

8.4.7 Theme 6: Communication

The communication theme was ascribed to data describing communication practices once patients were being treated at the hospital. This theme includes modes of communication and sources of or instances of miscommunication. In relation to data flow, such as patient data, an electronic health system was being trialled in the OPD at the time of research. Participants NMOD12, who worked in OPD, and PDFP14 who was largely based in paediatrics but sometimes did shifts in OPD, noted the trial use of the EHR in OPD.

“OPD has an electronic system called X. Where they enter everything in on a small card, smart card. Oh I don’t if its smart or its just. I don’t know what to call that card. But there is a card. So the moment they come everything is entered onto that card. So there is no hard copy. But when they get admitted then everything becomes analogue. So we write everything out” – PDFP14
Practitioners on ward, for example COMFM7 and COFFS6, referenced awareness of the system but had not had any interaction with it as wards still used manual pen and paper in handling patient data and communicating patient needs to the next practitioner on the next shift

“When they [patients] come from OPD then my role is to clerk in” – COMFM7

When asked if patient records from OPD are used to clerk in, COMFM7 responded,

“you have to take it again we don’t use the system in there because we use files on ward” – COMFM7

At the time of this research, the primary mode of communication across Hospital X was hard copy. This included the data that was communicated between clinicians in patient files and medical records as well as across teams. Patient files were used by teams for bedside care, these contained up to date patient medical history (NMOD12). Patient files would be discussed during handovers (FN2904). On the occasion that patients required lab tests, the primary mode of communication remained hard copy. Request forms would be filled, and the tests would be dropped off at the lab and lab tests results would be available on hard copy (FN1005). However, practitioners would often call or WhatsApp the results beforehand to expedite the clinician having access to results. In cases where the lab tests were processed off site, communication would extend to the use of email.

“Email, yes. Whatsapp – social media yeah. We choose which mode is easier, phone call” – PDFP14

Participants also discussed challenges in communication between colleagues, for example participants COFFS6 and COMFM7, both based in the female surgical wards, highlighted the challenge of communicating in relation to hierarchies. This was echoed in data from the KAP survey in iteration where participants responses were largely negative in reference to communication (see section 7.3.9).

During observations of morning handover, I was able to observe how practitioners’ handover at the end of the shift communicate patient needs for practitioners coming on
shift. Handover included going through patient files, communicating how patients had progressed over the course of the night (FN0905).

8.4.7.1 Summary
This theme presented data relevant to the theme communication and highlighted the relationship between modes of communication and patient care with specific reference to the bearing that communication has on AMR-related practice at Hospital X.

8.4.8 Theme 7: Lab capacity

Evidence from this phase of the study identified challenges in practice in relation to lab reliability, lab capacity, resources, and off-site processing, which are all captured under the theme ‘lab capacity’. Of which challenges in reliability and timely results were linked to inefficient communication between the lab and ward, whereby the clinicians would have to go looking for test results rather than results being communicated to the clinician, see section 8.4.8.1.

8.4.8.1 Subtheme – Reliability
Participants in the MoH wards who sent samples to the MoH lab spoke of a lack of reliability and timely results and how sometimes the mishandling or contamination of samples would require clinicians and doctors to repeatedly draw samples from the same patients. ‘Reliability’ was therefore a sub theme of lab capacity. On the surgical ward (MoH) for example, COMFS5 and COFFS6 discussed the issue, COFFS6 noted,

“you can request and when you go looking for results they tell you something was wrong with the sample, you pull the sample three times and have nothing at the end”

This was considered a challenge for timely delivery of care and sometimes meant clinicians would make the decision to forgo tests and diagnose empirically. However, on the MoH lab side, lab practitioners also reported contaminated samples, speculating that perhaps some samples were improperly drawn on the wards.
On the NGO side, COFTB9 spoke positively about the lab and the point of care diagnostics that were readily available on the NGO wards. LTMB03, a lab technician from the NGO ward, also spoke positively about the relationship between the lab and the ward. He noted that he provided practitioners with feedback and also attended and contributed to ward rounds so that he was aware of patient needs. Below, COFTB9 discusses lab capacity and diagnostics.

“Actually we have almost all the machines that we can get the results. We also have by the way our in-patient lab. We have MoH lab and we have NGO lab so we get results from our lab very fast and the difference is in the NGO wards we have other machines that are not in the MoH wards. For example, we have a PIMA machine for CD4, we have um, and that one you know can really help us...we can know the CD4 of the patient so that we straight away go to the [inaudible medical terms] as we do the diagnosis. We get the diagnosis very fast. Secondly, we have RPS machine. We can find out whether the patient is hypoglycaemic and more so in diabetic cases we have to monitor the sugars like RBS and FBS to know how much you give in medication and you know what time to give medication and we also monitor the three meals so that is very easy by the time you get a patient that is going down if you want the MoH lab, it will take like 20, 30 minutes and maybe the patient is getting really low so this bedside machines you can just prick and get the sugars of the patient and you act immediately. For example, if it is low you can deal with it. We have many things, we have the ultrasound machine you know, we have malaria, we also have the hepatitis.” – COFTB16

The NGO wards therefore had greater access to point of care diagnostic tools, as well as a more reliable lab. Part of that reliability was informed by more effective supply chains, such as having necessary reagents to conduct the necessary tests. The cumulative impact of this is a decrease in reliance on empirical diagnosis, because clinicians have the capacity to use the bench (read lab).
8.4.8.2 Subtheme – Offsite processing
Specific to testing for resistance, lab capacity across both labs was limited. In particular, the labs could not conduct blood cultures (for a broader discussion on blood cultures see section 8.3.4).

“As a facility we don’t have the capacity to run the cultures.” – PDFP14

When asked how tests are conducted PDFP14 noted

“They can go to [facility 1], they can go to [facility 2] Like [facility one] they have to go to [County Z]. And [facility 2] they have to go to County Z. Or give the sample to the lab here to send to County Y. The [private hospital] here doesn’t run such tests. They can only transport the sample” – PDFP14

Most samples were sent for processing off site to county Y. ‘Off site processing’ was therefore a subtheme, which was evidenced by participants discussing issues with offsite processing, including suspicion about the accuracy of tests sent to county Y. This issue was also therefore linked to clinical decision-making based on the results of tests processed off site, participants LBMA01, LTMB03, PCMP13, PDFP14 discussed low positivity rates in samples sent to County Y. Practitioners noted that this had caused them to suspect inaccuracy in tests. LBMA01 noted that these were transported by a driver, however there was no dedicated vehicle nor driver who remained on call in case samples needed to be sent. Of the cultures that the MoH lab could run, the lab manager for MoH lab (LBMA01), said cultures for susceptibility testing (these check for resistance) were infrequently requested,

“I would say maybe four a week maximum” – LBMA01.

This indicated the potential over reliance on empirical diagnosis across the Hospital.

8.4.8.3 Summary
This section presented data relevant to the lab capacity and corresponding subthemes, namely reliability and offsite processing. Data presented showed how challenges lab capacity and reliability can have an impact on AMR-related practice, including timely
delivery of care. Importantly data indicated that lab capacity can have implications on AMR practice including overreliance on empirical diagnosis.

8.4.9 Theme 8: Collaboration

Practitioners discussed the importance of and issues relating to collaborative practices, these discussions were captured under the theme “collaboration”. This theme was ascribed to participants referencing collaboration within the hospital, in teams within wards and across the MoH and NGO divide. Collaborative practices were visible during fieldwork, for example, ward rounds were defined by teamwork. These ward rounds involved different job roles, i.e. nurses and clinicians (FF1105). During these rounds tasks would be distributed by job role, i.e. where the doctors may have advised on the redressing of a wound during a ward round, the nurses would be in charge of wound dressing or administering medication prescribed during a ward round (FF1105). On some wards such as the MDR TB ward, collaboration would be across the MoH and NGO staff, MoH’s specialist consultants would join the MDR TB ward round to lend their expertise. Collaborative practice was also discussed in the case of patients whose care needs would change for example, a medical ward patient (NGO), who over the course of their hospital stay may require surgery which is conducted by MoH. Practitioners would work collaboratively across the MoH/NGO divide.

“Yes, there is sometimes from surgical wards they are reviewed by our doctors from our ward and there they give the authority to be brought into the medical wards and sometimes we even get surgical cases and we transfer them to the surgical ward so they can be reviewed by the surgical team” – COFTB16.

This differed from other such as paediatrics who were run by MoH and did not have cross over with NGO staff. Below, participant PDPF14, discuss not having any interaction nor benefitting from the NGO.

“Well the NGO system only takes care of a section of the hospital. It only takes care of adults who have been admitted on medical wards. So it doesn’t really take care of us with children. It doesn’t take care of the children, it doesn’t take care of surgical
How collaborative practice materialised across wards depended on various factors including potential patient cross over. Where there was no cross over and collaborative practice between paediatrics and the NGO run side of the hospital, paediatrics, maternity and surgical wards worked collaboratively and some of the staff on wards interchanged. Therefore, collaborative practice was in this way determined by patient needs and staff capabilities. For example, PDPF14 worked in both paediatrics and the New Born Unit and would be on hand to help in the outpatient department when children were brought in.

Collaborative practices were also visible in the build up to and during strike action but in a different way. During these periods the hospital was being run by a fraction of the usual staff, thus collaborative practices were based on circumstances that demanded a redistribution of staff. Therefore, when a ward had little to no staff some patients would be sent home and critical patients would be sent to another ward, or two wards would merge (FF1305). This included cross stream collaboration across NGO and MoH wards, of which NGO wards seemed to retain more staff during these periods.

8.4.9.1 Subtheme – Telemedicine
On the NGO wards, collaborative practice was also mediated by technology. The NGO used telemedicine to get assistance from other doctors and consultants who work for the NGO in different places across the world, no accurate data on the limitation of this scope of reach was provided. Telemedicine was generated as a sub-theme of collaboration.

“If the consultant is not around, we have our HIV doctors here and in the TB that is complicated we sometimes post them to the telemedicine for help, then we discuss” – COFTB16

In the case above, a clinical officer discussed how they use telemedicine in practice. Expounding on what they posted on the platform, they noted:

“we can post cases like ultrasound cases or chest x-rays that are complicated, we don’t understand then we discuss. Because we have even our bedside machine for
ultrasound, we call it focus, so we can always do this one bedside then we discuss so we can post this one to telemedicine and we can get their views “ – COFTB16

The telemedicine app was used in complex cases for second opinions from specialists who interpret patient data they are presented with or images. Conversely, the team at the hospital was also able to make contributions to other practitioners across the world who posted on the same app. Thus, some practitioners on the NGO wards were already familiar with the use of mhealth for learning and peer discussions, COFTB16, for example thought the platform would work well given previous experience using mhealth.

8.4.10 Theme 9: Site management

The site management theme was ascribed to discussions referencing hospital management, including the administrative divide between MoH and the NGO. This divide had an impact on resource distribution across the facility. For example, COFTB16 discussed the availability of point care diagnostics (covered in the lab capacity section 8.4.8) on NGO wards, which were unavailable on the MoH wards. The divide was marked by a visible disparity in resource availability and in the finances such as in delayed salary payments. In the analysis, the subthemes ‘strike action’ and ‘go slow’ were assigned to evidence related to the site management theme. Fieldwork was conducted during a ‘go slow’ period and in the lead up to and during ‘strike action’ period. Go slow was a period building up to strike action as a result of health workers on the MoH administrative side, having not received their monthly salaries on time. The ‘go slow’ period would be sustained either up to receiving payment or going on strike if payment was not received by a certain period. Notably there were differences in sources of salary, the NGO paid NGO workers and trainees were paid by the central government the challenge was therefore for the county staff, as COMFS5 explained below

“yes but remember , I’m not getting my pay from the county government, it’s from national government, our is timely. The internship is a function of central government”
However, strike action seemed to extend to workers whose pay was coming from the national government based on an agreement between the county government and the unions.

“the unions agreed with the county government that failure to pay salary by 8th of the subsequent month then salary parade begins” – COMFS5.

When asked about the frequency of strike actions, COMFS5 noted that strike action had been increasing over the preceding few months. During strike action, most patients would be notified that staff will not be in attendance, given advice for at home care before being discharged. At the time of conducting the interview with COFTB9, only three wards remained open in the hospital, these were NGO run. COFTB9, also noted that the strikes were happening “at least every two months” – COFTB9.

The TB ward where the participant COFTB9 was based remained largely functional, however with some limitations in terms of normal collaborative practices that ordinarily involved practitioners from the MoH wards such as consultants, who would join ward rounds on the TB ward. During strike action I still visited the hospital and observed practice to understand how it differed during these times. I for example witnessed, patients who had been referred to the site from a smaller facility arriving to find that there were no services available, patients for either further care or investigations such as x-rays. Where possible the staff that was available would help, however most patients were turned away. It is worth noting that for example the outpatient’s department had no doctors available during strike action, there was one nurse who was in the department for any patients that would come in. I interviewed this nurse, participant NMOD12, during strike action, on a night shift. In discussing his daily duties, he differentiated between daily duties during periods where the hospital was operating as normal and during strike action, notably this included changes in AMR-related practice, specifically prescribing practice. Noting that

“during strikes any nurses can prescribe and the pharmacy will give, but normally when doctors are here we don’t prescribe unless it’s the advanced nurse practitioners here or in other facilities like special clinics nurses can normally prescribe like in psychiatry and palliative care and renal units but only analgesics but
“again only nurses trained in advanced pain management and palliative care” – NM0D12.

It was therefore clear that strike action had an effect on AMR practice and importantly highlighted the importance of making available teaching on prudent prescribing to nurses even though it is normally limited to doctors. As data showed that strike action was not a one off, in fact other studies on CPD in Kenya have reported challenges in data collection due to strike action, for example, Kemei and Otowa, (2021) reported that amongst their limitations to data collection was strike action, as the data collection period had been affected by strike action.

8.4.11 Theme 10: Health professionals’ motivation

In the lead up to and during strike action, staff morale was seemingly lower compared to previous days in the field, prior to missed payday (FF1205). Participant recruitment for interviews became increasingly more difficult. For example, whilst in the ‘go slow’ phase, when I asked LBMA01, who was the lab manager of the MoH lab, if I could speak to lab staff. He gave me permission to do so if any of the lab staff agreed, with the caveat that he could not help to recruit because of a loss of authority during the go slow period. Health workers were less likely to listen to managers during this period and LBMA01, in part also found difficulty with making requests during these periods (FF1205). LBMA01 noted a lack of motivation and interest in completing normal tasks. The go slow was a form of protest against working with no pay. Therefore, any additional work or interactions that could be viewed as additional work were largely unwelcome. Health workers would therefore disengage in a variety of work-related tasks and/or interactions. Motivation was therefore a theme. Where participants showed motivation in engaging in for example self-directed learning and gaining additional qualifications, sometimes this was associated with being in or being able to move to the private health (COMFS5; PCMP13; COFFS6). Participants also discussed motivation in reference to seeing their patients get well (PDFP14; PCMP13, COMFM7) and more broadly in reference to the needs of the community. For example, LBFB04 was motivated by meeting the needs of community, this was evident in participants speech, phrases such as “our people need” – LBFB04
Several participants discussed the importance of serving their communities in association with their personal motivations to learn and engage in good practice (PCMP13; COMFM7; PDFP14). Broader public health goals such as tackling AMR and the role that learning can play in moving practitioners towards meeting public health goals framed within the context of their own practice were also discussed as motivations (DAFS11; PCMP13). Motivation was also discussed with reference to ease of access to and availability of learning materials, including challenges in accessing technology and costs associated with learning online. For example, where a participant such as PCMP1 was motivated to learn, his financial position meant he could follow through on his motivation this was not the case for other participants.

8.4.11.1 Summary
This section discussed the theme of health professionals’ motivations and the challenges for example in managing practitioners’ during periods leading up to strike action and where practitioners would disengage or become less motivated to work. The section also discussed motivation in relation learning.

8.4.12 Theme 11: Universal Health Coverage

Some of the factors that underpinned challenges in many of themes revealed (and covered above) were linked to challenges in Universal Health Coverage (UHC). According to the WHO, UHC “means that all people have access to the full range of quality health services they need, when and where they need them, without financial hardship” (WHO, 2022, n.pn). Financial hardship remains an issue in this Kenyan context, associated with underlying factors and impacting clinical decision-making. For example, it was a key factor in the decisions as to whether to run blood cultures (or not) and, by extension, courses of treatment (see section 8.4.3).

“No on this side, we don’t charge, so they can have whatever they need and even if we don’t have, like we run out of reagents, we can borrow from MoH or run the tests there because we are dealing with difficult cases... our wards we have the most HIV and we have Malaria” – COFTB9
UHC is therefore ascribed as a theme, to acknowledge the references to the issue of patient finances and subsequent access to services, including financial hardship or practitioners making clinical decisions based on the patients’ personal financial standing rather than best practice. These instances have been discussed reference to medication, drug quality, empirical diagnosis in the preceding sections however given the frequency with which finances were discussed across the other themes, it was fitting to ascribe a theme that was also interlinked with other themes.

8.4.13 Summary

This section presented data relevant to iteration 2 which was obtained through interviews and observations and analysed thematically. Data presented themes relevant to various aspects of AMR-related practice and learning, including data specific to how the hospital site was run such as site management and lab capacity. Data presented also included how practitioners communicated and worked collaboratively across the site. Importantly, data presented in this section provided evidence of what lies beyond the scope of the practitioner and the hospital, highlighting the importance of health system governance, policy and public health approaches that focus on effectively communicating the challenge of AMR to the general public.

8.5 Presenting iteration 3 data

Data from WhatsApp as a support resource were imported into Nvivo and analysed to subsequently generate themes (see section 6.7.3). At the end of the mHealth platform AMR module titled *Introducing a One Health approach to AMR* feedback from participants was requested over WhatsApp or participants could opt for a phone call interview, text or voice notes. These were also imported into Nvivo and analysed. Table 8.2 below summarises and exemplifies themes generated from iteration 3.
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8.5.1 Theme a: Political climate

At the time the module was released there was a national election in Kenya, and the now president, William Ruto’s campaigned on the slogan “Every hustle matters” (Schipani, 2022, np). This was based on the concept of having a hustle or hustling, a slang term for work performed for income. It can in some circumstances be supplementary to a main income, hence known as a side hustle (Merriam-Webster, 2023). The slogan spoke to the broad economic outlook for the ordinary Kenyan meeting the challenges in a cost of living crisis. This included the challenge that health workers faced in meeting the cost of living on their salaries, which I discuss more broadly in the personal finances theme 8.5.2. The Ruto campaign was a move away from conversations on ethnicity that have historically been a source of election violence, as ethnic tensions rise during election seasons (Schipani, 2022). As a result, as a precaution, businesses run differently, often closing offices in the period leading up to the election (de Smelt, 2009). The NGO I partnered with largely closed their offices during the election time with very few people working. As a result, when there were system malfunctions or glitches on the learning platform this was particularly difficult to resolve, and in some cases, it was not possible to resolve a glitch due to closures. In cases where there were glitches or issues during this period, I could try to help the participants with regaining access to the platform through the WhatsApp support centre. However, some challenges required backend access and an advanced understanding of the platform. Therefore, whilst I tried to help to the best my ability, there were circumstances where this proved insufficient. Image 8.6 below is an example of a participant looking for support because the system would not allow progress to the next stage.
The participant was effectively locked out of the platform and could no longer progress. There were several instances such as this with no resolve because of reduced working staff during election period.

It is worth noting that the national election had an impact on the local governor, who would be elected, and that the governor is in charge of health worker salaries. Health workers therefore had reasons to be heavily invested in the election and some expressed hoping for a candidate that would pay them on time in the future. Participants referenced the election as something that competed with the course for attention during the election period.

“I could not do the course. I was campaigning for my candidate” – COMFS5

Where I had sent a message to ask all participants for feedback on WhatsApp, not all participants responded with some responding well after the election to note despondency due to elections. Additionally, the election collided with strike action, (as mentioned 8.4.11) thus participants noted having other priorities away from work, especially in the context of not having been paid. Participants discussed or referenced income generating activities outside their main salary, these can be understood as examples of ‘side hustles’, captured under the theme personal finances.

8.5.1.1 Summary
This section discussed the theme of ‘political climate’ highlighting the impact of politics and more specifically election season on engagement amongst the participant group. It also
discussed the limitations on the module based on precautionary safeguarding measures that the NGO put in place given the history of election violence in the country.

8.5.2 Theme b: Personal finances

The theme of personal finances was ascribed to data that referenced salaries. This was often in relation to the strike action and wanting to be paid, which had an impact on engagement with anything relating to work, including learning. Personal finances, also referred to the need to make money beyond salaries. As a result the subtheme ‘hustling’ was generated. To consider the impact on engagement, or lack thereof, based on participants having to focus on income generation outside their jobs. Whilst data on this were limited as the instrument did not directly ask participants about income in anyway, participants did spontaneously raise the issue with particular reference to the strike, reliability of income and the broader macroeconomic landscape in as far as the cost of living. In iteration 2, (see section 8.4.10), participants referenced many consultants running their clinics, with some referencing aspiring to run their own clinics and move out of the public sector. For example, for a consultant with his own clinic, during fieldwork, in order to interview him, I had to go to his private clinic

Other participants ran businesses outside their jobs PHMP17 and COMFS5 discussed their businesses in reference to not being able to dedicate time to the module.

COMFS5 ran a small clinic that he was aspiring to advance, and also sold sugar.

“With no pay we can’t work on learning for work, we have to work on other things, I also sell sugar so I will do that until the strike is over. My clinic has also benefitted from the strike at Hospital X” – COMFS5.

PHMP17 ran a car hiring business, when initially interviewed during fieldwork. PHMP17, was a pharmacist whose business was due to benefit from a conference in Kenya that would attract delegates from the African region. For PHMP17, it was important to focus on this, PHMP17 subsequently reported not engaging in the module citing a busy business season as a reason. The theme of time constraint was subsequently generated to explore the challenge of time.
856.2.1 Summary
This section discussed the theme of personal finances, highlighting issues pertaining to personal finances, namely salaries and hustling. It highlighted that health workers having to engage in income generating activities had an impact on the amount of time practitioners could dedicate to engaging in learning.

8.5.3 Theme c: Time Constraint

The theme time constraint was ascribed to practitioners referencing limitations on their time in relation to having time to access the mobile learning platform. Practitioners discussed having other commitments and needing to prioritise other things outside their working hours. For example, the election also impacted the participants’ engagement, bringing a new dimension to time constraints. Participants were busy campaigning during this period, in reference to not having completed the module, COMFS5 noted being busy campaigning

“I was campaigning for my candidate” – COMFS5

Other time constraints were related to finances and COMFS5 and PHMP17 for example, both ran businesses outside working, these limited the amount of time they could dedicate to learning (see section 8.5.2). Other participants also discussed competing priorities, however, did not disclose the nature of competing priorities, for example COMM10 and COMFM7 did not offer explanations.

“Prioritising other things after working hours” – COMFM7

“Sorry got engaged” – COMM10

COMFM7, for whom finding time to complete the entire module was a challenge, explained that, despite not having found enough time to finish the module, he was passionate about the subject of AMR and was an advocate for the role that education can play in driving down behaviours. Similarly, NMOD12 was also passionate about the subject and also discussed competing demands on his time.
8.5.3.1 Summary
This section discussed the theme of time constraint in reference to dedicating time to learning. It highlighted that competing priorities played a role in limited engagement with learning.

8.5.4 Theme d: Motivation

Given the challenge of constraints on their time and requirements to meet the point requirement for CPD for licencing medical bodies, some participants noted that they would have been more motivated to complete the course if there was a certificate. For example, NMOD12, had competing priorities (noted under theme ‘time constraint’) in expounding on challenges in dedicating time to the module. He was amongst participants who noted that it would have been useful and, perhaps more motivating both for him and his colleagues, if participating in the module was going to gain participants some recognition, for example if the module were to contribute to CPD points or certification. ‘Recognition’ was subsequently developed as a subtheme of ‘motivation’. As undertaking the module was in addition to required CPD, this was indeed the case for all participants as the module was not certified. Other participants also made enquiries about recognition or certification, for example participants COFFS6 and COMM68 who discussed certification and/or recognition in relation to motivation.

Participants COMFM7 and DAFS11 discussed being motivated to learn and engage with the module because of the cases of AMR they had seen. COMFM7 discussed being aware of the AMR challenge after it was briefly covered in one of the weekly sessions in the NGO CPD. DAFS11 for example, worked in surgery and said she was doing the course because of experience and awareness of the challenge,

“we really need these kind of courses because in surgery I am worried we are not using responsibly” – DAFS11

‘Awareness’ was subsequently developed as a subtheme of motivation referring both for participants who engaged because they were aware and those who felt they did not possess enough awareness of the problem of AMR. For example, participants COMFM7 also discussed being aware of as a motivator. COFFS6, discussed being motivated to learn due to
not having a comprehensive understanding of the AMR challenge and its impact on daily practice.

8.5.4.1 Summary
This section discussed the theme of motivation to learn and engage using the platform. It discussed the subthemes of motivation, namely recognition and awareness, highlighting them as influencing factors based on participant data.

8.5.5 Theme: Access

The theme ‘access’ was ascribed to data describing or discussing accessing the platform, including network issues, platform malfunction and mobile settings. As discussed above, (see section 8.5.1) the capacity to resolve malfunctions was limited due to decreased staff availability at the NGO during the election season. This had an impact on retaining participants and participants progressing.

“He/Hello, I’ve been having a problem with the short messages being sent to me from the [X] services. Sometimes it states that there is tasks available but on following the instructions by dialling the provided number it informs me that there is no work available at the moment later after some days I’ve been getting report that places my scores at 00%. This had happened twice I don’t know the approach I should give it for a positive progress” – NMFS22

Despite progressing NMFS22 on the platform having completed certain stages, NMFS22 was receiving a completion rate of 00%. This was frustrating for the participant and could not be resolved until after the election period. Participants also reported back not being able to access messages, I had been trained on changing mobile settings to enable messages to come through and was able to provide support to participants to change their settings and enable messages to come through. This highlighted that a structured induction to the course would have been useful for participants, this could have been offered proactively rather than reactively in-person or through organising access to audio visual materials. In terms of access, participants also reported back network issues, these had been highlighted in iteration 2 as a potential issue, that became visible in practice (see section 8.4.2).
“I didn’t finish I didn’t understand where the problem was in my case whether it was the network. My network isn’t stable” – COFSS6

In another case, for example, a participant’s phone had been faulty, and they had to wait for a while to get it fixed. Despite being motivated to still undertake the module, they subsequently missed the module,

“Hi. My phone was faulty I didn’t receive the module. Kindly assist.” – NMFS20

It is worth noting that NMFS20, was particularly eager to learn and was amongst the participants who were motivated to learn because they did not understand the problem of AMR. In Iteration 2 surveys, NMFS20 had for example been nervous about getting the answers to the KAP wrong, and had not completed the KAP until I discussed with him once I was in the field (see section 7.3.2).

This evidence effectively demonstrates that, whilst there are many affordances afforded by mobile learning, and whilst the mobile phone has become ubiquitous, this is not synonymous with everyone having access. Access is nuanced and can differ between the same group of participants, for example NMOD12 another nurse access in terms of ease.

“Using phones was relevantly a brilliant method since mobile phones are very accessible and easier to use without constraints. Using SMS made learning easier due to ease of access.” – NMOD12

Therefore, despite challenges in access, participants also thought this was a more accessible mode of delivery than other modes, such as web-based modes of delivery that require internet connection. Thus the use of SMS and Interactive Voice Notes (IVRs) was more stable and reliable internet based platforms. Additionally, the course being free at the point of access made the course more accessible.

“The mode [referring to IVR and SMS] was appropriate as per audience” – COMFS5

Most participants raised the issue of cost, generally asking if they would have to pay for the course at the beginning of the module. In feedback they raised that its free cost as
advantage as internet access was deemed expensive for many amongst the cohort of participants.

8.5.5.1 Summary
This section discussed the theme of ‘access’ covering both the advantages of the mode of delivery in terms of accessibility as well challenges in access, that were infrastructural in terms of network connectivity as well as circumstantial in reference to the time that the module was undertake.

8.5.6 Theme f: Content
The theme ‘content’ was ascribed to data referencing content, some of the platform’s standardised messages were not user friendly nor intuitive, the subtheme user experience was subsequently generated and ascribed data describing the user experience.

8.5.6.1 Subtheme: User experience
Participants described content factors that had a negative impact on the user experience. For example, NMFS20 received the message below after having tried to access the course at a later stage,

“Dear subscriber, all sender names have already been whitelisted” – NMFS20

The message was a standard platform message to alert participants that the course was finished. It was difficult for the participant to understand, and I had not been privy to the message prior to that point, despite having personally developed all content that participants were to receive. Other issues pertaining to the standardised platform responses included the beginning of discussion messages, for peer to peer learning see image 8.7 below.
Image 8.7 Example of discussion group message sent to all participants

The text begins with “group Data Survey Extracted” to alert participants messages were coming in from other participants for peer-to-peer learning, this an identifier ascribed to the learner i.e. “ThirtyLearner”. Some participants reported back that the beginning of discussion messages was not user friendly and that the identifiers could have been more user friendly and made it easier to identify user. For example, NMOD12 suggested it would have been useful to know if the person who was texting was a nurse or doctor or from the lab as this may have also enriched their learning, to understand how the problem of AMR is viewed by different roles and how it affects those roles in practice. Some participants had reported back issues with ease of understanding audio messages, these were recorded in the researcher’s accent (Zimbabwean-British) and proved to be to the disadvantageous. For example, a participant wrote back in the WhatsApp group

“the lady is too fast what does EMA stand for” – COMFM7

On reflection, a Kenyan accent from the region may have served better.

8.5.6.2 Subtheme: Problem-based learning

Participant views on relevance of materials differed, for example participants COMFS5 and NMOD12 found materials to be relevant, reporting back that,

“The study was good it covered a lot of the aspects as per the study objective” – COMFS5

“The content was elaborate enough. It did address key areas of concern” – NMOD12
Some participants asked for greater contextual relevance in materials, highlighting the need for problem-based learning in line with the challenges and circumstances they faced in practice. ‘Problem-based learning’ was subsequently developed as a theme. COMFM7, for example, reported that in practice she faced challenges in having to make decisions based on available resources which sometimes meant deviating from what she understood to be best practice. Noting that it would have been useful for learning materials to factor in contextual challenges and develop problem-based learning materials that for example presented different cases in vignettes that could facilitate individual and collective reflection,

“to say with what we have we can we really do for this patient, what is best” – COMFM7

Thus the conceptualisation of PBL in this thesis is in line with the broader understanding of PBL, that often consists of the four elements namely scenario presentation to a small group, the presence of a learning facilitator, self-directed learning and learner engagement in a problem-solving process (Gewurtz et al., 2016). This explored in greater detail in the discussion chapter, see section 9.2.3.1.

8.5.6.3 Subtheme: Format
The subtheme ‘format’ was ascribed to data referencing the audio and short message format that was used to deliver learning.

In terms of format, whilst the majority of participants spoke favourably about the use of SMS and IVRs, NMOD12 suggested that the platform should have been supported by other materials

“I believe that back up notes sent on email post module would not only be an easy points of reference but also a platform for continuous learning and capacity building” – NMOD12

Participants may have indeed benefited from having to access in the future.
8.5.6.5 Summary
This section presented on the theme ‘content’ and its corresponding subthemes; user experience, problem-based learning, and format. The section highlighted challenges in user experience from participant data. It drew on data to present the opportunity to have enriched learning through problem-based learning and presented data on the format.

8.6 Conclusion

This chapter presented findings from iterations 2 and 3. Sections 8.1 to 8.4 set the context by presenting the environment within which the research site was located, whilst highlighting the relevance of the broader environment within the frame of One Health and the tensions that exist between an agrarian past and present and the introduction of modernity within the specific social space. Context was presented through visual mapping. The hospital structure, patient journeys and treatment pathways were presented in line with data from observations and interviews. Section 8.4 presented data from iteration 2, focusing on interview data to present themes generated through thematic analysis. Section 8.5 presented data from iteration 3, to present themes generated following participants’ engagement with the mhealth platform.
Chapter 9: Discussion

9.1 Introduction

This chapter provides a discussion of the study findings presented in chapters 7 and 8, and fuses study findings with concepts, ideas and literature discussed in all other chapters throughout this thesis. It centres on the concept of boundary crossing in drawing insights and perspectives from various disciplines, using critical thinking, theoretical frameworks and concepts from philosophy, health, and educational technology. This is in keeping with the move towards interdisciplinary research in higher education and global health that has become key in confronting some of the challenges of our time, not least amongst them antimicrobial resistance (AMR) (Minssen et al., 2020). To begin with, the chapter frames the study, situating it within the broader field (9.1.1). It then discusses the research question 1 in section 9.2, followed by research question 2 in section 9.3 and finally, research question 3 in section 9.4.

9.1.1 Framing the study

The most recent World Health Organization (WHO) progress review on the Kenyan National Action plan on AMR highlights education and training of health professionals as a significant facilitator for mitigating the misuse and overuse of antimicrobials in the human health settings (WHO, 2022c). To the best of my knowledge, this is the first study to explore the use of mhealth for AMR-related CPD in Kenyan level 6 hospitals. It is also among the first studies to centre decolonial thinking in educational technology for global health with specific reference to tackling the problem of AMR. Whilst I am unaware of any other studies that have adopted the same approach, I am cognisant of the important and rich conversations on decolonisation, decoloniality and justice seeking alternative imaginaries that are ongoing, in and beyond the academy, for example works by scholars such as Tamale (2020) and Chilisa (2020). Many of the decolonial works (see chapter 3) have provided useful thinking for this timely study that centres on addressing the question of how healthcare workers learn to tackle AMR Kenya. Research was guided by three research questions:
1. To what extent and through what methods do health professionals engage with continuous professional development?
2. What socioeconomic factors impact learning for health professionals?
3. What are the barriers and facilitators to learning about and practicing AMR stewardship?

These aims recognise the AMR challenge as a recent and complex phenomenon that in part arises out of attempts to control infection in the advent of epidemiological transitions across territories of life. The study also recognises that, whilst there is ubiquity of the mobile phone, the adoption of mobile learning and understanding of microlearning process is still emergent, particularly in the Kenyan health context. I understand both phenomena as micro and macrosocial processes and adopt a broad view in discussing the problem of AMR and the potential of educational technology to be effective as tool for training health professionals. Discussion of these phenomena benefits from being situated against a historical backdrop that explores how underpinning philosophical and cultural drivers can be harnessed to effect change in AMR-related learning and by extension health workers’ behaviour.

9.2 RQ1. To what extent and through what methods do health professionals engage with continuous professional development?

Research question 1 was aimed at examining methods and extent of engagement in continuous professional development (CPD) across all health professional cadres. CPD is an integral component of improving and maintaining overall quality of patient care (WHO, 2020b). It is critical to, and in part, determinant of the capacity of health professionals across all cadres to retain individual competence and align their practice with emerging best practice (Manley et al., 2018). CPD also has the potential to strengthen team competence, promote dialogue, and develop knowledge and collaboration among teams of health workers (Kemei and Etowa, 2021).

9.2.1 A changing CPD landscape

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6 Epidemiologic transitions occur in economies in transition, reflecting parallels between evolving economies and disease patterns, mortality, life expectancy (Agyei-Mensah & Atkins, 2010?).
The advent of the COVID-19 global pandemic highlighted the need for health professionals to consistently maintain engagement in continuous learning with access to CPD that reflects changes in epidemiology and an ever-evolving healthcare environment (Masai and Boibanda, 2022). This bolstered the case for on-demand access to medical research and learning materials (WHO, 2020b). A previous study in Kenya (Gituma et al., 2009) indicated access to new medical information to be sub-optimal across much of the country. Though the study focused on medical students, it was framed in the broader context of life-long learning skills and advocated for the use of digital tools to increase on-demand access. This is in keeping with changes since the advent of the COVID-19 pandemic, which brought about substantial changes in CPD delivery in Kenya, marking a departure from the dominant in-person delivery of CPD seminars and lectures to virtual spaces, through digital tools. Some have remained in place since, even with a subsiding COVID-19 pandemic (Masai and Boibanda, 2022). There remains a paucity in evidence and evaluations of the impact of this shift, on learning and practice and the perspectives of health professionals on changes in CPD (Gitonga and Muriuku, 2014). This study is therefore timely, in its provision of key findings on knowledge and attitudes to engaging in CPD and more specifically on the use of mhealth in the context of a Kenyan facility that serves a small town and surrounding rural areas.

9.2.2 CPD engagement at a Kenyan health facility

Findings showed that health professionals across all cadres engaged in learning through different modes, both in-person and online (see section 7.1.2). Specific to online learning, the majority of the 43 participants surveyed in Survey 2 (Knowledge Attitude Practice Survey) (69.8%; n=30) had experience with online learning and accessing learning through mobile apps or mobile platforms (74.4%; n=32). This was not surprising given the move to online delivery of CPD in the advent of the pandemic (Masai and Boibanda, 2022). It did however highlight the need to understand the barriers and facilitators of engaging in CPD online. Although scholars such as Mosol and colleagues (2017) and Masai and Boibanda (2022) have covered barriers and facilitators in CPD more broadly, there is a dearth of evidence relating to digital learning CPD. For example, data from iteration 2 (see section 8.4.2.1) showed that, whilst learning had been delivered through online modes, challenges in technological literacy had for some of the health workers undermined accessibility. Thus,
understanding barriers and facilitators to learning is important in ensuring that innovative and scalable approaches to learning that aim to increase access are not undermined by implementation barriers such as technological literacy at the level of the individual practitioner. This is comprehensively covered in subsequent sections specific to research question 3 (see section 9.3).

9.2.2.1 CPD Requirements
Formally, all cadres were required to engage in Continuous Medical Education (CME) courses, though there was some discrepancy in survey 1 (scoping survey) where some participants reported no formal requirement to undertake CPD (see section 7.1.2). This was consistent with other studies that found a lack of understanding of CPD requirements and what is considered CPD due to a lack of written policies for CPD and CPD specific guidelines (Mosol et al., 2017). This study reinforces the need for exactitude in communication through clear policies and guidelines at national, regional and facility level that are easily accessible to practitioners and provide them with clear guidance that effectively communicates the importance of CPD and the requirements for each cadre. This is in keeping WHO recommendations (WHO, 2020b). Amongst the challenges with CPD, specific to this study, was the reported lack of access to AMR-related learning participants had with limited if any opportunities to engage in AMR specific learning, for example in iteration 2 (see section 8.4.3). For example, one of the participants (PCMP13) who recognised the importance and need to advance knowledge on AMR, reported finding an online course in lieu of the health facility offering one (see section 8.4.3). This was in keeping with iteration 1 data where majority of participants from survey 1 reported not having taken part in an AMR course (see section 7.1.2).

9.2.2.2 Challenges in accessing CPD
The finance related challenges in accessing CPD for the individual practitioner in Kenya are well documented in literature (Kanamu et al., 2017; Priscah et al., 2017). These are reported as including financial shortfalls between the number of practitioners who need to access given courses and the budget available, such that decision on who goes on what course is documented as often being the managers’ (Gitonga and Muriuki, 2014). In Gitonga and Muriuki’s (2014) study in Kenya, the number of years in service at specific facility were positively correlated with the number of chances practitioners were offered to attend CPD.
Gitonga and Muriuki (2014) asserted that this was associated with the likelihood of practitioners who had worked at the facility for longer being offered more chances to attend CPD.

At Hospital X, access to courses was also related to the financial budgets that determined the number of practitioners that could be accommodated in training. As a result, only a few members of staff were trained at a time, with decisions on who attended what training being decided by management. For example, according to study findings in iteration 2, (see section 8.4.5.2) amongst the courses that were said to have covered aspects of stewardship, access to the course had been limited. It was a course that was reported to take place approximately once every 5 years by PDFP14 (see section 8.4.5).

More broadly, in relation to accessing AMR-related learning at hospital X, data reflected a lack of standardisation in accessing learning, for example participants reported experiences with AMR learning that varied from a brief mention on a course, to nothing or a comprehensive course, albeit the latter was self-directed, self-funded learning (see section 8.4.3). Therefore, whilst findings positively reflected a high level of engagement in CPD, with most participants taking part in CPD regularly, as evidenced in the scoping survey 1, where 93.1% (n=40) of the 43 health workers surveyed reported having taken part in CPD in the preceding 11 months (see section 7.1.2). However, learning was not standardised, this is in line with Kemei and Otawa’s (2021) findings in a Kenyan study that indicated the absence of standardised training guidelines and the lack of clearly structured implementation policies relating to CPD for knowledge update of for example new policies and processes. Kemei and Otawa, (2021) noted the lack of standardisation in CPD policy and implementation as a challenge for evaluating the gap between knowledge and practice. Similarly, during initial reviews of literature and policy documents on AMR, and by extension AMR in Kenya, there were no available standardised policy documents.

As a result, to research and understand expected practitioner competency, I used the WHO’s competency framework for health workers’ education and training on AMR as a guideline. That enabled me to develop an understanding of what effective AMR practice may look like across the cadres (WHO, 2018). This enabled me to begin to understand how
contextual barriers would for example impede competency, which was useful for mapping barriers and facilitators of AMR stewardship in practice and within the activity system.

9.2.2.3 Challenges in CPD policy
The challenge in Kenya now is the apparent need for clear guidelines that map out expected practitioners’ competency and access to AMR learning (WHO, 2022c). This need was made visible at the level of the facility in terms of the lack of uniformity in reported participant data on previously accessed AMR learning, lack of clarity on required learning and variation observed in understanding and awareness of One Health in the KAP survey data (see section 7.3.4). Importantly, the lack of clarity extended to senior members of staff, including the hospital leadership; the hospital director (HDMS02) spoke about the challenge of AMR in practice but reported no standardised measures for evaluating competencies and knowledge (see section 8.4.3), this in line with reported challenges in AMR specific training elsewhere in literature (Ajuebor et al., 2019). There is, therefore, a need to develop a competency framework that is contextually appropriate and has the capacity to facilitate development of a curriculum that takes into account the intersecting barriers to learning and can meet the needs of the learners. This is important for improving AMR-related practice and in line with the WHO competency framework, which is purposefully broad, and designed as a reference tool. This can be foundational to the development of more in-depth, context specific education and training materials for health workers in various countries (WHO, 2018). The WHO (2018) recommends that the framework is adapted to specific country settings. There is therefore the opportunity for Kenya to adapt and standardise learning and expected competencies and to make these easily available and accessible for health professionals. This would also contribute to expanding the capacity of leaders in health such as HDMS02 to make informed strategic decisions on managing the challenge of AMR in daily practice.

9.2.2.4 In person learning
In person learning at the health facility happened through different modes including:

- lectures and seminars
- weekly trainings
- ward rounds
• death audits
• one to one consultations between junior and senior members of staff
• Experiential, point of care learning.

Learning delivery modes and the frequency with which learning was delivered differed between the across the NGO and MoH administrations. This is explained in the findings chapter (see section 8.4.2). This section focuses on a discussion of the methods of delivery rather than the administrative body through which this was delivered, though this is mentioned at times as signposting.

Lectures and seminars were reported as having been undertaken on and off site, delivering learning through in-person lectures remains a common feature in CPD delivery for the health workforce across Kenya. The benefits of this have been reported as including enhanced on the job performance (Ngeny, 2014). However, the challenge cited elsewhere (Kanamu et al., 2017) and supported in the findings of this study is in the degree to which practitioners are able to engage in learning through these modalities based on the availability of courses and funding. The previously discussed issue of access to courses in relation to financial budgets that determined the number of practitioners that can be accommodated in training was also relevant to in person training (see section 9.2.2.2). This presents an opportunity for digital learning to increase access to courses at scale as well as ownership of CPD learning. Participants also discussed learning through one-to-one consultation with senior members of staff and at the point of care. Including during ward rounds, as well as when junior staff shadowing senior staff to observe practice. However, this was sometimes undermined by for example, absenteeism and strike action, whereby senior members would be unavailable. Digital learning offers the chance to make learning available on demand. Thus, where practitioners may for example, find that they cannot attend one to one consultations at given times, the availability of on-demand education maybe useful in allowing participants to learn through other avenues during times when in-person learning may be inaccessible.
9.3. In person learning and tacit knowledge

This section builds on the literature on tacit knowledge and experiential learning explored in the section 5.6.2. In his work, Nonaka (1998) defined tacit knowledge as skills acquired through experiential learning that become tacit knowledge — unarticulated knowledge.

9.3.1 The bedside and clinical history-taking

In the context of health workers there is an understanding that the practice of medicine is a balance between the bench and the bedside, the latter has been cited as the art of medicine and can be understood as experiential, tacit knowledge (Patel, 1998). For example, the use of empirical diagnosis discussed in the findings is a reliance on the latter (8.4.5.3), whereas a reliance on the bedside (read empirical diagnosis) typically requires information to reach a rational and informed clinical decision. Findings in iteration 2 showed information asymmetry at various points in practice, information asymmetry in this context is used to refer to an imbalance in knowledge created by missing information. For example, practitioners were often not privy to previously administered antibiotics before patients reached the facility. This was among the numerous issues that undermined the practitioners’ capacity to effectively rely on the ‘bench’ as samples for cultures should be drawn before antibiotics are administered. At the same time, it highlighted the need to expand practitioner capacity to utilise knowledge gained by the ‘bedside’ and use that knowledge to help make an informed decision. This may include how they encourage information sharing and the important role of clinical history-taking. Oyedokun and colleagues (2016) in their report on the role of clinical history-taking, note widespread concerns about decline of bedside skills and clinical aptitude amongst doctors. Specific to Africa.

History taking and examination had been cited as being in possible decline across Africa owing to a number of factors, such as poor low physician to patient ratios. Given the low physician to patient ratios (discussed in section 2.6) at health facility X, the challenge of AMR and lack of an antibiogram program that provides clinicians with AMR relevant data to bolster rational clinical decision making, the role of the bedside and history taking becomes ever more important. In this context, it is important that professional learning aims to
deviate from the often-observed trajectory that shows that once in-service health professionals sometimes fail to maintain or improve their history taking skillset (Oyedokun and colleagues 2016). In hospital X and other resource-constrained settings access to medical tests are often a challenge due to a number of factors including socioeconomic factors as discussed in the findings chapter. As a result, detailed history-taking remains of particular importance in these contexts.

9.3.2 Dynamism in clinical settings

Nonaka (1994) expounded on the idea of knowledge that is unarticulated. In his work, he explored the mechanics of effective management of knowledge creation (Nonaka, 1998) through critically controlling tacit knowledge and reconceptualising business practices. By treating companies not as machines but much alike individuals. This reconceptualization centred the idea of organisations as living organisms endowed with self-knowledge and self-awareness and the capacity to build a collective sense of identity and purpose (Eraut; 2009). Innovation in the context of Nonaka’s (1994; 1998) work with Japanese businesses was a process of re-creation, and self-renewal at personal and organisational levels to create a culture of knowledge creation that tapped into subjective insights. The grounds for borrowing from organisational theory developed in the context of business and adopting them in the public health sector has been justified in the literature review (section 5.6.2). Here a fuller argument is made for the kinship between consumer-driven markets, that maybe volatile, and disease-driven contexts, where degrees of volatility that is akin to certain businesses can be observed. Importantly, dynamic theory of organisational change (Nonaka, 1994) is built on an idea of organisations that are highly responsive, innovative and maintain dynamism.

The COVD19 pandemic showed the need for public health organisations to possess these qualities of responsiveness, innovation, and dynamism. Health organisations are poised to experience more change in the future in relation to the growing threat of drug resistance and the potential emergence of new strands of disease (Tegama, 2020). To that end, borrowing from theories of organisational change such as Nonaka, (1994), may prove beneficial in numerous ways. For example, in the context of Health Facility X, health workers’ experiential learning was in part shaped by the socioeconomic conditions of their
patients. Findings in chapter 8 (see section 8.4.12) showed how the financial burden and lack of Universal Health Coverage (UHC) impacted practice. Given that many resource-constrained settings serve populations who do not have access to UHC, the impact of this may extend to comparable settings. The challenges posed by the lack of UHC highlights that best practice is circumstantially prescribed. This sometimes causes tensions in practice in low resource settings, where the distance between best practice and what is contextually possible can become a source of moral and ethical dilemmas for practitioners. For example, practitioners made decisions on whether to run cultures based on patients’ finances and whether they could afford the test, as a result cultures were rarely requested at Health facility X (LBMA01) (see section 8.4.8). It is therefore important for policy to consider what would work best in practice. In iteration 2, for example, section 8.5.6.2 presents data on problem-based learning, where the need for solutions that commensurate to resources at the facility are highlighted.

9.3.2.1 Experience and tacit knowledge
Tacit knowledge is informed by experience, and Bloomer and Hodkinson (2000), (explored in the literature review, see section 5.6.3) offer useful thinking on experiential learning. They posit that learning can be understood in terms of changes to individual thought and action, both momentary and permanent such that everyday thinking and acting changes knowledge in some way. Section 8.4.8 presented data on lab capacity and the issues with tests sent to an external site in County Y that were providing consistently low positivity rates. On site the MoH lab was perceived as lacking in reliability by practitioners. These experiences had created a feedback loop that was visible in data, whereby practitioners had lost trust in process of running samples to check for susceptibility and then focus on the ‘right’ drug, in accordance with prudent prescribing practices that recommend starting smart and then focusing (see section 1.7) (Dryden et al., 2011). It is therefore arguable that the experiences that health practitioners had with blood cultures sent to county Y, and the challenges encountered in processing samples through the MoH lab, had an impact on their thinking and actions, forming what Bloomer and Hodkinson (2000) would refer to as experiential learning. Learning gained through those experiences would then be transferred onto other experiences through recall, such that when practitioners encountered similar cases that required antibiotic intervention, their decision-making process would be guided by their
experiential knowledge. In these cases, using recall, positive transfer would enhance performance, whilst negative transfer would undermine clinical decision-making materialising in for example, an overreliance on empirical diagnosis (Perkins & Salmon, 1992). The challenge of facilitating positive transfer lies in bringing knowledge under critical control (Eraut, 2009).

A challenge for managing knowledge and competence within the activity system was the lack of consistent collective reflection and meaning making across the entire health facility site. Practitioners often independently made decisions to resolve tensions in practice caused by factors such as information asymmetry, for example when they were not privy to what medicines had been administered to the patient prior to arrival (see challenges with data from feeder facilities in section 8.4.6.3). Whilst practitioners were effectively resolving tensions with each interaction, they were doing so independently and may have inadvertently created knock-on effects to negatively impact other functions of the hospital. In this way they can be understood as potentially causing tensions and/or contradictions in the activity system, which is in line with Engestrom’s (2018) assertion that activity systems are both a source of innovation and trouble (see section 4.5). Bringing knowledge under critical control can be instrumental to harnessing innovation from tensions and contradictions.

In recognising the heterogeneity that underpins activity systems, Engestrom, (2018) offers expansive learning, as a method that can facilitate collective problem solving. Thus, ideas to use problem-based learning (PBL) which came from participants (see section 8.6.6) in the study can be said to be in keeping with ideas about resolving contradictions in an activity system. The term PBL was not used by participants, rather it was assigned by the researcher. No uses of PBL were observed during fieldwork. PBL is discussed in greater detail in the next section (9.3.2.2).

9.3.2.2 Problem-based learning
PBL has embedded within it affordances, such as group work and collaboration, that can facilitate collective tension resolution that can be a source of innovation. Like notions of expansive learning, it similarly calls for a small group to collaboratively engage in the problem-solving process (for expansive learning see section 4.5). Participant data that
referred to concepts that were in keeping with the traditions of PBL were ascribed the PBL theme in analysis (see section 8.5.6.2). These data highlighted the value of contextually grounded learning (see section 8.6.6).

Now used across many disciplines, PBL has its roots in medical education (Gewurtz et al., 2016). Having been developed in the 1960s, it has over the decades evolved into an accepted instructional approach that has continued to prove useful in health professional programs (Neville, 2009). Its touted learning-promoting attributes include the assertion that “knowledge acquired in relevant context is better remembered” (Neville, 2009, p. 3). Where (mobile learning) mlearning is conducted online, the process of collaboration and calling on the input of other health professionals, is the same as collaboration required in practice. Thus, mlearning can for example deliver vignettes that are in keeping with the PBL’s traditions of simulating a problem, that conforms to the context including in terms of available resources (human and physical) for practitioners to actively engage thinking through problem resolution (Gewurtz et al., 2016). In the context of AMR-related learning with reference to this study, and building on participant feedback, vignettes could have been delivered through the mhealth platform. These could be designed to elicit knowledge input from different health professionals and specialisms, in order to facilitate the brand of collaboration that maybe required on the ward. This could effectively contribute to context simulation by requiring peers on the learning platform to communicate and collaboratively solve patient cases related to AMR. These scenarios could include complex cases, whilst simultaneously facilitating further development of other learning attributes of PBL, such as acquiring concepts in a way that facilitates mobilisation to solve or view similar problems (Neville, 2009). This can then, over periods of time, facilitate pattern recognition whilst activating prior knowledge in processing new information. This is in keeping with literature on education and learning in medical workplaces such as Eraut’s, (2009) work that conceptualises the learning transfer process in practice as five stages:

1. Extraction of potentially relevant knowledge
2. Understanding a new situation (often dependant on informal social learning)
3. Recognising relevant knowledge and skills
4. Transforming and knowledge and skills to fit the situation
5. Integrating transformed knowledge with other skills to operate within new situation (think, act and communicate).

An mhealth platform can therefore potentially facilitate the practice of engaging in knowledge transfer for health professionals, through the use of PBL, practitioners can engage in knowledge extraction, transformation and integration, practice dealing with complex cases of for example multi drug resistant disease. In the context of AMR in resource-constrained settings where there is a lack of supporting AMR data infrastructure, building, and utilising tacit knowledge can be part of bridging the data gap (discussed in section 8.5.3) to strengthen practice and improve patient outcomes.

9.3.2.3 Bringing the ‘bedside’ under critical control

Though not systematically used across the entire hospital, XTRCH had forms of institutionalised collaborative reflection and practice through the use of death audits and telemedicine. As discussed, individuals are constantly embedded in a flow of experience that changes their knowledge on which they are able to reflect on by way of pulling from memory to reflect on discrete experiences (Heusser, 2018). Death audits, described in the findings (section 8.5.2) are an example of pulling experiences from memory and reflecting on discrete experiences (Heusser, 2018). Through calling discrete experiences into attention, engaging in meaning making and forming constructs, individuals are able to, extract and commit experiences to long term memory to be reflected on in the future.

Within the context of hospital X, the collective reflection of the group in death audits enabled the group to extract their individual experiences and, importantly, form collective meaning, committing their experiences and newly constructed meaning to long-term memory to draw upon in the future for when they encounter similar medical cases. Where death audits were more consistently used on the NGO wards, they were used to a lesser extent on MoH wards and not at all on some MoH wards (see section 8.5.2). Death audits are an opportunity to bolster and improve antimicrobial stewardship by engaging practitioners in collective reflection on antibiotic practice, particularly in complex cases where patient mortality may have been linked to drug resistance. Study findings on death audits provided useful thinking for future development of digital tools, to incorporate the notion of pulling discrete experiences, asking specific questions to practitioners, giving
practitioners the chance reflect on practice and pull discrete memories and form meaning around best- in-situation practice.

9.3.2.4 The wisdom of the clinical crowds
Moving towards collective meaning making will help to create best-in-situation practice that will benefit patients. For example, this can include a culture of encouraging practitioners to discuss subjective views or intuitions within the context of collective reflection in order to move the organisation from being a static entity, that is unresponsive and out of sync with what is unfolding on the ground. This is in keeping with Nonaka’s (1994; 1998) theory of dynamic change and the historical use of community palavers within Kenyan communities (see section 3.3.1), both concepts can be leveraged to bring knowledge under critical control.

The use of the telemedicine app on the NGO wards is one such example of collaborative work that facilitates collective meaning making (see section 8.4.9.1). The telemedicine app financed by the NGO, leveraged the wisdom of crowds – collaborating colleagues, distributed across the world. Medics are able to collaboratively work towards what they would consider best in practice solutions – for example, a practitioner seeking help would list patient data and available resources and collaborating colleagues are able to contribute what they think can be done given the condition and resources (see section 8.4.9.1). Learning was therefore in this way embedded in collaborative work practices, as the telemedicine app was employed to actively seek knowledge in complex cases. Other collaborative practices, such as ward rounds, also enabled learning to take place across cadres, and job roles, as these were interprofessional collaborations. 100% (n=43) of participants either strongly agreed or agreed that they learnt through discussions and communication with peers in the place. However, the extent to which practitioners were able to learn through for example ward rounds or discussions may have been hampered by the reported challenges in communication. The majority of participants (76.9%, n=43) in the KAP survey, for example, reported that hierarchies affected communication. Communication is central to collaborative practice. Scholars, such as Fewster-Thuente and Velsor-Friedrich (2008), found that a lack of communication and collaboration may be responsible for as much as 70% of the adverse events in the health sector. Communication is thus further explored in relation to barriers and facilitators to learning section 9.4.
In line with research on collaborative practice, 100% (n=43) of the participants believed that collaborative learning would increase efficiency across the hospital as well as benefit their teamworking skills. It is here worth noting that participants already engaged in learning with other professionals for example, in lectures and seminars, as well as on ward rounds. However, data also showed that there were hierarchies at Hospital X and participants perceived lines of communication as not always open and cooperation as difficult across different health professional roles (see section, 7.3.9). As such it is important to highlight that learning together in the same room is not synonymous with meaningful engagement and this can undermine collaborative practice. For example, in their work on interprofessional models of learning, Bridges and colleagues (2011) reported that successful experiences of interprofessional learning amongst medical students from different professions required helping students to develop a stronger understanding of their professional identity, as well as an understanding of the roles of other healthcare professionals on the teams they worked with. In the context of this study, I would extend the need to understand professional identities of others and self to the need to understand the challenges that each role faced. This is in line with Bridges and colleagues’ assertion that there needs be a sense of community and Nonaka’s (1998) assertion of the importance of organisational self-awareness.

An organisation that is self-aware, is cognisant of all its components, amongst those components are the roles that exists across the organisation. This sense of collective awareness and community is central to collective meaning making and innovation that has the propensity to address problems, whilst factoring in how proposed solutions may impact the broader hospital community that constitutes the activity system. Additionally, a better understanding of each other’s roles and challenges may serve to re-establish collaborative practices where trust has been diminished. For example, to strengthen the relationship between the lab and doctors and clinical officers previously mentioned, and more broadly covered section 8.4.8. Ward based and lab based staff had different narratives of what was going wrong with the samples in relation to positivity rates and processing. Both parties had the idea that the other party must have been doing something wrong and contributing to inaccurate results in some way. Collaborative learning, through collaborative reflection on experiences and meaning making, may help to tackle challenges such as these as well as
strengthen the sense of community and shared goals and vision. These findings through interviews were in keeping with the challenges in communication and cooperation that participants reported in survey 2, where they discussed challenges in cooperation and communication between different professions.

Importantly, collective reflection and collaborative problem solving that contributes to best-in-practice guidelines can be done within a framework that has the mechanics to foster continuing dynamism. This could ensure that the organisation continues to be a source of knowledge creation that meets the needs of the patients.

9.3 RQ2. What socioeconomic factors impact learning for health professionals?

The answer to the inquiry of how health professionals can learn to tackle AMR is in part embedded in the understanding of the health professional and their pedagogic histories. This should include experiences with different methods and modes of learning delivery, as well as the contexts they work in and the socioeconomic circumstances that shape those contexts. These factors are considered in studies that seek to understand unwarranted variation in clinical practice across geographies and localities (Atsama et al., 2020).

In centring the research question on socioeconomic factors and how they impact learning, my aim was to adopt a comprehensive view of health professionals and the broader contexts they work in. To facilitate the consideration of how context impacted AMR practice (at the time of fieldwork) and by extension AMR-related professional learning, or the context related factors that educational planners will have to consider in designing future AMR-related learning content for resource-constrained contexts such as Hospital X. To that end I begin by acknowledging context in relation to the health workers, recognising that life beyond the hospital gates where health workers live their public and private lives has a bearing on hospital life and practice. The things that constitute health workers’ human experiences, such as being part of families, friendships, communities, social groups, political parties have an impact on their capacity to show up to work, to treat and support patients. Thus, the moving dynamics in their private and public lives matter; they are part of what constitutes the socioeconomic context. This work would therefore be at fault if it failed to consider the broader impact of socioeconomic factors on health workers and their capacity
to do their jobs and to engage in learning, particularly since the advent of COVID19 and its impact on the health workforce, where practitioners had to leave their families, live in isolation for fear of spreading COVID19. The pandemic intensified and illustrated the challenges working on the front of fighting disease (Shah et al., 2021).

9.3.1 Exploring socioeconomic context during fieldwork

The fieldwork for this study was conducted through periods of political volatility – during election season in a country with a history of political violence (de Smedt, 2009). Healthcare workers were experiencing financial difficulties as a result of delays in salary payments from the county government (see section 8.4.10). Their immediate community was also experiencing financial difficulty given that the county government was one of the larger employers in the town and had failed to release payment on time (FN0905). This was going on against the backdrop of an ongoing global pandemic where frontline health workers across the globe were encountering challenges in working on the frontline of the fight against COVID19. At the time of the fieldwork, the pandemic was reported as having had a significant impact on the healthcare workforce. Over a two-year period, health workers had to varying degrees sustained increased workloads, longer working hours and resource scarcity in personal protective equipment and medical resources (Shah et al., 2021). They had also during that period been required to make ethically and morally difficult decisions with increased frequency (Shah et al., 2021; Chersich et al., 2020).

Evidence on the psychological impact of COVID19 on healthcare workers is still unfolding. Specific to Kenya, Shah and colleagues (2021) conducted a recent cross-sectional survey of 432 Kenyan frontline health workers who reported symptoms of “depression, anxiety, insomnia, distress and burnout”. Shah and colleagues’ (2021) paper presents an important backdrop that maps out parts of the socioeconomic landscape, to foreground challenges that participants encountered in engaging in learning as a result of these factors. For example, the election and strike action sat amongst the reasons that participants reported in relation to none or partial engagement in learning. This was captured under the political climate theme (see section 8.5.1), highlighting that learning does not happen in a vacuum. The election sat close to home in many respects. Where the presidential candidate had an impact at a national level and in broader policy (Schipani, 2022), at home, in the focal
county, the question of who governed the county was important amongst health workers because it affected their daily lives, their jobs, hospital resource budgets, whether they would get paid on time (see section 8.5.3). It was therefore no surprise when participants, such as COMFSS5, communicated via the WhatsApp support centre that they could not complete the module because of elections, including explaining how they were involved in campaigning for specific candidates. Others reported time constraints and other priorities outside work, with no data on the nature of the other priorities reported, this is more fully explored in relation to barriers and facilitators to learning in the subsequent section specific to research question 3.

9.3.2 The universal health coverage challenge

The socioeconomic conditions of the patient demographics had a marked impact on the hospital structures in terms of the running of the hospital and, by extension, AMR practice and experiential learning (see section 8.4.6). If we are to borrow useful thinking on experiential learning from Bloomer and Hodkinson (2000) then thought and actions change knowledge in some way. Those changes can be positive or negative, in this context positive changes refers to improvements in AMR-related practice and negative, the inverse. The first and most noticeable socioeconomic impact on the hospital is the two-stream administration whereby one side of the hospital was under the management of the NGO and the other was under the management of MoH as a result of the NGO wanting to serve the most vulnerable with limited access to UHC. Thus, alleviating them of the financial burden of treatment and medication. UHC was identified as a theme, focusing on the provision of treatment that was free at the point of care and the implications of accessing care for free versus patients having to pay and the subsequent impact of that on practice. In the context of this study, the question of whether patients had to pay for treatment had significant implications for patients and practitioners. These findings are in keeping with other research that identified resource constraints as contributing to resistance promoting behaviours (Porter et al., 2021).

The role of resources in constraining good AMR-related practice was visible across the NGO and MoH wards. This has an impact on the experiences of practitioners and by extension their experiential learning differed across the two streams, NGO and MoH alike. To put this
in context, the NGO wards offered free treatment and had access to point-of-care diagnostics. Amongst the ward staff they had a positive attitude towards the lab in terms of reliability and worked closely with lab practitioners, who for example would be present during ward rounds (see section 8.4.8). As a result, practitioners were more reliant on the bench, that is to say, they more routinely requested and run tests. This was markedly different to the MoH wards where patient finances to a large extent shaped practice. For example, on the MoH wards, prior to beginning treatment the MoH staff would need to know the available finances that a patient had and then they would make decisions on treatment based on that budget (see section 8.3.4). This had implications in terms of undermining the practitioner’s capacity to enact the recommended best practice of starting smart by initially giving a patient a broad-spectrum antibiotic and then focusing once the lab results were out (see section 1.7) (Dryden et al., 2011). For example, the question of whether to run tests to check for susceptibility was in part based on whether a patient could afford both the tests and treatment. In cases where patient budgets were limited practitioners would make the decision to forgo tests and diagnose empirically.

9.3.2.1 UHC and workarounds

The lack of UHC had an impact on clinical decision-making and undermined AMR-related practice, through experiential learning. Practitioners on MoH wards had developed ‘workarounds’ that were deemed necessary given the socioeconomic conditions of the patients they were working with as well the challenges the hospital faced in resources. For example, this included running out of reagents to run tests meaning that they couldn’t conduct certain tests (see section 8.3.2). However, some of the ‘workarounds’ were effectively resistance-promoting behaviours, inadvertently creating tensions in the activity system that would impact other aspects of the activity system. Mula and colleagues’ (2019) work evidences this concept of tension resolution in one part of the system that creates other tensions or contradictions. In their study they looked at the impact of workarounds in relation to antimicrobial stewardship (AMS) in a resource-constrained, referral hospital setting in another LMIC context (Malawi). Mula and colleagues, (2019) found that workarounds in nurses’ practice would impact doctors’ practice and instigate another workaround on the doctors’ part that would be a deviation from recommended practice. Tensions and contradictions in activity systems, amass over time to cause aggravated
contradictions in a system, these aggravated contradictions maybe in the number of readmissions based on increased resistance or rises in mortality. This highlights the need to keep practitioners’ knowledge under critical control (Nonaka, 1998). Whilst workarounds maybe necessary, collective meaning-making, where practitioners are able to work across professions collaboratively innovating and developing workarounds are important. In the context health facility X, collaborative learning would help to avoid resolving a tension by for example creating a contradiction. In this way, institutionalising workarounds may benefit the system; this would require an enabling environment for knowledge creation.

9.3.3 Contextually appropriate antimicrobial stewardship

In relation to learning, the two streams (NGO and MoH) created differences in learning opportunities. The NGO was able to provide weekly trainings for their workforce. The finances, budget structure staff availability on the MoH, could not facilitate for practitioners to take part in learning at same frequency as the NGO staff. As previously noted, where practitioners were able to attend trainings, attendance was limited and subject to managerial decision making (see section 9.2.2.2). Given these challenges for the MoH, another way to bolster AMR-related practice would be through the establishment of an antibiotic committee and AMS champions. Scholars such as Gebretekle et al., (2021) advocate for the establishment of AMS programs, that are tailored to existent systems and resources, as part of organisational commitment to tackling AMR, this is in keeping with Kenya’s national AMS guidelines and the WHO’s guidelines for establishing stewardship programs in LMICs (GovKenya, 2017; WHO, 2019c). In the context of health facility X, AMS committees would bolster clinical governance in improving practice without heavily impacting an already constrained budget, as AMS committees are typically made up of members of staff, who are knowledgeable about AMR and able to educate other members of staff and champion AMS.

9.3.3.1 AMS programs and factors that lay beyond scope

The theme ‘beyond scope’, referred to issues beyond the scope of practitioners, and these were broadly socioeconomic factors including public behaviour, drug quality. The challenge for designing effective learning for the given context (Hospital X) is to bring some of the factors that were mapped as beyond scope into scope, this would facilitate more culturally
and contextually relevant AMS programs. For example, on occasions where patients were given prescriptions to purchase antibiotics, PCMP13 noted that it was important to educate patients on accessing cheap, lower quality drugs. PCMP13, a consultant noted how he had to teach junior practitioners to educate the public on the dangers of cheap drugs as part of their practice. It is in these ways that socioeconomic factors impacted learning. Where stewardship guidelines normally centre on educating the public on adherence – finishing the antibiotic course, in contexts such as these, it becomes important that practitioners learn to extend advice to the purchasing of drugs, in keeping with Gebreteklel et al. (2021) assertions on the need for contextually fit for purpose AMS programs, in LMIC contexts.

In relation to public behaviour, the Kenyan National Guidelines on AMS highlight challenges that are associated with regulations including accessing drugs from unauthorised sellers on open markets and other forms of unauthorised pharmacies. Other recognised challenges with dispensing culture extend to authorised pharmacies dispensing prescription medication without prescriptions (GovKenya, 2017). This is well documented in LMIC contexts (e.g. Do et al., 2021 in Ghana, Mozambique, South Africa, Vietnam, Bangladesh and Thailand and Karimi et al., (2023) in Kenya. The challenge in terms of illegal dispensation is two-fold. Firstly, on the supply side, prioritisation of profit versus adhering to regulations in places where regulations are not enforced are documented as being amongst reasons for driving this dispensation culture (Ardagh, 2017). Secondly, on the demand side, self-treatment is common amongst certain populations. Misuse is said to be in part fuelled by perceptions of the pharmacy as a first point of call for antibiotics as “less time-consuming, less expensive, and more convenient than visiting health facilities for a medical review” (Karimi et al., 2023, p. 2). The challenges of affordability and access (waiting times) were relevant for communities in County X because of poverty rates in the county and observed significant waiting times during fieldwork (FF0805). This is also linked to the theme of UHC, highlighting that the question of medical expenses continues to contribute to resistance-promoting behaviours not only in practitioners, but also the general public. Thus, creating an enabling environment in which practitioners can effectively enact behaviours to tackle AMR in line with prudent antibiotic use requires policy to be directed towards achieving UHC for all.

The challenge of extended waiting times was exacerbated during periods of strike action were staffing levels had an impact on waiting times in Outpatients Department.
Additionally, during the peak of the strike, patients who had been sent from other facilities would sometimes arrive to find that there were no available doctors. During these times patients were either seen by a nurse, if available, or not seen at all. This would increase the likelihood of turning to the pharmacy as well as reinforcing the idea of making the pharmacy the first point of call as “less time-consuming, less expensive, and more convenient than visiting health facilities” (Karimi et al., 2023, p. 2).

During these periods, nurses would prescribe medication, even in cases where they were not qualified to do so not having undergone advanced nurse practitioner (APN) training. For example, NMOD12 was a nurse without APN training. During the strike period, on a night shift during which I interviewed him, he was the only health professional present in OPD. He explained that as a result of being the only one there, if he deemed that a patient needed an antibiotic then he would under these circumstances prescribe (see section 8.4.10). It is therefore important that AMS programs factor in these challenges that arise. An effective AMS program may look to upskill nurses broadly. For example, they might make sure practitioners have a good understanding of the antibiotics on the WHO’s list of critically important list (WHO, 2019c). Whilst the majority of participants in the KAP reported being aware of the existence of the critical list, they were not asked about the particularities of the list i.e. which medicines are on it (see section 7.3.6). Additionally, the existence of situations where non-specialist nurses prescribe indicates the need for nurses to be well versed in the WHO’s watch and reserve list, to understand when antibiotics should be used. This would also bolster the nurses’ capacity to champion prudent antibiotic use. This is in line with the WHO’s competency framework, that recommends that nurses be positioned as AMS champions given that, amongst the different practitioner roles, nurses spend the most amount of time at the bedside next to patients (WHO, 2018). As such, the WHO notes that nurses are well positioned to contribute to encouraging prudent use of antimicrobials within clinical teams, as well as contribute to public health literacy and advocacy.

In these contexts, where the public and patients are reported to use open markets and illegal pharmacies for drug access, it is important that the public is aware of antibiotics on the watch and reserve lists, as such the nurses’ public health education role may extend to educating the general public and patients about what they absolutely should not be accessing from these illegal spaces (GovKenya, 2018). Whilst the messaging should broadly
be for patients to turn to qualified practitioners for medical attention and prescriptions, if public health is going to appreciate that the socioeconomic factors impact public behaviour and by extension public health then there is a need to understand that a combination of the slow decline in the sub-Saharan African poverty rate and a rise in the number of poor people across the continent coupled with the current lack UHC is a recipe for disaster where AMR is concerned (Schoch and Lanker, 2020). These combined factors impact public behaviour in a way that increases their likelihood to engage in resistance promoting behaviours, that then undermine the health practitioner’s capacity effectively contribute to tackling AMR based on current stewardship guidelines such as start smart then focus (see section 1.7) (Dryden et al., 2017).

Across sub-Saharan Africa, public health financing continues to be a challenge that most governments are failing to meet, falling short of commitments made in the Abuja declaration to allocate 15% of national budgets to healthcare systems (Bwalya, 2021). As a result of the budgetary challenges that ministries of health continue to face across the continent at national and county levels strike action within the health sector is a well-documented continental challenge (Dhai et al., 2011; Oleribe et al., 2018) that can have an impact on patients obtaining antibiotics through informal channels. To this end, messaging around antibiotics to the public should increase transparency in relation to greater awareness and understanding of what is on the WHO’s critical lists. It is important for the public to understand that not all antimicrobial drugs are equal and the attached risk of accessing certain drugs, specifically those on the reserve list in relation to resistance and broader public health risk, should be communicated. Previous research on patient facing educational interventions has post-intervention shown significant improvement in knowledge and attitude scores including knowledge about which patients should take antibiotics (Larson et al., 2009).

In terms of the previously mentioned point, of increasing transparency and knowledge that effectively communicates risk whilst not advocating for certain behaviours (read misuse or overuse), public health has previously adopted this approach in tackling other diseases. For example, Buse and colleagues (2016) in their commentary titled A farewell to abstinence and fidelity discuss that sexual health education for more than 30 years promoted abstinence and fidelity as prevention against sexually transmitted infections and teenage
pregnancy. Abstinence was associated with core values that aligned with world religions. Yet studies revealed the ineffectiveness of abstinence and fidelity approaches in individual behaviour (Lo et al., 2016). I therefore contend that, in the same way that Lo and colleagues (2016) found that abstinence funding was not associated with reductions in HIV risk behaviour in Sub-Saharan Africa, abstinence-promoting campaigns where access to antibiotics without a prescription are concerned may also not reduce risk in AMR. This would require further studies to understand the role of socioeconomic dynamics and behavioural psychology associated with access. This thinking is in line with other public health interventions that have focused on increasing safety rather than abstinence in for example illicit drug use through the use of needle exchange programs (Drucker et al., 1998). More recently, the UK has been commissioning research into pharmacy first services, an approach that looks to increase access to care, giving self-care advice on minor ailments (Chua et al., 2022). SSA countries may benefit from a move toward ‘pharmacy first’, that equips pharmacists with the capacity to prescribe antibiotics, given the current pharmacy first culture based on cost, expense and UHC. The reality is, for many population groups, the pharmacy first option is the only option. In chapter one for example, I described the plight of stateless populations, this extends to other population groups, a recent report from the WHO (2022) argued refugees to be at increased risk of AMR promoting behaviours.

9.3.4 Viewing One Health through a decolonial lens

Across African communities, there exists shared “ontological views that depict creation as lively, active, and complex”, spatiotemporally bound together and dependent on each other (Burnett et al., 1995, p. 201). Creation can be understood as animals, people, and land. The same three components that are the focus of One Health, are through an African ontological lens viewed as existing in communion and interaction with each other in complex ways, both metaphysical and spiritual (Murove, 2009). I contend that this has implications for our African understanding of One Health and in this section, I adopt a decolonial lens to expound on the opportunities that decoloniality and African scholarship can offer in tackling AMR through education.
9.3.4.1 Conceptualising the relationality between animals, land, and people

As discussed in the ethics chapter (section 3.2.3), whilst there are similarities between Nilote and Bantu peoples there exists nuances and differences that can be appreciated across the indigenous groups that are visible in today’s Kenya. Postcolonial Kenya is an amalgamation of 44 tribal groups that have developed a shared spatiotemporal understanding of territory and what it means to exist within that territory now as Kenyan citizens (Ogunyemi, 2020). Various traditions from across the groups, including agriculturalist and pastoralist traditions, have remained prevalent in contemporary society. For example, there is visible continuity in value systems through community structure. In particular, in the interaction between social and ecological systems across indigenous groups (see section 8.2.3). These can be understood as “territories of life” (Sajeva et al., 2019, p. 5).

Sajeva and colleagues’ (2019, p. 5) conceptualise “territories of life” as

the connection between [communities] and territory [that] is much richer than any single word or phrase can express.

There are phrases amongst indigenous peoples that attempt to capture these deep and lasting bonds between people, animals, and their communal territories. Images presented in section 8.2.3 (images 8.1 - 8.5) are an example of what the Shona people would call ‘kuyanana’. This loosely translates to ‘fellowship’ in English. A harmonious fellowship that can exist between people and animals that is bound by deep bonds and a shared understanding that is known as ‘kuyanana kwevanhu ne mhuka’. The Shona consider themselves ‘vana vevhu’, that loosely translates to sons of the earth, and carries with it notions of having come from the earth, to be nourished by the earth in human form and to, in death, return to the earth. ‘Vana vevhu’ evokes a deep-seated respect for nature and land and importantly, speaks to the deep bond that exists between the Shona and the land they inhabit. Similarly other indigenous African people share this notion of ‘kuyanana’. During fieldwork, I sought to understand how the Luo7 relate to nature through language, because language can reflect cultural patterns (Scotton, 1956). In this case, language highlighted similarities between the Shona and the Luo understanding of the relationship between land,

7 A Nilotic tribe who were the most populous in County X
people, and animals. Interestingly, there exists a Luo phrase, “wuod lowo” loosely translating to an equivalent of the Shona phrase ‘vana vevhu’ that loosely translates to sons of the earth, it is a concept attached to both identity and community (FN1405). This supports the idea of similarities in value systems across indigenous peoples, particularly where the relationality between land, animals and people is concerned.

Sajeva and colleagues, (2019, p. 5) argue this relationality amongst the three elements to be

“...a bond of livelihood, energy, and health... a source of identity and culture, autonomy and freedom... a link among generations, preserving memories from the past and connecting to the desired future. It is the ground on which communities learn, identify values and develop relationships and self-rule.”

Given that AMR transmits across the three elements: people, animals, and land, the deep and lasting bonds between the three elements heighten the need to understand communities that live in communion and close proximity to animals and the unique risk that AMR poses to them.

9.3.4.2 One Health and indigenous knowing

The idea of a One Health approach is in keeping with indigenous philosophies because it is based on the mutually constitutive relationships that exist between environment, people, and animals. I would argue that whilst One Health is a foreign concept to for example, my tribe, the Shona, ‘kuyanana’ is not. Indigenous philosophies have long recognised the relationality across the three elements. Our (read African) philosophies and ontological views are grounded in an understanding of mutual dependency across the three elements. Ramose describes this as “the ecosophical dimension of the indigenous African concept of Ubuntu” (Ramose in Murove, 2009, p. 308). I here contend that an understanding of that ecosophical dimension is important to understanding how to tackle AMR within this specific context as it provides further understanding of the underpinning philosophies that inform culture and community as studied within the frame of CHAT. This has implications for approaches to for example, professional learning for health workers, in terms of learning that focuses on building their capacity to educate the public as part of their bedside manner in line with the WHO competency framework (WHO, 2018). One must take into account these contextual dynamics, to facilitate effective public health education.
9.3.4.3 The move toward decolonising public health education

African scholars, such as Murove (2009), have long contended that the obvious bias towards western scientific and philosophical outlooks as the primary starting point in healthcare has debased African traditional healthcare practices. I argue that, by extension, using western scientific and philosophical outlook in public health education and professional learning for health workers as a starting point can debase traditional communitarian values in African public health that can make for ineffective public health education. The implications of which can be the silencing of meaningful discourse that is rich and has the potential to contribute to effectively tackling challenges such as AMR in our (read African) communities.

Kulesa and Brantuo (2021) offer examples, of challenges in decolonising global health education and partnerships in Lesotho and South Africa. In a phenomenological study in Lesotho, Kulesa et al. (2017) found that in a bid to decolonise relations, an international NGO hired almost exclusively local Basotho clinicians. The Basotho clinicians reported that their capacity to educate patients and community members was affected by cultural tensions. In this context for example, rural based women who wore traditional face paint communicated discomfort in seeking information from healthcare professionals. Conversely, clinicians had in some cases dismissed patients who described symptoms using traditional terminology. These challenges are linked to giving primacy to western outlooks and approaches in teaching local practitioners. This is linked to a colonial legacy of the use of western education to debase local knowledge systems, in a way that may materialise in for example, dismissive attitudes towards traditional terminology to the detriment of public health. To stress this tension in practice, and the role of power differentials rooted in colonial debasing of traditional knowledge, Kulesa and Brantuo (2021) highlight that in the South African context for example, “no matter how long western medical clinics had been established in South Africa, community members still viewed clinics as ‘little colonies’” (Kulesa and Brantuo, 2021, p. 3) providing them with only colonial information. Thus, the challenge that AMR-specific public health education now faces is embedding decolonial scholarship in developing AMR-related curricula, to importantly bridge the gap between traditional ways of being and knowing, the use of western medicine and challenge of AMR.

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8 Bantu people native to Southern Africa than inhabit the region of Lesotho
There are movements towards decolonising healthcare across Africa evidenced by, for example, The Traditional Health Practitioners’ Bill in South Africa (Murove, 2009). Within AMR there is evidence of an increased understanding of the need to adopt holistic approaches that pay attention to social factors, including culture and belief systems (Asiimwe et al., 2021; Leadingham et al., 2019; WHO, 2022d). In East Africa, for example, a consortium has brought together expertise across a number of disciplines, including microbiology, epidemiology, human geography, anthropology, sociology, from across seven institutions in Uganda, Tanzania Kenya and the UK and the USA. The Holistic Approach to Unravel Antibacterial Resistance (HATUA) exemplifies the move towards grounding approaches to research in local knowledge, for example the word ‘hatua’, which inspired the acronym for the consortium is a Kiswahili9 word for step or action, reflecting the consortium’s aim to take action in holistically unravelling the social and biological drivers of drug resistance (Asiimwe et al., 2021).

9.3.4.4 Moving towards decolonising AMR specific learning
Similar to HATUA, I adopt a holistic approach to consider leveraging an African ethic in thinking about approaches to tackling AMR. Tamale (2022, p. 176) asserts that “decolonial research would entail processes that value, reclaim and foreground indigenous voices and ways of knowing”. As such I problematise the challenge of AMR through a philosophical lens to foreground indigenous knowledge in a manner that enables me to focus on an African ethic of personhood that is grounded in our (African) collective responsibility to each other.

I argued in chapter 8, that images 8.1 to 8.5 (see section 8.2.3) represented a frictious transition or something of a clash between agrarian, nomadic traditions and modern present ways of living that has become the aetiology of multiple diseases. Using the ethical framework that I developed through CHAT (presented in section 3.6), this frictious transition can be conceptualised as tensions and contradictions that are due to the introduction of novelty. Thus, in a context such as County X, the process of change that integrates traditions and modernity can negatively impact collective health of the community and mortality rate. As a result of the grave implications of AMR (see section 8.2.2), I argue that the challenge of AMR can be interrogated in terms of ethics. Accessing antibiotics through informal channels,

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9 A Bantu language, native to Swahili people found in several African countries including Kenya, Tanzania, and Uganda
misuse and overuse has implications for both the individual and the collective. An ethic of personhood in Africa, asserts that a person is a person through other people, it is based on communitarianism and prizes virtues and morals in African societies (Murove, 2009).

There is scope to leverage African ethics and social systems in discussing the problem of AMR within the public space. Molefe, (2020, p. 3) for example, asserts that “African people are most likely to embrace ethical systems that are in tune with plausible interpretations of African thought and values”. I would argue that this extends to conversations about why the accessing antimicrobials through formal channels and responsible use that adheres to medical advice is important. This would create room to discuss the AMR challenge in a way that is in keeping with “African thought and values” (Molefe, 2020, p. 3). This may transform public engagement, particularly given challenges such as indigenous people perceiving clinics as “little colonies” (Kulesa and Brantuo, 2021, p. 3). Thus, future research may look to better understand patient perceptions and views of western medicine and health professionals. This should include trust in information on AMR that is communicated by health professionals, because effectively educating the public on AMR is amongst the WHO competencies for health professionals (WHO, 2018).

Lastly, in relation to adopting a decolonial lens in One Health, it has been argued that nomenclature played a key role in advancing colonial ideology and epistemic erasure (Ndlovu-Gathseni, 2018). The imposition of concepts manufactured elsewhere often clash, undermine, and infantilise indigenous knowledge. The introduction of the concept of One Health to Africa, and other indigenous people who constitute the global majority, presents an opportunity to examine the coloniality of global health in its communications. Indigenous people have long understood the oneness that One Health is geared toward. Long before the introduction of One Health, we (read Africans) understood the relationality and totality of all living things, that is shaped by a dependence on each other. This is embedded in our traditional belief systems, that denote our responsibility to look after the land that we share with animals (Murove, 2009). Thus, there is scope alike HATUA to localise dialogue on One Health. Misuse is in part attributed to a lack of knowledge (WHO, 2022c) in communicating the message of the importance of responsible use of antimicrobials across the three elements (land, people, animals), requires an education that is in keeping with already existent “African thought and values”. There is therefore an opportunity to adopt a
decolonial approach to One Health. For example, Mazrui, (2003) argues that purposive selection where the adoption of western concepts, ideas and technologies were concerned safeguarded Japanese culture. Mazrui (2003) notes that the Japanese’s development ambitions were guided by the mantra “Western Technique, Japanese Spirit” (Mazrui, 2003, p. 141). We (read Africans) have the opportunity now to adopt ‘Western technique, African spirit’ in navigating how we (read Africans) use technologies and medicines such as antimicrobials while deliberately protecting African ways of knowing and thinking.

9.4 RQ3. What are the barriers and facilitators to learning about and practicing AMR stewardship?

Since the WHO set the goal to reduce AMR as a global priority in 2015, the AMR research landscape has seen much advancement in areas such as antimicrobial stewardship (AMS), learning, training and guidance tools (WHO, 2019c). Various works have been developed in reference to AMR education and training for health workers, for example, several tools now exist for competency-based training (WHO, 2018) albeit with a bias to online learning. For example, in their paper, Van Katwyk et al. (2018) mapped 94 educational initiatives of which more than half were online resources including: 42 online reading materials, 16 online courses, 3 apps, and offline resources such as conferences, guidelines, and other assets. The number of available resources has continued to grow since then, with more online courses now available, for example, the Global AMR curriculum, alongside other massive online open courses that are available on platforms such as Future Learn (Fleming Fund, 2021; Future Learn, 2023). It is therefore important to understand barriers and facilitators in implementation and use with particular reference to emergent AMR learning programs and, more specifically, technology-mediated educational programs that are designed to make learning available at scale. Studies such as Littlejohn et al. (2019) and Charitonos et al. (2021) have explored tensions specific to lab professionals’ in-service education and training, within LMIC contexts. However, there remain gaps in literature on the barriers and facilitators to learning for all health professionals who work across the antimicrobial recommendation, prescription, dispensation pipeline in human health. This section focuses on discussing study findings specific to facilitators, including identifying barriers to AMR learning for health professionals in a Kenyan Health facility. This is with a
view to provide thinking that can guide other scholars that may seek to conduct research in similar contexts or policy planners and educational developers who may wish to develop technology mediated tools for learning in similar contexts. This approach is in line with the concept of developing principles in DBR (see section 4.7) which often "involves active and thoughtful consideration of what has come together in both research and development (including theoretical inputs, empirical findings, and subjective reactions) with the aim of producing new (theoretical) understanding" (McKenney & Reeves, 2012, p. 151; Shattuck and Anderson, 2013). This section thus draws together barriers and facilitators from across the thesis development process.

9.4.1 Conceptualising barriers and facilitators

In section 6.10, I borrowed useful thinking from the broad educational design landscape and introduced insights from Collins et al. (2004) Rogoff’s (1995) multi-layered and multi-level analyses of learning. I triangulated their thinking (Collins et al., 2004; Rogoff, 1995) with scholarship from sociotechnical theory scholars (see section 5.6.3), in considering the complex relationships between different elements (Sittig and Singh, 2010). In this section, I use study findings to conceptualise barriers and facilitators across eight interacting factors through which barriers and facilitators materialise. Figure 9.1 below displays a complex web of the interactions across the eight nodes. I discuss these in detail in subsequent sections.
Figure 9.1: A schematic diagram representing multiple interacting factors where barriers and facilitators to learning about and practicing antimicrobial stewardship maybe encountered

The nodes represent key areas where barriers and facilitators may be encountered in the design process of developing technology-mediated AMR learning. Used as guiding design principles, these may be used to pre-emptively consider each node and how its dynamics interact with other nodes as well as implications of those interactions on implementation and usability in practice. Each node is discussed in relation to barriers and facilitators in subsequent sections. Of which, the nodes are broadly in keeping with previous WHO recommendations of areas to focus in implementing AMS programs (WHO, 2019c).

9.4.1.1 Infrastructure
The infrastructure node refers to broader infrastructure in the country and region, this can be viewed in two ways; the first, to consider its impact on health service delivery and the second on technological implications and capacity. I consider technology-related infrastructure under the node technology (see section 9.4.1.3) and focus this node on scoping other relevant infrastructure. For example, electricity, water sanitation, and hygiene (WASH) are often considered health enhancing sectors. Within the scope of AMR for
example, WASH and wastewater management across all sectors are critical for infection control and reducing the spread of AMR (WHO, 2020a).

Kenya faces challenges in sanitation, for example amongst its goals for Vision 2030, is universal access to sewered sanitation. The latest available Water Services and Regulatory Board Kenya (2022) data shows this to be at only 16% coverage. County X has only 2% countywide sewage coverage, leaving the rest of the 98% reliant on open sewers and an adoption of a panoply of onsite sanitation solutions (Water Services and Regulatory Board Kenya, 2022). The challenges in sewage coverage are coupled with shortcomings in water coverage. County X, for example is ranked amongst the 10 counties with least water coverage in Kenya. This has epidemiological implications and, within the hospital settings, has implications for hospital-acquired infections (Kibira et al., 2022; Water Services and Regulatory Board Kenya, 2022). In terms of water coverage in the health sector, it has recently been reported that only 23% of health facilities in County X have access to clean water (Oketch, 2022). This highlights the need for further investment in infrastructure by policy makers. For health education planners it highlights the need to design educational materials for practice that are implementable. Thus, there is a pronounced need to scope infrastructure, in educational planning, prior to design in order to map existent infrastructure-related barriers to enacting behaviours that are in keeping with antimicrobial stewardship (AMS). Exploring and understanding barriers can then inform the learning content node, with the view to maximise the utility of learning materials in practice. This therefore requires the consideration of what useful learning in a given context may look like. Asking key questions such as given the infrastructure and the resources around the infrastructure, what is implementable, what is cost effective, what is likely to be effective in practice? This is in line with The WHO’s approach to cost-effective solutions that are considered ‘best buys’. This thinking can be leveraged in learning design for AMR programs, to begin with a question of infrastructural capacity and provide learners with training that can be implemented to improve their AMR-related practice, these be conceptualised as learning best buys.

10 This source identifies the County and will thus be redacted after examination
For example, a learning ‘best buy’ maybe a greater focus on supporting infection control measures. Kibira et al. (2022) report contaminated healthcare worker hands as a common source of infection in Kenya. Teaching antimicrobial champions the importance of establishing and using hygiene stations, these often include handwashing and sanitizers, may serve to be of benefit where there are challenges in lack of cleanliness. For example, Hilburn et al. (2003) observed a 36.1% decrease in infection rates during a period where sanitizers were installed in an acute care facility. In these ways, an understanding of infrastructural challenges can be used to facilitate focused and implementable learning.

Elsewhere in relation to infrastructure, in a recent editorial, Jain et al. (2022) argue all infrastructure to be health infrastructure, asserting that intersection of infrastructure whether in health or transport is a broader “conversation about social determinants of health and the intrinsic connections between infrastructure and human health” (Jain et al., 2022, p. 24). This was visible in study findings where, for example, road and transport infrastructure mattered because samples from the hospital needed to be transported to another facility over 100km away (see section 8.3.4). This has implications for practice and learning. In terms of practice, participants reported suspecting the results were inaccurate. Challenges in relation to inaccuracies in processing laboratory tests within LMIC contexts has been reported elsewhere in literature (Meyer et al., 2019; Okeke et al., 2022). For example, Okeke et al., (2022) argue that challenges in infrastructure have implications for AMR surveillance and offer the example of the challenge courier services experience in relation to sample processing in LMICs. These services are often poorly networked and dependent on poorly developed road infrastructure and are often suboptimal for handling both routine and urgent samples. In practice, the implications of this at XTRCH were an overreliance on empirical diagnosis, discussed in section 9.3.2. The challenge being two-fold; firstly, there was a need to understand the pain points in practice that were possibly causing the inaccuracies. Secondly, and more importantly for educational planners, is the development of materials that are geared at improving empirical diagnosis, to for example consider how clinical history-taking can facilitate improved diagnosis and treatment (see section 9.3.1).
9.4.1.2 Health System Governance

The importance of health system governance as a central component of achieving Universal Health Coverage (UHC) in resource-constrained settings has been gaining traction in research (Barasa et al., 2020; Fryatt et al., 2017). As discussed in section 8.4.12, challenges in UHC, undermine health workers’ abilities to engage in antimicrobial stewardship in clinical decision-making. Health system governance is in this context used to refer to the management of the health system at state level, including financial investment and human capital management. Human resources for health account for a large proportion of health resources, and affect health system efficiency, quality of care and overall system performance (Nyawira et al., 2022). As discussed, in section 2.2, the Kenyan health system is now managed under a devolved system of governance, where county governments are in charge of finances and budgets. The devolved governance systems within the health sector have cited benefits, such as increased local ownership, community participation and greater accountability (Barasa et al., 2017; Tsoka et al., 2017).

There is scope to closely examine health system governance at the county level in order to map where barriers and facilitators specific to practice and learning exist. This is particularly important given that Kenya has a devolved system of governance (see section 2.2). Examining governance at the level of the county can therefore facilitate a better understanding of issues related to efficient resource mobilisation and allocation mechanisms, prudent financial management and technical efficiency, amongst other functions (Nyawira et al., 2022). Within the LMIC context, resource mobilisation is often the largest challenge, thus improving technical efficiency is amongst the more viable options for systems improvement. Technical efficiency includes health workforce management, and this has implications for broad health outcomes and, more specifically, AMR-related health outcomes. In the context of County X there were several challenges in human resource management, including inefficiencies such as delayed salaries, which had knock on effects in motivation. These subsequently materialised as barriers for AMR-related practice and learning (see section 8.4.10). Barriers in practice included absenteeism of senior members of staff which would result in a loss of expertise in treating patients, including loss of access to their tacit knowledge, which was discussed in section 9.3.2.1. For junior practitioners this materialised as a barrier to learning. During these periods junior staff would experience
learning loss on ward rounds and miss one to one consultation opportunities. These barriers related to learning are important for educational planning. For example, the module was designed to be completed within a limited timeframe, whilst designing the module in this way may have in some cases encouraged practitioners to complete the course within the given time frame, when this collides with strike action or a ‘go-slow’ period where engagement is generally lower, it may also have resulted in increasing non-completion. Thus, exploring factors under this node helps to navigate what will materialise as a barrier or facilitator to learning. In the case of the study findings for example, running the module for longer may have been beneficial, not only because of the collision with strike action but also because of competing priorities and other challenges in access (see section 8.5.5).

9.4.1.3 Technology
The node technology is used to consider technology readiness, acceptability, and usability (TRAU). Exploring barriers and facilitators in relation to these three elements is in keeping with other approaches to pre-empt barriers and consider facilitators in implementing digital health solutions in LMIC contexts. For example, Lynch et al. (2022) conducted a Technology Acceptance and Usability Survey (TAUS) in Nigeria, to scope feasibility of using an mHealth tool in cancer care. In the context of this study, I have added technology readiness to refer to the capacity of the given context to absorb the intended educational technology. For example, in exploring smartphone penetration levels, location of the research site, demographic data on disparity (see section 2.5 – 2.6), it was likely that using a platform that was only accessible on smartphones may have been exclusionary. This led to the decision to use a platform that was likely to be more inclusive and accessible on smartphone and basic phones and did not require access to the internet. Understanding technology readiness and the infrastructure that impact access to technology such as connectivity and internet, can help users to choose a tool that can be a facilitator rather than a barrier to learning.

Acceptance refers to the likelihood of the given population to accept the technology for the intended purposes. To gauge this, it is important to hear the voices of potential users and understand for example, what professional learning already looked like at the research site (see section 8.4.2). This then influenced thinking on the likelihood of participants to accept the technological intervention. It was also useful to use iterative design that facilitated hearing participant voices. For example, in iteration 2, participants were able to explore the
platform during an interview and provide feedback relevant to acceptability of the technology. Technology usability is used to refer to the feasibility of implementation, adoption, and use. For example, an intervention that required constant internet connectivity would have had limited usability in the given context, based on challenges in network and cost of access to the internet. The use of DBR and iterative design facilitated an exploration of the TRAU.

9.4.1.4. Institutional barriers and facilitators
Institutional barriers and facilitators are used to refer to health facility-related barriers and facilitators. At the level of the health facility these were associated with rules and norms and culture as per the CHAT model. For example, where a culture of learning existed, it was evidenced by the different modes of learning that were available on site as well as CPD requirements (see section 8.4.2). There were barriers in learning, such as time constraints, (see section 8.5.3). Thus, in designing learning materials, it was important to develop self-paced materials that enabled participants to start and stop as and when they had time. Specific to AMR there was an inaccess to and unavailability of AMR data and learning materials specific to data. For example, the lack of a hospital antibiogram (see section 8.4.3) impacted the capacity of health workers to make informed, rational clinical decisions. Thus, in designing learning materials and content, there is a need to understand such limitations in practice, to consider how practitioners can be supported in improving decision making in lieu of these important factors that typically inform recommended practice. This can be done in a way that facilitates dynamism within the clinical setting, (see section 9.3.2), essentially managing to create best-in-situation practice whilst remaining open to progressive adoption of recommended policies, such as an antibiogram programme as and when the institutional resources become available. In the same way, that I discussed the need for dynamism in clinical settings in section 9.3.2 (Nonaka, 1998). I contend the same brand of dynamism needs to be incorporated into learning materials, so they can accommodate institutional barriers that exist in practice and learning alongside working through those barriers to progress towards greater facilitation of learning and improving practice.
9.4.1.5 Social
The social node is used to refer to barriers and facilitators related to the broader social landscape. I found these to be particularly important for thinking about how professionals tackle AMR and how social factors influence and shape their practice. For example, in the context of this study, social factors had an impact on practice that were extensively discussed in section 9.3. This covered challenges related to socioeconomic factors and how they shaped practice, including shortcomings in UHC, and how that undermined practice. It also revealed challenges associated with cultural factors, traditions of pastoralism and agriculturalism, as well as a colonial history that has in previous studies been shown to impact views and attitudes towards the health workers (Kulesa and Brantuo, 2021, p. 3).
Section 9.3 sought to expand on the degree to which the social influences the health sector and the challenges that social barriers pose to AMR learning. It is therefore important that barriers and facilitators relating to social landscape are explored prior to designing learning content. In order to increase the propensity of ideas and concepts communicated in learning content to be implemented in practice. Specific to this study, social facilitators such as leveraging ecosophical aspects of an African philosophy were discussed in section 9.3.

9.4.1.6 Epidemiology
The epidemiology node refers to the local epidemiology. An understanding of disease patterns can facilitate the design of more targeted CPD, that is well timed in delivery. This can potentially be a facilitator for greater engagement by way of making available and highlighting learning materials relevant to the diseases that practitioners are dealing with in practice. For example, delivery can correspond to particular seasons. In section 5.3.1, I discussed opportunities to leverage data in timing of learning delivery. This could, for example, factor in the relatively higher malaria transmission in Western Kenya during rainy seasons. Learning relating to malaria-related antimicrobial use could be delivered in the lead up to and during those times. For instance, learning platforms such as the mhealth platform used in this study have the capacity to push out messages to invite participants to specific modules. As such, the importance of a module could be communicated in a message inviting participants to learn. This is in line with broader literature such as Godman et al. (2021) who advocate role of education in tackling resistance in Malaria, given the concerns with rising resistance rates to antimicrobials that are used to treat malaria.
9.4.1.7 Personal
The personal node, is in part interlinked with the health system governance node and institutional node in as far as these two nodes have a bearing on health worker motivation and productivity, which have an impact on AMR-related learning and practice (Nyawira et al., 2022, p. 11). For example, Nyawira et al. (2022, p. 11) note that “determinants of health worker motivation span financial and non-financial and include some of the factors…such as timeliness in payment of salaries”. The personal node, can be used therefore to map profiles of health workers, develop an understanding of barriers and facilitators to learning at a personal level, for example practitioners in this study discussed motivations to work privately and the need to gain certification. Thus, badged and certified courses or micro credentials\(^\text{11}\) in the context of Count X may increase motivation. Therefore there is scope to consider personal practitioner circumstances to understand barriers and facilitators to learning.

9.4.1.8 Learning content
The learning content node can be explored in two ways. The first is whether content is appropriate for the given context. It is important to ensure, for example, that content does not recommend practice that is simply beyond practitioners’ capacity, given the resources that they have at their disposal. The second is in considering pedagogy, to leverage affordances such as microlearning in consideration of other factors such as health system governance and shortages in human resource that result time constraints for practitioners. In one respect, this node is really an amalgamation of all the other nodes. Learning should consider for example infrastructure, as discussed in section 9.4.1.1 infrastructure can impact access to lab, it can mean transporting samples over long distances this has implications for packaging, correct handling during transportation. As such, learning content should be relevant to context for example this may include learning the correct procedure, and the importance of proper handling, especially given that replacing spoiled samples, has added challenges of time and cost of transporting over distances. Learning content should consider health system governance, in several ways, including for example, CPD budgets and financing and how those impact the practitioner. For example, in the context this study

\(^\text{11}\) A micro-credential is a proof of the learning outcomes that a learner has acquired following a short learning experience (European Commission, 2020, p.10)
making CPD accessible through an mhealth platform, which in turn facilitated greater ownership over learning, was important. This countered the usual practice that decisions on who goes on what course are often a managerial decision (Gitonga and Muriuki, 2014), whilst there maybe benefits to more advanced practitioners in managerial positions making decisions on junior practitioners’ CPD to ensure that the skills required for efficiency in the team are in place, literature continues to site the importance of ownership in adult learning. For example, Kemei and Etowa, (2021, p.126) note that “the lack of a transparent process in the distribution of on-the-job training opportunities disempowered some nurses” in a Kenyan health facilities. Thus, mhealth may present the opportunity for practitioners to take ownership whilst also receiving guidance on which course to opt for on the platform. Platforms such as the mhealth platform used in this context can also provide feedback on the number of practitioners who have taken part in a course. This may in turn help managers gain a clear perspective on CPD needs within their teams. In terms of technology, learning content needs to fit the mode of delivery, for example consider whether videos are accessible for the given population, this requires factoring challenges and facilitators in for example technological readiness and accessibility (see section 9.4.1.3).

9.5 Conclusion

This chapter drew insights from study finds and broader literature. It offered discussions relevant to each research question. Specific to research question 1, it discussed the changing CPD landscape in Kenya and current CPD engagement and methods of delivery. Including the important role of in-person learning and the practitioners’ beside manners. Specific to research question 2, the section discussed socioeconomic factors that have an impact on practice, importantly highlighting the role of culture and how global health education may benefit from adopting a decolonial lens. It highlighted the friction that can exist between western medicine and public health education when it fails to consider and incorporate indigenous knowledge and ways of life, making clear, the need for a broader conversation on decolonial public health policy, particularly in relation to one health. Specific to research question 3, a framework was offered to conceptualise barriers and facilitators to practice and learning. These were then subsequently discussed.
Chapter 10: Conclusion and Recommendations

10.1 Introduction

This thesis began with an introduction to the problem of AMR and a contextualisation of the problem across the African continent and more specifically, in Kenya. It highlighted AMR as a challenge that is hurtling towards Africa and the role that education can play in mitigating some of the AMR-related challenges. Throughout the thesis process, I sought to explore the question of how health workers in a Kenyan health facility learn to tackle AMR, with the view to understand how findings in the study may inform learning to tackle AMR in similar contexts. This chapter provides answers to the research questions based on evidence gathered during this study, then considers limitations and presents recommendations for future research and practice.

10.2 Answering the research question

To address the overarching question of how health professionals learn, I engaged with three research questions:

RQ1. To what extent and through what methods do health professionals engage with continuous professional development?

RQ2. What socioeconomic factors impact learning for health professionals?

RQ3. What are the barriers and facilitators to learning about and practicing AMR stewardship?

In the following sections, I address each of these three questions.

10.2.1 Addressing RQ1

Health professionals in Kenya are required to engage in CPD, commonly referred to as Continuing Medical Education (CME) in Kenya. The requirement comes from the Ministry of Health and is implemented and monitored through licencing medical bodies (GovKenya, 2014). As a result of this requirement, healthcare participants in this Kenyan context were
broadly engaged in CPD delivered through multiple modes, commonly: in-person seminars, learning at the point of care and through one-to-one consultations. Where online delivery methods such as online courses were already in use prior to the COVID19 pandemic, the advent of COVID19 increased delivery through online modalities. For example, seminars previously offered in-person pivoted to online delivery through software such as zoom (Masai and Boibanda, 2022). Across all learning modes there were barriers and facilitators to learning. For example, whilst in-person learning offered participants the opportunity to gain important experiential knowledge that would inform tacit knowledge required in practice, especially in cases where empirical diagnosis was the only option, this learning was sometimes undermined by shortcomings in health system management. This included delayed payments which would in turn impact absenteeism and subsequently strike action. Similarly, online delivery modes had their challenges, such as cost of internet and network and connection issues. Thus, whilst participants engaged in learning through multiple methods and engaged to various extents, their engagement was informed by other factors such as motivation, accessibility, and finances, as discussed in chapter 8. Importantly, findings showed that there exists an opportunity to use mhealth to encourage further engagement in learning and deliver AMR-related learning content through mhealth platforms.

10.2.2 Addressing RQ2

The study findings reflected that socioeconomic factors have a large bearing on learning and how learning should be designed if it is to be transferable to practice in a given context. Findings demonstrated the necessity to understand the socioeconomic factors that affect the public/patients. This was highlighted as important given that public/patient socioeconomic conditions have an impact on antibiotic use, including misuse. For example, there was evidence of accessing antibiotics through informal channels such as open markets and unauthorised pharmacies. Socioeconomic factors such as culture broadly, and the culture around antibiotic use beyond the hospital gates therefore has implications for how practitioners learn how to tackle AMR. Given that the WHO (2018) competency framework describes practitioners’ role as including the capacity to effectively communicate prudent use of antimicrobials to patients/the public, understanding the socioeconomic conditions of patients is important. It is important that learning for practitioners is able to adequately
address behaviours that drive misuse of antibiotics amongst given populations. Other socioeconomic factors that impacted learning included political climate at the time of research, whereby elections were underway, and challenges to personal finances which were linked to delayed payments to practitioners. However, opportunities to positively impact learning within the sociocultural space were explored. For example, this research highlighted that there exists the opportunity to leverage cultural traditions and values such as the ecosophical dimension of Ubuntu philosophy that depicts the three elements of One Health as dependent on each other. The opportunity lies in the capacity to build on the philosophy that already exists across local cultures, to bring in learning materials that are in keeping with African thought and value systems and will thus be more likely to be embraced by both patients and practitioners. Thus, creating effective AMR education requires a broad scope of sociocultural challenges and facilitators, that can be factored in to designing learning materials, whether they are delivered online through an mhealth platform alike the platform used in this study, or for in-person learning. It is concluded that antimicrobial stewardship programs will need to be steeped in context if they are to successfully improve antimicrobial use amongst practitioners. This was in keeping with findings that indicated that professionals would benefit from problem-based learning, that enables them to gain knowledge and skills that are readily transferable in practice.

10.2.3 Addressing RQ3

The barriers and facilitators to learning revealed to affect both online and in-person modes of delivery of CPD to healthcare practitioners in this Kenyan context, are conceptualised as broadly existing with 8 nodes. These are:

- epidemiology
- infrastructure
- technology
- social
- learning content
- institutional
- health system governance
- personal
Across these exist barriers to AMR-related learning that have an impact on how educational planners should think about designing for AMR-related learning and antimicrobial stewardship programs, particularly those that are delivered online. Research findings highlighted the importance and bearing of these sectors on learning. For example, where a question of infrastructure relevance arose, its answer through exploring the evidence highlighted that, for example, challenges in road infrastructure impact and shape practice related to urgent and routine transportation of samples from hospitals that lack lab capacity to those that have the capacity to conduct the tests. Given the challenge in infrastructure, context-specific learning may include learning related to correctly packing samples, time lapse between samples and inoculation and correct transportation. Thus, shaping learning content. An exploration of barriers and facilitators that exist across the 8 nodes is therefore important for AMR-related learning (evidenced in section 9.3 of this thesis).

10.3 Recommendations

This section discusses recommendations for policy, practice, and future educational research.

10.3.1 Policy level recommendations

There is a need for stronger regulation of access to antimicrobials, including within hospital settings as this study’s findings showed that nurses who were not advanced nurse practitioners were put in ethically-difficult positions of prescribing in the absence of doctors. This highlights the need for consistently effective management at county level, to minimise occurrences of strike action. This is important because in lieu of qualified practitioners prescribing, the next stop for some patients is likely to be informal and unauthorised routes of access. Health practitioners would benefit from greater access and frequent opportunities to learn about the WHO’s critical list of antibiotics, which needs to be more accessible to all health practitioners. This also relates to the evidence from this study that nurses, under certain conditions such as strikes, assume the role of prescriber. It is appreciated that providing guidance and access to regulations may take some time to be put in place, but it is important that all nurses are aware of the critical list of antibiotics and
have an understanding of which antibiotics are on access, watch and reserve lists in order to inform their decisions should the occasion that they assume the role of prescriber arise.

Additionally, as part of the WHO competency framework, nurses should be able to educate the public about antimicrobials, given the challenges that exist in Kenya related to unauthorised pharmacies, open markets, and over-the-counter use. As the point of contact that often the most amount of time with patients, nurses can play an important role in making the public aware of challenge of AMR and the significance of the critical list. This might help discourage patients from seeking and using particular antibiotics independently, specifically through informal routes of accessing medications revealed over the course of the study. This study’s research indicated that there is scope to explore a ‘pharmacy first’ policy as (discussed in section 9.3.3.1) in relation to antimicrobial use in LMIC contexts, where there are pronounced socioeconomic challenges and shortcomings in Universal Health Coverage (UHC). Further research is required to explore whether this is a feasible and safer option that may curb access from open markets and unauthorised pharmacies.

Whilst many LMIC countries including Kenya have made strides in UHC, this study’s findings indicate a need to reinvigorate efforts to finance UHC in order to safeguard antimicrobials by facilitating public access to health professionals who are authorised prescribers. Antimicrobial stewardship programs and committees that work within the policy space such as the antimicrobial Stewardship Interagency Committee in Kenya should include advocacy for UHC across the policy space.

Challenges in the Kenyan medical supply authority’s supply chains result in stock outs. These undermine antimicrobial stewardship and can facilitate the introduction of lower quality drugs into public hospital settings. The prospect of drugs obtained outside the hospital makes practitioners suspicious of medicines and nervous around decision-making, such that in the context of this study, practitioners’ prescribing behaviours were sometimes guided by what is available in the hospital. The lack of ease around medicines procured outside hospital settings amongst practitioners is echoed in the most recent WHO, (2022c) brief on AMR in Kenya. As such, there is scope to explore whether the medical supply authority can work with local counties and health facilities to establish emergency procurement strategies that involve reliable and authorised suppliers.
10.3.2 Recommendations for Educational Planners

Learning content for antimicrobial stewardship in resource constraint settings should look necessarily different to well-resourced contexts. This includes recognising in-country variation in countries such as Kenya that have notable disparity in resources (physical and human) and cultural composition.

Technology educational planners within the LMIC health sector should consider barriers and facilitators prior to designing content and learning platforms. These can include the analyses of technology readiness, acceptability, and usability and should take into account interacting dynamics. These may include epidemiology, infrastructure, social context, institutional dynamics, health system governance and personal factors that shape practice and impact learning and engagement amongst practitioners.

Planners should adopt a decolonial lens to developing learning materials. Specific to AMR, there exists the opportunity to leverage African traditions and values of relationality between animals, people, and land. These can be adopted to effectively communicate the message of One Health in keeping with African thought and value systems.

There is scope to increasingly use mhealth platforms such as Leap that rely on short message service and interactive voice notes. These are particularly appropriate for use with practitioners that are in rural and remote areas and amongst groups of practitioners where internet access and engagement may be impeded by cost.

There is scope to use a platform such as Leap to offer a cost-effective solution to providing learning at scale. The free at point access dimension would mean that practitioners do not need to wait for managers to send them on CPD courses, which may increase ownership of professional development.

Study findings indicated AMR-related practice in primary and secondary care has a big impact on the capacity of health workers in tertiary level facilities to make informed clinical decisions and engage in recommended practice in line with WHO guidelines on prescribing antibiotics. Where many AMR programs such as GLASS and studies including this one have focused on tertiary level sites, the study findings demonstrated that there is a need to
engage health practitioners in community, primary and secondary facilities. This would improve their practice and act as a mechanism to support AMR-related practice in tertiary level facilities.

There is scope to explore extending learning opportunities to community level workers such as Community Health Workers (CHWs), given that countries such as Kenya have strong networks of CHWs whose role include educating the public. Future research may explore using a platform such as Leap to extend learning to CHWs who in relation to Leap are the ordinary users of the platform.

10.3.3 Future research opportunities

This study’s research indicated that there lies a gap in literature that broadly explores patient and public perceptions and views of western medicine and health professionals across different countries, as discussed in section 9.3.4, negative views and mistrust of health practitioners can undermine public health education, including AMR specific education.

There is a need to better understand public trust in information on AMR that is communicated by health professionals, as part of understanding how to effectively educate the public on AMR.

Study findings reflected that participants may have benefited from problem-based learning (PBL). Future research on mobile health platforms could explore effective PBL design for AMR stewardship in LMIC context.

This body work was conducted with a commitment to producing work that is reflective of the community of practice as well as wider community. The process of undertaking the research and the study findings have contributed to the broader project and conversation on decolonisation. Specific to the research community, it has added to the conversation on decolonisation in research ethics and highlighted the need for institutions to reassess what they mean by ethical research, to centre question of whose ethics? There is a clear need for a broader conversation within the research community on how researchers should engage with the ethical systems and the philosophical values of the spaces they undertake their
research in order to ensure that knowledge production neither reinforces nor legitimises colonial legacies and their accompanying inequalities that are tied to knowledge production. There is a need for institutions to reconfigure ethics requirements, asking researchers to demonstrate engagement with local ethics and reflexivity in relation to how those ethics fit in with their ethics and how they intend to honour local ethics.

10.4 Limitations

This research was conducted during the COVID19 pandemic, as such aspects of the design shifted to adapt to a then unfolding pandemic. Changes to research included the use of a smaller, less extensive piloting phase. Changes also included, hiring an in-country consultant and tasking them with submitting ethics forms (completed by the researcher) that needed to be submitted manually. There were issues with processing payments including transferring monies for ethics submissions. This had implications on timelines across the project life cycle.

Over the course of fieldwork, there were strikes across healthcare cadres at the facility due to delayed salaries. This had implications for engagement of health workers on the platform as well as in getting feedback from participants.

During fieldwork the third president of the Republic of Kenya died and, as a result, a period of national mourning was instigated which included public holidays. This had implications for observations as there were reduced staff working on site.

Fieldwork and module release were conducted during election season. Given a history of political unrest during these periods, organisations typically take safeguarding measures to in case of unrest. Safeguarding measures include giving employees time off to engage with the democratic political process. This had implications for the study. The module was delivered during a period where members of staff who ordinarily worked on the software team that managed health platform were off. During this time, glitches on the platform that resulted in challenges in access for health workers could not always be resolved by the researcher as some challenges required backend access. In cases where the researcher could not resolve challenges, practitioners were excluded and unable to access the module. Additionally, there were challenges associated to backend data collection that would
provide time stamps and amount of time spent on the platform. The researcher had intended to conduct analyses on these data however data was rendered inaccessible and could not be resolved given the challenges in staffing of software developers associated to the political climate.

Whilst the study aimed to be as inclusive as possible, the use of a mobile phone was still exclusionary to health workers who did not have access to mobile phones for the mhealth intervention. Survey one was implemented online due to the COVID19 pandemic. In the initial design the survey would have been available both online and in-person. Online recruitment therefore meant that individuals who may have wanted to take part but did not have access to the internet were unable to take part.
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Appendices

Appendix A – Leaflet

Volunteers Needed

Kenya has over the last decade experienced high levels of antibiotic resistance. This is a public health threat to all of us. It risks widely available and affordable antibiotic treatments becoming ineffective. As part of National Health policy, on prevention and containment of antimicrobial resistance (AMR), the government recommends scaling up AMR education for health professionals. This project is working to develop a new and exciting mobile learning platform suited to your needs as a health professional. Your opinion is of the utmost importance.

Would you like to learn more about AMR, take part in a course designed at The Open University, UK and tell us how we can improve this?

This course is free of charge.

To find out more email or WhatsApp the researcher

Researcher contact details:

Name: Natalie Tegama

Email: [email removed]

Whatsapp: [number removed]

Join the fight against antibiotic resistance!
Invitation email Subject Line: Mobile learning survey: looking forward to receiving your views

Dear health worker,

I am writing to health professionals across three health facilities including yours. This is part of a study on effectively tackling antimicrobial resistance across the country. As you may already be aware, Kenya has over the last decade experienced high levels of resistance, this poses danger to public health and risks widely available antibiotic treatments becoming ineffective. As part of National Health policy, on prevention and containment of AMR, the government recommends scaling up AMR education for health professionals. The opinions of health professionals on learning needs across facilities are of the upmost importance to this project.

I therefore would like to ask you a series of questions about your continuous professional development, online learning, and antimicrobial resistance. The information you provide through the survey will inform the design of a mobile learning platform for health workers on your site.

The link below will take you to a short survey which should take you approximately 10 minutes to complete. The information you provide will not be used to identify individuals, instead, your comments will inform the mobile platform design and its future developments.

Please make sure that you read the Information Sheet for Participants [link to the sheet] and save a copy of the file for your records in your hard drive, before you provide your consent and start the survey.

If you are willing to participate in this research, please [click here] to access the survey.
Or copy and paste the link below into your internet browser: [Survey link here]

If you have a disability or an additional requirement that makes it difficult for you to complete the survey online, please contact the researcher via natalie.tegama@open.ac.uk

Thank you for your support and help.

With best wishes,

Natalie Tegama

After 2 weeks, I will send an email reminder to participants with the same title and content.
Information sheet

Tackling Antimicrobial Resistance mHealth platform

Using a mobile health platform for AMR learning with health professionals in Kenya

This project invites you as a prospective participant to take part in a module on antimicrobial resistance (AMR) using a mobile health platform if you have a smartphone or a basic phone. The module introduces you to the importance of adopting a one health approach to AMR. The aim of the project is to better understand what effective AMR for you as a health professional may look like. The project therefore uses a method called co-design. This means that it values your opinions and views and will encourage you to share them throughout the process.

Why is this project important?

Kenya has over the last decade experienced high levels of resistance, this a public health threat to all of us. It risks widely available and affordable antibiotic treatments becoming ineffective. As part of National Health policy, on prevention and containment of AMR, the government recommends scaling up AMR education for health professionals. This project is working to develop a new and exciting mobile learning platform suited to your needs as a health professional and share its findings with hospitals, policy makers and academics.

Voluntary Participation

This study relies on your voluntary co-operation to gather and use data. The information you give during the study is confidential and will not be shared with your employers and therefore impact on your employment. You do not need to take part in this research if you do not want to. You do not need to answer any questions that you do not want to. Even if you agree to take part, you are entitled to withdraw your participation at any point up to the 30th August 2022. To withdraw contact the researcher on the following email:

Who can participate?
Health professionals (doctors, nurses, lab technicians, microbiologists, pharmacists) working in at X County Teaching and Referral Hospital.

What is involved?
Thank you for completing the survey(s) as the initial part of this project, which have helped inform the delivery of this course.

You will be asked to take part in a two-week AMR module using a mobile health platform on your smart or basic phone to access text and audio learning materials. The modules will take up to four hours to complete. Tasks on the platform are split into 5 minute segments to give you flexibility to take part when you can spare 5 minutes or more. The platform will seek your consent to collect data on how you engage with the app, this data will allow the research to understand how you used the app. In addition, the researcher will invite you to share your views on the app in an interview. Your personal information will not be shared with anyone however the data gathered will be anonymized and used as part of a doctoral thesis. 

Access to the course is limited to participants who are able to take part in the study.

How long will the project last?
This study takes place over 2 months between June and July 2022. There is one module, which you will be able to access as of June 1st 2022. The month of July is reserved for interviewing and debriefing.

What are the risks?
Whilst questions in any survey, interviews and focus groups you agree to participate in associated with this project are designed to ensure you are comfortable, should you find yourself uncomfortable with answering any questions pertaining to your role, you do not have to answer these questions. Your data collected through the App whilst using the course is lawfully collected as long as you provide your consent and the platform provider, AMREF and I conform that this data will be stored safely to minimise risks to you.
What are the benefits?

The research aims to further develop the understanding of effective learning strategies for health professionals in addressing AMR relevant to the Kenyan healthcare context. The research will benefit health education policy makers, governments, and non-governmental organisations.

Is it confidential?
Yes. Everything you share with me as the researcher will be in confidence. No personal information will be passed on to anyone else and it will be stored safely on password protected devices on the AMREF Kenya and OU servers. This includes but is not limited to anyone in your workplace. No information from your participation the course or in the associated research project will impact on your employment. I will share data with my supervisory team at the Open University but only after it has been deidentified. I will write a report of the study. However, no individual will be identifiable in the published study.

What will happen with the data collected?

The data collected will be used as part of my PhD Research. Anonymised data may be used for other publications including, but not limited, to reports to AMREF and Fleming Fund.

Compensation

All participants will be offered digital data vouchers for their chosen mobile data provider. These will cover the cost of data to take part on the mobile learning platform.

My responsibility to you

Your participation is treated with strict confidentiality in line with the Data Protection Act 2018 (UK) and Data Protection Act 2019 (Kenya). The data collected will be securely locked in storage and servers at the Open University and will be destroyed seven years after the end of the project. I am happy to answer any questions you may have about the research.
What if I have other questions?

If you have any questions you can contact me via email at: natalie.tegama@open.ac.uk

If you have questions about your rights as a study subject, you may contact:

The Research Officer
Amref Health Africa in Kenya
Wilson Airport, Lang’ata Road
Office Tel: +254 20 6994000
Mobile No: 0795746777
Fax: +254 20 606340
P.O Box 30125-00100
Nairobi, Kenya
Appendix D - Survey 1

1. Do you work at XTHRH?
   Yes
   No

2. What is your job role?
   Doctor
   
   Laboratory Technician
   
   Microbiologist
   
   Other (Please specify) ____________________

3. In your role, do you prescribe, dispense or recommend antibiotic use?
   Yes
   No

4. Do you understand the term antimicrobial resistance?
   Yes
   No
   
   If yes, can you explain your understanding of antimicrobial resistance?_________________

5. What types of professional learning opportunities are there for you to develop new skills and knowledge in your workplace?
   ________________________________
6. Does your job role require you to do continuous professional learning? (i.e. attend courses and trainings)
   Yes
   No

   If yes, how many courses are you required to do a year? ___________________

7. How long ago did you last take part in a professional learning activity that was required for or related to your job role? (this includes lectures, online and in person courses, CPD)
   0 – 3 months ago
   4- 6 months ago
   7 – 9 months ago
   10 – 11 months ago
   12+ months ago

8. Have you taken any courses or other professional learning activities on antimicrobial resistance?
   Yes
   No

   If yes, can you specify the course.
   __________________________________________________________

9. Have you taken part in an online course before?

   If yes, can you specify how you accessed the course?
   Desktop/Laptop at work
   Desktop/Laptop at home
   Mobile phone or tablet
10. Have you used a mobile app or mobile platform for learning before?

If yes please specify

11. Do you have regular access to the internet?
   Yes
   No

12. How do you access the internet? (tick all applicable)
   Mobile phone
   Home
   Work
   Other setting e.g. internet café

13. Which word best describes internet affordability for you?
    Cheap
    Affordable
    Expensive

14. How old are you?
    __________

15. How many years of experience do you have in your current role?
    __________

16. What is your gender?
    Male
    Female
    Prefer not to say
17. The information you have provided will inform the next phase of this study. This will involve answering another survey that explores what mobile learning opportunities maybe suited to your workplace. Would you like to be contacted for this phase?
Yes
No

17b. If yes, please provide your email address and/or your Whatsapp number
Appendix E - Knowledge, Attitude and Practice Survey

Knowledge Attitude Practice Survey

This survey is about understanding your knowledge, attitude and practice about antimicrobial use (AMU) and antimicrobial resistance (AMR). Thank you for taking part in this survey. Your responses will increase understanding of how learning can be tailored to optimise AMU and address AMR in the hospital.

The survey records your opinion based on statements. For each statement you are presented with, reflect how far you agree with it using a 5 point scale. – Please answer 1 to 5.

1. Strongly agree
2. Agree
3. Neutral
4. Disagree
5. Strongly Disagree

Knowledge 1.1

In this section you will be asked questions about your general knowledge of AMR.

Knowledge 1.2

In this section you will be asked questions that are specific to studies in Kenya. These will measure awareness of scientific research amongst health professionals.

Please indicate your agreement with the following statements:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am not aware of studies in Kenya about drug resistance</td>
<td></td>
</tr>
<tr>
<td>Resistance to the first-line treatment for P. falciparum malaria (artemisinin-based combination therapy) has been confirmed in five countries of the Greater Mekong sub-region</td>
<td></td>
</tr>
<tr>
<td>Studies in Kenya have found that common life-threatening pathogens resistance to common first-line drugs such as ampicillin and cotrimoxazole</td>
<td></td>
</tr>
<tr>
<td>Multi-drug resistant non-typhi Salmonella in Kenyan hospital and community settings rose from 31% in 1993 to 42% in 2003</td>
<td></td>
</tr>
</tbody>
</table>
Attitude and Opportunity

In this section you will be asked questions about your attitude to AMR practice and learning.

| I have a key role in helping control antibiotic resistance | |
| Antimicrobials are overused in our hospitals | |
| Drug resistance in another part of Kenya will potentially impact drug resistance in hospital and community | |
| AMR/ Super bugs can be a cause of death. | |
| Every person treated with antibiotics is at an increased risk of antibiotic resistant infection | |
| I give out leaflets, pamphlets or advice on prudent antibiotic use or management as often as I prescribe, dispense or administer antibiotics | |
| I don't have the opportunity to learn about AMR at work | |
| I would like to receive more training about antibiotics | |
| I learn at work through others e.g. peer support or conversations and discussions with other practitioners | |
| During training sessions, I learn with healthcare professionals from other disciplines. i.e. laboratory professionals learn with doctors | |
| Learning with professionals from other healthcare professions would be more beneficial to improving my teamwork skills than learning only with my peers. | |
| I would prefer to learn only with peers from my own profession. | |
| Learning collaboratively with other healthcare professionals would help us to work more efficiently across the hospital | |
| I would enjoy the opportunity to learn with professionals from other healthcare professions. | |
| The line of communication between all members of the healthcare professions is not open. | |
| It is not easy to communicate openly with people from other healthcare disciplines. | |
| Different healthcare professionals are not always cooperative with one another | |
| There is a status hierarchy in healthcare that affects relationships between professionals | |

Practice

In this section you will be asked questions about your AMR practice.

<p>| I have confidence in the antibiotic guidelines available to me | |
| In my role I guide people on the proper use of antibiotics | |</p>
<table>
<thead>
<tr>
<th>Statement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a need for the AMR stewardship programs in my Hospital.</td>
<td></td>
</tr>
<tr>
<td>I use the national antimicrobial stewardship guidelines for healthcare settings in Kenya to guide my practice</td>
<td></td>
</tr>
<tr>
<td>Antibiotic guidelines and antibiotic committee (if present) are an obstacle more than a help to clinical care.</td>
<td></td>
</tr>
<tr>
<td>I am confident that my practice uses antibiotics optimally</td>
<td></td>
</tr>
<tr>
<td>I do not understand how my AMR related practice impacts AMR resistance rates across the hospital</td>
<td></td>
</tr>
<tr>
<td>I have easy access to the materials I need to give advice on prudent antibiotic use and antibiotic resistance</td>
<td></td>
</tr>
<tr>
<td>I do not have access to local resistance data</td>
<td></td>
</tr>
<tr>
<td>I have access to national resistance data</td>
<td></td>
</tr>
<tr>
<td>The AMR trainings that I receive are often useful and improve my practice</td>
<td></td>
</tr>
</tbody>
</table>
Appendix F - Hospital Director Interview Schedule

Your role and the AMR landscape in your facility

1. Please tell me what’s your role in this facility.
   1.2 What do you do on a day-to-day basis / what are your main responsibilities?
   
   - If any please describe 1-2 tasks you do on a daily basis that relate to AMR surveillance.
   - If any please describe 1-2 tasks that relate to managing AMR learning in your role

AMR Data at the facility

2.1 Can you please help me understand how patient data flow looks in your facility? I mean from a moment a patient comes in.

2.2 Does this facility collect any AMR data? If yes, is it collected as soft or hard copies?

2.3 Once collected what do you do with the data?

2.4 Is your facility part of the AMR surveillance network in Kenya? If so can you help me understand how this facility fits in with the surveillance system? (e.g. processes, requirements)

Managing AMR and AMR data

3. In your role, what are the difficulties if any, that are related to managing AMR practice and learning in the facility?

3.1 How do you go about addressing these difficulties? (draw on the tasks above?)
4. What are the implications of having the NGO running a lab and wards at the hospital? (In terms of your job role)
   a. Are there any differences between that ward and lab in terms of administration?

4.2 Are there any differences in terms of practice and/or training?

4.3 (If capturing AMR data) What are the implications of having the NGO running a lab and wards on your AMR data capturing capacities?

**AMR Learning at the facility**

5. What approach has been taken at your facility, if any, to support staff in becoming AMR aware?

   (if answer is positive you go to 5.1, if answer is negative you go to 5.3)

5.1 What tools/processes/procedures did you introduce/use to allow staff to become more AMR aware? (give examples if possible)

   How did you find this process? E.g. What, if any, were the challenges you faced in this process?

5.3 Is there anything in the pipeline / in the future to allow staff to become more AMR aware? Do you have any worries about this?

5.4 What types of opportunities are there for staff involved in AMR surveillance to develop new skills and knowledge, for learning about AMR in this facility?

5.5 Do you the employ the use of any technological tools to facilitate learning? If so, can you give me an example?

5.6 Are there any challenges you think the staff would encounter in offering learning opportunities using mobile phones?
5.7 Are there any challenges you think staff would encounter in collecting AMR data using mobile phones?

As you are aware, this project intends to use a mobile health platform to deliver AMR related learning.

5. Would you be willing to trial part of a module and provide feedback on whether you think it would be appropriate for health workers at this facility?

I will talk you through the functionality and then allow you some time to try the platform and then I will ask you some follow up questions.

6. If this platform was to be used by health workers at this facility, can you talk me through any barriers you think health workers may face in accessing the platform?

6.1 Do you think there maybe benefits to using a mobile learning platform to access work-related learning at this facility? If so, can you talk me through them?

7. Having used the platform, are there anyways in which you think the platform can be improved in terms of functionality and presentation of learning content?

8. What did you think of the content? (did you find it appropriate for health workers at this facility?)

9. Having used the platform, are there ways in which you think the content could be improved?

10. Do you have any further comments or questions relating to the platform?

11. Do you have any further comments or questions about the project?

Thank you for your time.
Appendix G - Lab professionals Interview Schedule

1. What is your job role?
   1.2 Which lab do you work in?

2. What do you do on a day-to-day basis / what are your main responsibilities?
   - If any please describe 1-2 tasks you do on a daily basis that relate to AMR surveillance.
   - If any please describe 1-2 tasks that relate to managing AMR learning in your role

3. In your opinion, is there a difference in teaching/training between the MSF wards/labs and the MOH wards/labs?
   3.1 If yes, how would you describe the differences?
   3.2 How would you describe the relationship between people working in microbiology laboratories and clinicians at this facility? (For example, do they interact and in what ways?)
   3.3 Drawing on your previous answer, what in your opinion are the factors that affect the relationship between lab professionals and clinicians. Can you recall an example of where you’ve seen the two groups working well?

4. Can you describe the moment you get a new sample for testing. What do you do next?
   4.1 What happens if you do not have the capacity to conduct the test in your lab?
   4.2 Can you describe a case where a lack of capacity has meant you could not conduct the test and what you did?

AMR surveillance process

5. What do you need patient data for? How do you use it? What happens next to patient data after you have completed your role?
6. Are you using any particular tools to generate/analyse/store data?

7. Is there any evidence of cases with increased resistance to antibiotics in your facility? How do you know?

General Learning Opportunities

8. What opportunities do you have to learn at this facility?

8.1 How is learning delivered to you (i.e. online/in-person)

8.2 What challenges, if any, have you had with in person or online learning?

AMR Learning Opportunities

9. Have you had the chance to engage in any AMR related learning?

If yes, can you tell me about the course, where it took place, course content? Did it involve the use of technology if so what/how was it used?

10. Are there any challenges you think you would encounter in offering learning using mobile phone?

10.1 Are there any challenges you think you would encounter in collecting AMR data using your mobile phone?

mHealth Platform

As you are aware, this project intends to use a mobile health platform to deliver AMR related learning.

11. Would you be willing to trial part of a module and provide feedback on whether you think it would be appropriate for health workers at this facility?
I will talk you through the functionality and then allow you some time to try the platform and then I will ask you some follow up questions.

12. What do you think about accessing learning on your phone, do you think it is an appropriate platform for accessing work-related learning?
13. Did you experience any challenges using the platform?
14. If this platform was to be used by health workers at this facility, can you talk me through any barriers you think health workers may face in accessing the platform?
14.1 Do you think there maybe benefits to using a mobile learning platform to access work-related learning at this facility? If so, can you talk me through them?
15. Having used the platform, are there anyways in which you think the platform can be improved in terms of functionality and presentation of learning content?
16. What did you think of the content? (did you have any difficulties specific to the content)
17. Did you find the content relevant to your work?
18. Having used the platform, are there ways in which you think the content could be improved?
19. Do you have any further comments or questions relating to the platform?
20. Do you have any further comments or questions about the project?

Thank you for your time.
Appendix H - Interview Instrument for clinicians/nurses

**Your role**

1. What is your role in this facility?

1.1 Which ward do you work on?

1.2 Have you previously worked on a different ward? If yes, are there any notable differences in training or practice in the wards you have worked across?

2. What is your role in this facility? What is it that you do / what are your main responsibilities? Please describe 1-2 tasks you do on a daily basis.

2.1 Who do you work with on this?

3. In your role, what difficulties related to AMR have you encountered if any?

3.1 How do you go about addressing these difficulties? (draw on the same task)

3.2. What worked? What didn’t? What enabled you to meet these challenges? If not yet, why?

**AMR awareness in practice**

4. Can you help me understand what happens once a patient arrives / describe the moment a patient walks into the hospital. What is the process you follow in this facility about treating this patient?

4.1 What is your role in this process? What do you do?

4.2 Who else is involved in this process?

4.3 How many patients do you see in a day (on average)?
To my understanding some patients arrive here and may have symptoms that may signal an infection (or not). How do you determine whether it is an infection due to bacteria or viruses?

5.1 What makes you decide what medication is appropriate for the patient’s treatment?

5.2 Is there anything that helps how you make decisions in this process?

Give an example (e.g. diagnostic tools, people, special tests etc)

5.3 If there are cases where you need to ask for blood samples or urine samples to be sent to the laboratory for further testing, can you talk me through that process?

5.4 How often do you request this?

5.5 When you decide to send samples, why is this? Is there anything special with these cases? What makes you decide NOT to send samples to the laboratory?

5.6 Are there ever cases of suspected infection where you opt out of laboratory tests when you think you should send for tests? If so can you describe an example of the circumstances that may lead to the decision?

5.7 Let’s take a scenario that you are dealing with a patient where you send samples to the laboratory.

5.8 What do you do after you get the results from the laboratory?

5.9 Do you ever talk to the laboratory people about the results? Do you ask for their advice about what to do next?

If yes – give an example

If not – Why not? In your opinion, is there any benefit to talk to lab people about the results?

6. How do the lab results affect how you treat/prescribe/advise a patient?
6.1 What, if any, do the lab results enable you to do in your practice / in the treatment of patients? Give an example

AMR Learning Opportunities

6.2 What types of opportunities are there for clinicians to develop new skills and knowledge, for learning in this facility, especially about AMR?

6.3 In your opinion, how can capacity building in AMR be improved?

6.4 Global Antimicrobial Surveillance System (GLASS) encourages the use of data that is generated through samples and encourages improvement in the quality of the results at the local level. In your view, are there any gaps in this process?

7. Do you know if your facility is part of a wider AMR surveillance network in the country? How does your role fit in the facility’s surveillance system?

7.1 Have you had the chance to engage in any AMR related learning?

If yes, can you tell me about the course, where it took place, course content? Did include the use of technology, if yes which technology?

8. Are there any challenges you think you would encounter in offering learning using mobile phone?

9. Are there any challenges you think you would encounter in collecting AMR data using your mobile phone?

10. What if anything, do you like about your job?

mHealth Platform

As you are aware, this project intends to you use a mobile health platform to deliver AMR related learning.
11. Would you be willing to trial part of a module and provide feedback on whether you think it would be appropriate for health workers at this facility?

I will talk you through the functionality and then allow you some time to try the platform and then I will ask you some follow up questions.

12. What do you think about accessing learning on your phone, do you think it is an appropriate platform for accessing work-related learning?

13. Did you experience any challenges using the platform?

14. If this platform was to be used by health workers at this facility, can you talk me through any barriers you think health workers may face in accessing the platform?
   a. Do you think there maybe benefits to using a mobile learning platform to access work-related learning at this facility? If so, can you talk me through them?

15. Having used the platform, are there anyways in which you think the platform can be improved in terms of functionality and presentation of learning content?

16. What did you think of the content? (did you have any difficulties specific to the content)

17. Did you find the content relevant to your work?

18. Having used the platform, are there ways in which you think the content could be improved?

19. Do you have any further comments or questions relating to the platform?

20. Do you have any further comments or questions about the project?

Thank you for your time.
Appendix I - Interview Instrument nurses

Your role

1. What is your role in this facility?

2. Which ward do you work on?

3. Have you previously worked on a different ward? If yes, are there any notable differences in training or practice in the wards you have worked across?

4. What is your role in this facility? What is it that you do / what are your main responsibilities? Please describe 1-2 tasks you do on a daily basis.

   4.1 Who do you work with on this?

5. In your role, what difficulties related to AMR have you encountered if any?
   
   5.1 How do you go about addressing these difficulties? (draw on the same task)
   
   5.2 What worked? What didn’t? What enabled you to meet these challenges? If not yet, why?

AMR awareness in practice

6. Can you help me understand what happens once a patient arrives / describe the moment a patient walks into the hospital. What is the process you follow in this facility about treating this patient?

   6.1 What is your role in this process? What do you do?

   6.2 Who else is involved in this process?

   6.3 How many patients do you see in a day (on average)?

   6.4 To my understanding some patients arrive here and may have symptoms that may signal an infection (or not). Clinicians may request for samples to be sent to the lab, are you involved in this process? Can you tell me in what you are involved?
AMR Learning Opportunities

7. What types of opportunities are there for nurses to develop new skills and knowledge, for learning in this facility, especially about AMR?

7.1 In your opinion, how can capacity building in AMR be improved?

7.2 Do you know if your facility is part of a wider AMR surveillance network in the country? How does your role fit in the facility’s surveillance system?

7.3 Have you had the chance to engage in any AMR related learning?

   If yes, can you tell me about the course, where it took place, course content? Did include the use of technology, if yes which technology?

8. Are there any challenges you think you would encounter in offering learning using mobile phone?

9. Are there any challenges you think you would encounter in collecting AMR data using your mobile phone?

10. What if anything, do you like about your job?

mHealth Platform

As you are aware, this project intends to you use a mobile health platform to deliver AMR related learning.

8. Would you be willing to trial part of a module and provide feedback on whether you think it would be appropriate for health workers at this facility?

I will talk you through the functionality and then allow you some time to try the platform and then I will ask you some follow up questions.

9. What do you think about accessing learning on your phone, do you think it is an appropriate platform for accessing work-related learning?

10. Did you experience any challenges using the platform?
11. If this platform was to be used by health workers at this facility, can you talk me through any barriers you think health workers may face in accessing the platform?

10.1 Do you think there maybe benefits to using a mobile learning platform to access work-related learning at this facility? If so, can you talk me through them?

12. Having used the platform, are there anyways in which you think the platform can be improved in terms of functionality and presentation of learning content?

13. What did you think of the content? (did you have any difficulties specific to the content)

14. Did you find the content relevant to your work?

15. Having used the platform, are there ways in which you think the content could be improved?

16. Do you have any further comments or questions relating to the platform?

17. Do you have any further comments or questions about the project?

Thank you for your time.
Appendix J – mhealth platform feedback

1. What did you think about accessing learning on your phone, do you think it is an appropriate platform for accessing work-related learning?

2. Did you experience any challenges using the platform over the course of the module?

3. If this platform was to be used more widely by health workers at this facility, can you talk me through any barriers you think health workers may face in accessing the platform?

4. Do you think there maybe benefits to using a mobile learning platform to access work-related learning at this facility? If so, can you talk me through them?

5. Having used the platform, are there anyways in which you think the platform can be improved in terms of functionality and presentation of learning content?

6. What did you think of the content? (did you have any difficulties specific to the content)

7. Did you find the content relevant to your work?

8. Having used the platform, are there ways in which you think the content could be improved?

9. Do you have any further comments or questions relating to the platform?

10. Do you have any further comments or questions about the project?
Appendix K Coding relevant to section 7.2.5 titled AMR Knowledge

Imported data from NVIVO
Examples of course coding relevant to section 7.2.5 titled AMR and Knowledge

Nodes\Learning codes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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Below examples of data coded as clinical or lab practice

<Files\Survey 1 thematic analysis workbook> - § 7 references coded [2.87% Coverage]

Reference 1 - 0.47% Coverage
Good clinical practice

Reference 2 - 0.47% Coverage
Good laboratory clinical practice

Reference 3 - 0.17% Coverage
Certificate clinical management

Reference 4 - 0.37% Coverage
Medical laboratory upgrading

Reference 5 - 0.47% Coverage
Clinical medicine lectures

Reference 6 - 0.47% Coverage
Clinical medicine

Reference 7 - 0.47% Coverage

Clinical medicine

Nodes\AMR definition

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Below examples of data coded as semi-correct

Files\Survey 1 thematic analysis workbook> - § 12 references coded [5.58% Coverage]

Reference 1 - 0.47% Coverage

Antibiotics being ineffective against treatment or usage of antibiotics

Reference 2 - 0.46% Coverage

When an antibiotic fails to cure an infection for which it should be effective against

Reference 3 - 0.47% Coverage

When drugs are not able to treat a particular disease

Reference 4 - 0.47% Coverage

This is where individuals fail to respond to antibiotics treatment because they misused antibiotic drugs

Reference 5 - 0.47% Coverage

It comes about due to long term use of antibiotics or even abuse causing resistance to antibiotic medication

Reference 6 - 0.47% Coverage

Its frequent use of antibiotics resulting to infectiveness when used.
Appendix L – Transcript extract

Whilst initial coding data examples were provided in section 6.12.3, this extract from a transcript has been provided to demonstrate how themes generated following coding were relevant to data as data were revisited and codes and subsequent themes were developed iteratively.

COFTB16
We don’t have but it is sent to [county 1] for culture [Theme: Lab capacity]  
INTERVIEWER
So can you talk me through, if a patient comes in with suspected MDR TB, can you talk me through the process of admitting them and then what happens with the samples?  
COFTB16
When there is one detected from any county, it is that county TB or chest clinic department to call out facility and the person is driven in by their ambulance. They don’t travel on public. So we are prepared, the patient so and so is coming from which county. So we prepare a bed for him or her and we wait to receive the patient. Its just like a transfer, they don’t come on their own.[data informed mapping patient journeys section 8.3.3] [Theme: Feeder facility]  
INTERVIEWER
I understand. So those facilities would have already drawn samples and checked for resistance and then decided that the patient has MDR TB?  
COFTB16
Actually, TB Gene Xpert will just tell them its drug resistant if it is one. When they put in the machine. The machine will just say this person is resistant or is not resistant so that’s why [Theme: AMR data and learning]  

INTERVIEWER
Okay, so that happens at the other facilities. If it is resistant they send to this facility. What’s particularly different about having a TB Ward that looks at MDR  
COFTB16
Yeah because in MDR you know it is um, the patient in that ward is being reviewed by the
MoH chest clinic, it’s a team of people who comes to review it and I think there is a sponsorship that takes care of all the samples taken for culture or what not even here in [County] but sent to county 1 and county 2. [Theme: UHC] [Theme: Collaboration]

INTERVIEWER
Okay, and the team that comes to review would be a mix of NGO and MoH?

COFTB16
Yeah MoH and it is the NGO doctors and the nurses who work there everyday, but this team just comes on a major ward round. Like they can come twice in a week so the NGO staff are left to give the medication, give food, clean the place you know, everything done by NGO staff [Theme: Collaboration]
Dear [Name],

This message confirms that the research protocol for the following research project, as submitted for ethics review, has been given a favourable opinion on behalf of The Open University Human Research Ethics Committee.

Project title: How do health professionals learn to tackle AMR in Kenya? (Phase 1)

HREC approval date: 14/03/2021

As part of your favourable opinion, it is essential that you are aware of and comply with the following:

1. You are responsible for notifying the HREC immediately if any information received by you, or of which you become aware, which would cast doubt on, or alter, information in your original application, in order to ensure your continued safety and the good conduct of the research.

2. It is essential that you contact the HREC with any proposed amendments to your research, for example - a change in location or participants. HREC agreement needs to be in place before any changes are implemented, except only in cases of emergency when the welfare of the participant or researcher is or may be affected. If you need to amend your project, please complete the amendment to research project summary form which can be found on the HREC website.

3. Your HREC reference number has to be included in any publicity or correspondence related to your research, e.g. when seeking participants or advertising your research, so it is clear that it has been agreed by the HREC and adheres to OU ethics review processes.

4. Researchers should have discussed any project-related issue with their Line Manager and/or Supervisor, to ensure that all the relevant checks have been made and permissions are in place, prior to a project commencing, for example compliance with IT security and Data protection regulations.

5. Researchers need to have read and adhere to relevant OU policies and guidance, in particular the Ethics Principles for Research with Human Participants and the Code of Practice for Research - http://www.open.ac.uk/research/hippomeman/policies

6. The Open University's research ethics review procedures are fully compliant with the majority of research council, professional organisations and grant awarding bodies research ethics guidelines. Where required, this message is evidence of OU HREC support and can be included in an external research ethics review application. The HREC should be sent a copy of any external applications, and their outcome, so we have a full ethics review record.

7. All the end of your project, you are required to submit a final report to HREC. The purpose of the final report is to ensure OU research is being carried out as agreed; assess how any additional ethics-related issues have been dealt with if they have arisen, and to inform the development of the ethics review process to ensure a continued high level of review. The final report template can be found on the HREC website.

Sent on behalf of the Human Research Ethics Committee

Dr Claire Hewton  
Chair

Dr Duncan Banks  
Deputy Chair

Dr Alison Fox  
Deputy Chair
Appendix N - Ethics Approval AMREF & Required Ethics Certification

REF: AMREF – ESRC P1015/2021

Natalie Tegana
The Open University
Walton Hall, Kents Hill, Milton Keynes MK7 6AA
United Kingdom
Tel: +44
Email:

Dear Natalie Tegana,

RESEARCH PROTOCOL: HOW DO PROFESSIONALS IN KENYAN HEALTHCARE FACILITIES LEARN TO TACKLE ANTIMICROBIAL RESISTANCE.

Thank you for submitting your protocol to the Amref Ethics and Scientific Review Committee (ESRC).

This is to inform you that the ESRC has reviewed and approved your protocol. Your application approval number is ESRC P1015-2021. The approval period is from January 7, 2022 to January 6, 2023, and is subject to compliance with the following requirements:

a) Only approved documents (including informed consents, study instruments, advertising materials, material transfer agreements etc.) will be used.
b) All changes including amendments, deviations, violations etc., are submitted for review and approval by Amref ESRC before implementation.
c) Death and life-threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the Amref ESRC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to Amref ESRC within 72 hours.
e) Clearance for export of biological specimens must be obtained from the relevant government authorities for each batch of shipment/exports.
f) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
g) In case of late renewal, the Amref ESRC shall not be held responsible for any severe adverse events (SAEs) that may occur as a result of research activities that were carried out after the expiry of approval.
h) Submission of an executive summary report within 90 days upon completion of the study to the Amref ESRC.
i) All government regulations for prevention and control of the spread of COVID-19 including social distancing, provision of personal protective equipment for participants and research assistants should be adhered to during data collection. All research assistants should be monitored for COVID 19 symptoms and referred for testing in case they present with symptoms.
Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Please do not hesitate to contact the ESRC Secretariat (esrc.kenya@amref.org) for any clarification or query.

Chair,

CC: Samuel Mahala, Monitoring & Evaluation and Research Manager, Amref Health Africa in Kenya.