


# Addressing antibiotic use:

## insights from social science around the world

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AMIS
FRESH APPROACHES *to the* STUDY *of* ANTIMICROBIALS *in* SOCIETY

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# Contributors

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# Summary

Antimicrobial resistance (AMR) is a major threat to global health and economies, the harmful effects of which are disproportionately experienced by those living in Low- and Middle-Income Countries (LMICs). Tackling this complex problem requires multidisciplinary and multisectoral responses. In the last few years, there has been a growing acknowledgement of the vital role of social science in understanding and intervening on antibiotic use, a key driver of AMR. Existing reviews summarise evidence of specific aspects of antibiotic use and specific intervention types. The growing concern that our off-the-shelf toolkit for addressing antibiotic use is insufficient in the face of rising use across humans, animals and plants, requires that we take a fresh look at the ways we are understanding this problem and possibilities for solutions. The ambition of this report is to provide a timely intervention into this global debate, by formulating a conceptual map of the insights from the growing body of social science research on addressing antibiotic use conducted in a diverse range of economic, social, and health system settings around the world.

A series of panel presentations and discussions was held in 2020 with leading social scientists working on antibiotic use in different settings. Analysis of the proceedings of these panels, together with a literature review which snowballed from the work of the 76 researchers profiled through the antimicrobialsinsociety.org community of practice, led to a grouping of the key points of entry for recommendations to act on antibiotic use.

**The report identifies three main areas of focus of social science recommendations to address antibiotic use:**

- The **Practices** grouping, in which the majority of the social research on antibiotic use has been carried out over the years, focuses on addressing end user antibiotic use. It shows how scholarship has moved away from knowledge deficit models to embracing an 'ecological' approach and to considering practice as embedded in lives and livelihoods. This body of work emphasizes the centrality of the local context to identify possible targets for intervening to change practice.

- The **Structures** grouping assembles the growing body of work that understands antibiotic use as a product of economic and political conditions. This research draws from political economical perspectives to identify the ways antibiotics have taken on critical roles in modern societies. Based on research investigating water, hygiene, sanitation (WASH), health systems and the political economy, the report considers how interventions that target these societal structures might reduce recourse to antibiotics as a 'quick fix'.

- The **Networks** grouping collates recent work that draws attention to the mundane networks of logics, classifications and flows within which antibiotics are entangled. Research exploring agricultural and development imperatives, global health architectures, and circulating discourses has revealed the material and meaningful connections between human and non-human actors – animals, medicines, microbes, technologies, for example – that extend through time and space far beyond the moment of antibiotic use. These studies help render visible for action the apparatus such as clinical guidelines, delivery chains and models of care that have previously been overlooked when studying and addressing antibiotic use.

The domains for action on antibiotic use presented in this report raise important questions for the AMR community. First, how can we move from standardised approaches to developing, refining, and monitoring impacts of interventions locally? Second, what time horizons should we set for interventions that aim to address AMR, and what other impacts should we expect of efforts to optimise antibiotic use? Third, what forms of evidence are most relevant, and what professional and infrastructural investment is required for this to support meaningful and responsive evaluation? The analysis in this report suggests new forms of transnational and intranational engagements to address this pressing bio-social-political issue could provide a platform for widening the options for addressing antibiotic use and its associated challenges.

# Introduction

*"Drug-resistant diseases already cause at least 700,000 deaths globally a year, including 230,000 deaths from multidrug-resistant tuberculosis, a figure that could increase to 10 million deaths globally per year by 2050 under the most alarming scenario if no action is taken".*

**Interagency Coordination Group on Antimicrobial Resistance 2019 (p.1)**

*"Huge quantities of antimicrobials, in particular antibiotics, are wasted globally on patients and animals who do not need them, while others who need them do not have access. Fundamental change is required in the way that antibiotics are consumed and prescribed, to preserve the usefulness of existing products for longer and to reduce the urgency of discovering new ones"*

**Lord Jim O'Neill, 2016 (p.4)**

*"The mechanisms which lead to antimicrobial resistance are biological. However the conditions promoting, or militating against, these biological mechanisms are profoundly social. How our farmers, vets, and regulatory systems manage livestock production for human consumption; how regulatory and fiscal frameworks incentivise or deter antimicrobial development, production and use; how the public and healthcare professionals understand, value and use antimicrobials; the context in which animals and humans interact; the ways in which particular groups of humans are exposed to particular microbial infections; all these are shaped by social, cultural, political and economic forces."*

**Professor Dame Sally Macintyre, 2014 (p.1)**

**Antimicrobial resistance** (AMR) is a global threat to public health that has been increasingly recognised as a biosocial phenomenon requiring input from the social sciences, alongside biological and clinical sciences (Smith, 2015, WHO, 2015). Research funders have been proactive in developing specialist funding streams and initiatives to bring more social scientists into this field (Lambert, 2015) and into conversation with scientists from other disciplines (Tarrant, 2017). In the UK, these efforts were catalysed by the Economic and Social Research Council-appointed AMR Champion Helen Lambert, to foster research agenda-setting activities and an understanding of how the theoretical and methodological approaches across the social sciences can be applied to further our understanding of AMR and antibiotic use (Chandler and Hutchison, 2016, University of Bristol, 2016, Wood, 2016). One programme of work emergent from this effort was the Antimicrobials In Society Hub, one of seven consortium grants funded by Theme 4 of the UK Research and Innovation (UKRI) cross-council initiative on tackling AMR,[1] 'Behaviour within and beyond the healthcare setting' (see Box 1).

[1] https://mrc.ukri.org/research/initiatives/antimicrobial-resistance/tackling-amr-a-cross-council-initiative/

**Box 1. Antimicrobials in Society**

**The Antimicrobials in Society** (AMIS) programme (2017-2021) sought to develop and promote fresh perspectives to social studies of AMR. In addition to running empirical research programmes in Uganda and Thailand, the programme set up the AMIS Hub as a connecting platform for social researchers working on AMR. The AMIS Hub ran a 2018 symposium at the Royal Academy in London with participants representing over 40 countries[2].

The monthly newsletter has highlighted activity in the field and the website[3] connects and promotes the work of social scientists working on AMR across human and animal health and around the world. The website also provides a curated library of essential social research readings with accessible summaries aimed at introducing those designing and implementing AMR policy as well as funders and researchers from the life sciences to social science insights.

In the short time since the UKRI and other funders around the world began to invest in social research on AMR, there has been a significant increase in activity including research publications. Lu et al. (2020) traced how the number of social science publications in this area has grown rapidly (Figure 1), with the latter two years seeing an increase in the numbers of publications from researchers based in Asia and Africa. As a proportion of the total volume of AMR research, however, two bibliometric analyses have shown that social science publications still make up a small minority (Frid-Nielsen et al., 2019, Haenssgen et al., 2018b), illustrating the continued dominance of the biomedical sciences in this field.

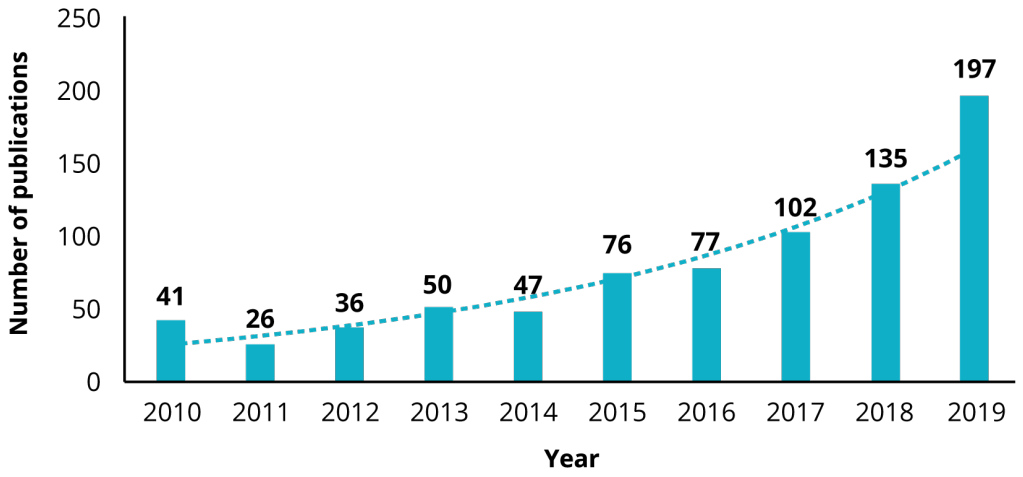


**Figure 1 Number of antimicrobials social science research publications in the last decade. Reproduced from Lu et al. (2020) under the terms of a Creative Commons Attribution 4.0 International Licence)**

[2] An abstract book, proceedings and videos from the Social Science and AMR symposium can be found here: https://antimicrobialsinsociety.org/commentary/symposium/

[3] www.antimicrobialsinsociety.org

We now face the welcome challenge to synthesise and provide orientation around the findings from social research on AMR (Vedadhir et al., 2020). The field has expanded in multiple directions, with innovative and informative studies that have focused on medicines, microbes, patients, animals, care providers, policies, and much more. To capture the depth of this research, synthesis will require segmenting the field, for example by disciplinary or topic dimensions. The reasons for antibiotic use in particular patient groups or particular health sectors warrant their own in-depth reviews. The effects of particular types of intervention on AMR, and antibiotic use, have already led to a large number of systematic reviews and better understanding effects will require further collaborative efforts (Wernli et al., 2020).

In this report, we respond to the need for a birds-eye conceptual map that captures the breadth of insights from the growing body of social science research. Some of the impressive contributions of arts and humanities research to inform efforts to address AMR has recently been nicely summarised, highlighting how such scholarship can help to challenge circulating assumptions, offering novel ways to think, see, understand and present the phenomenon of AMR (Macduff, 2020). A policy brief for WHO-Europe describes how understanding the cultural dimensions of antibiotic use and AMR transmission is critical in addressing AMR (Ledingham et al., 2019). In this report, we focus specifically on the topic of antibiotic use, and the types of insights for action that have emerged from social research.

> **In this report, we respond to the need for a birds-eye conceptual map that captures the breadth of insights from the growing body of social science research**

A variety of fresh perspectives from social theory have been applied across multiple settings around the globe to the topic of antibiotic use. The increasing number of excellent research studies have explored and explained different aspects of antibiotic use, drawing on disciplines that include anthropology, sociology, geography, history, philosophy, economics, psychology and design. These studies present insights into the ways that societies – and constituent groupings and architectures – use antibiotic medicines.

Each provides ideas for response, in policy, programme or pilot form. The momentum for action on AMR at a global and national level has generated strong interest in the drivers of antibiotic use, and in 'what to do'. The growing concern that our off-the-shelf toolkit for addressing antibiotic use is insufficient in the face of rising use across humans, animals and plants, is met in this report with a fresh look at the ways we are understanding this problem and possibilities for solutions. Intervention studies, and implementation research within policy and programme roll-out, are on the rise. This is a critical moment to join together insights from across the many social research projects that have generated new evidence and ideas in recent years, to inform the development of pilots, policy and programmes on antibiotic use (Minssen et al., 2020).

The ambition of this report is to provide a timely intervention to the global debate on how to address antibiotic use, by formulating a conceptual map of the insights of social science research. The report is intended to be usable by a range of actors within and beyond the AMR research, policy and programmes communities.

# Methods

The development of this report was a collaborative process within the AMR Social Science community. In mid-2020 an advisory committee was established from amongst researchers listed on the AMIS website[4] to work towards a report and launch event in February 2021. The group agreed on themes and proposed speakers for a series of four online panels designed to provide an overview of antibiotic use research and its implications for practice (Box 2). Presenters were invited on the basis of their research locations in low-, middle- and high-income countries, with both human and animal health foci.

**Box 2. 2020 Panels on Antibiotic Use Social Research**

**Panel One:**

**Antibiotics as Care: health facility based**

- Alex Broom, University of Sydney
- Paula Saukko, Loughborough University
- Justin Dixon, London School of Hygiene and Tropical Medicine
- Esmita Charani, Imperial College London

**Panel Two:**

**Antibiotics beyond health facilities: care, pharmaceuticals and markets**

- Papreen Nahar, University of Sussex
- Marco Haenssgen, University of Warwick
- Susan Nayiga, Infectious Diseases Research Collaboration, Kampala
- Mark Davis, Monash University
- Helen Lambert, University of Bristol

**Panel Three:**

**Antibiotics beyond humans: ecologies, production**

- Stephen Hinchliffe, University of Exeter
- Claas Kirchhelle, University College Dublin
- Salla Sariola, University of Helsinki
- Rijul Kochhar, Massachusetts Institute of Technology

**Panel Four:**

**Antibiotic science, technology and infrastructures**

- Charlotte Brives, University of Bordeaux
- Komatra Chuengsatiansup, Princess Maha Chakri Siridhorn Anthropology Centre
- Catherine Will, University of Sussex
- Nik Brown, University of York

[4] www.antimicrobialsinsociety.org

Each panel comprised four speakers and a panel discussion chaired by either Clare Chandler (London School of Hygiene and Tropical Medicine) or Helen Lambert (University of Bristol) to draw out implications for research, policy and practice from across presentations. [5] Written summaries of the panels were prepared for analysis. An online survey was also circulated through the AMIS newsletter and advertised at the panel sessions. This provided academics beyond the 16 presenters with an opportunity to share their research, especially unpublished work or projects in progress, and the practical implications of their work. To complement the panel discussions and survey, the publication lists of members of the AMIS online community were searched for relevant outputs.

Data sources were uploaded into NVIVO 12 (QSR International Pty Ltd, USA) and thematically coded. Emerging themes were refined following their presentation at a meeting with a small cohort of advisory committee members. A draft report was then written and circulated to the full advisory committee members for their contributions.

The report's targeted approach in data collection is not intended to replace more systematic efforts to identify, map and synthesise the social science literature on AMR (Lu et al., 2020, Vedadhir et al., 2020). Furthermore, it does not seek to supplant existing reviews of antibiotic practices such as Aslam et al. (2020), meta-ethnographies synthesising qualitative insights such as Germeni et al. (2018), or reviews evaluating interventions, for example, McParland et al. (2018), Tonkin-Crine et al. (2017) and Wilkinson et al. (2018). Rather, it seeks to offer a conceptual map through which we might approach different ways to understand and address antibiotic use based on insights from socially informed research.

The core writing team were English speakers based in the UK, which limited the data sources consulted. We note that much of the cited literature has a first author based in the Global North. This presents illustration of the uncomfortable situation of initiatives – including research – on antibiotic use originating in the Global North, discussing challenges occurring in the Global South (Haenssgen et al., 2020a, Kirchhelle et al., 2020).

[5] Recordings and short summaries of the panel series are available online (https://antimicrobialsinsociety.org/events/antibiotics-in-societies-panel-series-2020/).

# Results

The report is organised into three sections that serve to group the field into three areas of focus: Practices, Structures and Networks.

Figure 2 illustrates these three overlapping fields that were chosen over the subject-based panel themes as they offered a greater means for harmonising insights across studies.[6] Appendix one provides a summary of the studies referred to in the preparation of this report, describing their settings, insights regarding antibiotic use and recommendations for practice.

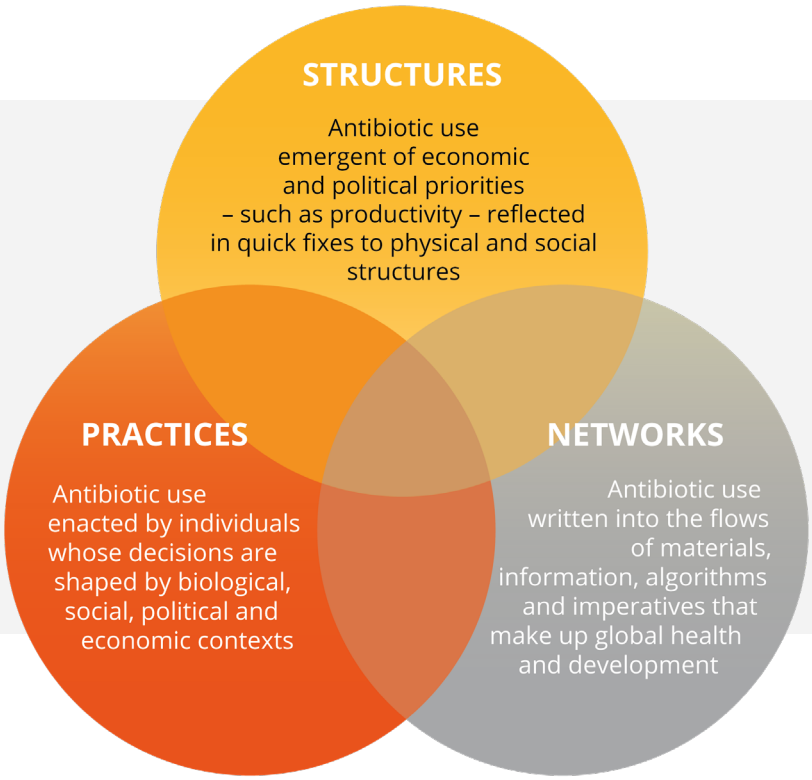


**Figure 2 The three overlapping areas of social science focus when studying antibiotic use**

[6] https://antimicrobialsinsociety.org/commentary/addressing-antibiotic-use-report-launch-roundtable-event/


## PRACTICES

**A major achievement in AMR social research has been the production of a large body of work that characterises how antibiotics are used in practice by patients, farmers, drug sellers, clinicians and others.**

Key themes in this body of work are that antibiotic use does not primarily result from a deficit in knowledge about AMR but rather is related to a web of social, economic, political and historical conditions. Therefore, modifying antibiotic use requires addressing these wider issues in order to support change in practice.

## Knowledge deficit models

While there are information challenges for many end users of medicines regarding which antibiotics to use, and the specific antimicrobial sensitivity profiles for local pathogens (Pearson et al., 2018), the knowledge gap often assumed to be most important to address is a lack of understanding of drug resistance, which is thought to undermine appropriate use of medicines. A theme in common across the social science literature on AMR has been the observation that knowledge of resistance is insufficient to change antibiotic use practices.

Social researchers note a tension between the focus of policies on raising awareness of AMR and the realities of antibiotic use (Lambert et al., 2019, Rodrigues, 2020). Analysis of AMR policy – such as the WHO's Global Action Plan (WHO, 2015) and the UK's review on AMR (O'Neill, 2016) – however suggests a persisting premise that 'inappropriate' antibiotic use can be reduced through raising awareness of the dangers of AMR, thereby triggering more prudent prescription, sale and consumption of antibiotics. Table 1 illustrates how, across settings and contexts, researchers have shown that the reasons for using antibiotics are not primarily linked to a knowledge deficit about the consequences for AMR of their overuse. Rather, this body of works points to multiple factors that shape antibiotic use.

Social scientists have highlighted that increased awareness of AMR does not neatly translate into predictable changes in beliefs or antibiotic use (Charani et al., 2019, Haenssgen et al., 2019b, Lambert et al., 2019). Perhaps counterintuitively, research with medical and veterinary practitioners from six countries in the global south found awareness of AMR translated in more ready use of next-line antibiotics (Pearson and Chandler, 2019). A systematic review of interventions seeking to improve AMR awareness and behaviours in the general public found the quality of evidence to be poor, largely based in high-income countries, with more well-designed, experimental studies needed (Price et al., 2018). In terms of infection prevention, social scientists have also questioned the efficacy of hand washing and hygiene knowledge and awareness campaigns, the effects of which have been found to be mixed and sometimes transient (Denyer Willis and Chandler, 2019, Pinto et al., 2020).

**Table 1: Reasons for using antibiotics, other than knowledge deficits extracted from social science studies listed in appendix one**

**Hospital settings (Australia, India, Sri Lanka, UK)**

| | |
|---|---|
| The role of hierarchy, communication and prescribing etiquette between staff. | High workloads resulting in rushed/ less collaborative decision making |
| Professional reputation management and risk mitigation. | Within the private sector, the influence of business models and imperative to make a profit. |
| Delayed treatment seeking by patients concerned about the cost/ hospitalisation. | The role of the pharmaceutical sector and their representatives in shaping prescribing 'norms'. |
| Lack of an effective primary care system resulting in patients being gravely unwell on admittance. | The role of insurance companies in setting 'appropriate' care thresholds. |
| Communication barriers between patients and hospital staff. | Overcrowding and limited ability to follow infection control procedures. |
| Diagnostic uncertainty and the lack of accessible local AMR data. | Outdated but ingrained prescribing practices. |

**Community settings (Australia, Bangladesh, China, India, Laos, Mozambique, Myanmar, South Africa, Thailand, Vietnam)**

**General public**

Inaccessibility of affordable formal primary care and the necessity of self-care.

The unaffordability of taking time off work to attend healthcare or to be unwell.

Necessity to be well enough to care for family and/or livestock.

The role of family and other community members in co-producing treatment seeking behaviour and appropriate antibiotic use.

The social roles of antibiotics beyond their biomedical characteristics.

**Primary care**

Lack of time to fully discuss the patient's health and causes of ill health.

Concern about the patient's ability to return in case their condition deteriorates.

Limited affordable treatment options available.

Professional reputation and managing the risk of complaints.

Perceived patient pressure to prescribe.

Outdated but ingrained prescribing practices.

Diagnostic uncertainty and the lack of accessible local AMR data.

**Pharmacy, drug stores**

Business models and the need to keep customers.

Helping those who cannot afford to remain sick for long time or cannot afford other treatment.

Circulation of fake prescriptions.

The role of the pharmaceutical sector and their representatives in shaping prescribing 'norms'.

Limited access to training/ appropriate use information.

Lack of regulatory oversight and/or monitoring.

Perceived client demand.

**Agricultural and aquaculture setting (Bangladesh, Guatemala, India, France, UK)**

Protecting investment in livestock and livelihoods.

Inaccessibility of affordable formal veterinary care.

Business models and the need to keep customers satisfied.

Professional reputation and managing the risk of complaints.

Role of the pharmaceutical sector and their representatives in shaping prescribing 'norms'.

Disease outbreaks caused by weather events and living conditions

Haenssgen et al. (2018b) and (Charoenboon et al., 2019) evaluated an educational scheme based on locally-adapted WHO-derived antibiotic information in villages in PDR Laos and Thailand respectively. Rather than seeking to convince lay people that their behaviour was wrong, the scheme aimed at raising awareness and developing an understanding of local people's conceptions and behaviour. Despite spending time and resources on tailoring the activities to local context, both studies found that there was a very limited effect on behaviour. Careful mixed-methods evaluation found that the intervention had a number of unintended consequences, possibly inadvertently increasing antibiotic use and marginalising less privileged groups through their lesser availability to participate in the scheme.

These findings add to the growing body of doubts about the preoccupation with awareness raising when tackling AMR (Haenssgen et al., 2018b). Charoenboon et al. (2019) concluded that alternative behaviour change approaches are needed that address contextual constraints such as precarity and lack of social support rather than perceived knowledge deficits.

Reaching a correct biomedical diagnosis is often positioned as a central step in achieving 'appropriate' antibiotic use (O'Neill, 2016). Through the lens of knowledge deficits, diagnostic tests are seen as providing a mechanism to correct misjudgement of patients, carers and/or prescribers. As a consequence, the role of clinical or veterinary expertise and acumen are downplayed. Social science informed studies have questioned this framing, showing that diagnosis entails the collation and interpretation of different strands of knowledge, signs and symbols (Buller et al., 2020, Helliwell et al., 2019). It also is an emotive, relational process involving different groups of healthcare (or veterinary) practitioners and patients and their carers (Khine Zaw et al., 2018, Saukko et al., 2019, Saukko and Rousham, 2020) and their context (Haenssgen et al., 2019a). The frontline insights provided by these studies illustrate how, rather than replacing these forms of work, diagnostic test information adds another strand. Given this, introducing a diagnostic test to correct antibiotic use may have limited or unintended consequences.

The AMR field might be understood to have inherited a preoccupation with the knowledge deficit model, which is common across public health and global health (Will, 2018). Social scientists have suggested that initiatives that seek to change people's practices through increasing their awareness of risks can fall into the trap of assuming an 'empty vessel' – a perceived as ignorant so that a top-up of knowledge will set in motion behavioural change (Khan et al., 2019, Lambert et al., 2019).

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This not only ignores pre-existing understandings but assumes that populations who are the focus of such awareness-raising initiatives always have the ability to choose their behaviour and prioritise changing antibiotic use over other interests (Broom et al., 2017, Chandler, 2019, Haenssgen et al., 2018a). The limitations of knowledge deficit models have long been acknowledged in the behaviour change (Dolan et al., 2010, Kollmuss and Agyeman, 2002) and health communication (Cho and Salmon, 2007) literatures, so why do they continue to form such a central part to our response to antibiotic use? Such models align with discourses that situate risk with citizens rather than requiring the state to intervene (Chandler, 2019).

They also reflect the primary emphasis on individual actors in Western thought (Broom et al., 2020a), and the popularity of Knowledge Awareness Practice (KAP) surveys as tools to measure awareness from which our understanding of antibiotic use is largely derived (Haenssgen et al., 2020a). Public discourse analysis has identified how awareness campaigns entangle people in conflicting messages of taking responsibility for their health, whilst urging them to trust healthcare practitioners to act in their best interests; this is a possible explanation for the limited impact of such interventions (Lohm et al., 2020, Davis et al., 2020b).

## Ecological models

Social scientists have emphasized the breadth of behaviour change models, beyond simple dissemination of training or information, and the diversity of vantage points offered by the social science disciplines when seeking to address antibiotic use (Lambert, 2019, Lorencatto et al., 2018, Will, 2018). For example, Krockow et al. (2019) used the health beliefs model – which suggests that antibiotic use can be explained by people's beliefs about ill health, perceived benefits and barriers to action and their self-efficacy – as an analytical framework when synthesising qualitative evidence on antibiotic use in hospitals. Based on this,

the need for interventions that manage the risk associated with decisions not to prescribe were identified, for example through organisational protection from personal litigation.

Ecological models seek to frame behaviour in a wider context – recognising the close links between health and the socio-physical environment to help identify behavioural and institutional targets in order to change behaviour (Grzywacz and Fuqua, 2000). Much research on antibiotic use practices aligns with this perspective, focusing on the interaction between the social environment and decision making (Charani and Holmes, 2019, Haenssgen et al., 2019b).

*Photo credit: Roengit, Society and Health Institute, Ministry of Health, Thailand.*

Wang et al. (2020) used the Socio-Ecological Model as a framework to investigate antibiotic dispensing without a prescription by pharmacies in China at intrapersonal, interpersonal, institutional and policy levels. Having identified the role of patient demand, the need to ensure economic survival, competition with other pharmacies, the use of fake prescriptions and the minimal consequences of providing antibiotics without prescription, they recommended standardised prescriptions, tracking of antibiotic sales data, and tighter regulations with higher fines for pharmacies contravening them – in addition to public education programmes.

Antibiotic stewardship interventions – typically those in healthcare settings in the Global North – have been informed by behaviour change models including the Behaviour Change Wheel, which uses the COM-B (capability, opportunity, motivation and behaviour) model (Michie et al., 2011) to summarise the individual, socio-cultural, and environmental influences on behaviour (Lorencatto et al., 2018, PHE, 2015, Thompson et al., 2020). Work in progress is using this model to develop policy recommendations based on insights from interviews with householders, drug shop staff and pharmaceutical company representatives in Bangladesh (Nahar, personal communication) and from a mixed methods study conducted in pharmacies, village clinics and township health centres in Anhui province, China (Zhao et al., 2019).

> **“ Ecological models seek to frame behaviour in a wider context – recognising the close links between health and the socio-physical environment to help identify behavioural and institutional targets in order to change behaviour**

In recent years, behavioural economics approaches – which seek to nudge individuals into behaviour change through targeting their automatic and reflective decision making – have gained popularity (Will, 2020b). Nudging the systems in which antibiotic use decisions are made has been proposed as a cost-effective means to alter antibiotic use as these approaches do not require investment in staffing or new technologies (PHE, 2015). Such nudges might include prescribing checklists so that clinicians do not relying on mental shortcuts that result in ‘inappropriate’ antibiotic use (Langford et al., 2020).

Even with this broader understanding of behaviour, questions remain about whether these frameworks sufficiently describe the dynamics of antibiotic use (Charani and Holmes, 2019, Will, 2018). Social research methods can provide a fuller picture by enabling the study of collectively produced understandings of illness, health and medicines use, for example (Lambert et al., 2019).

## Lives and livelihoods models

Many researchers have illustrated the importance of understanding and responding to the everyday lives and livelihoods of those whose antibiotic use behaviour is of concern. Here, researchers question that antibiotic use is 'irrational', and rather propose that given the economic and cultural situations people are living and working in, current practices may better be understood as 'rational.' By attending to everyday realities in the cultural contexts of use (Ledingham et al., 2019), researchers try to identify potential leverage points for those seeking to modify antibiotic use, beyond communicating about 'appropriate' antibiotic use (Will and Kamenshchikova, 2020).

Building on previous ethnographic work on antibiotics from around the world (for example Craig, 2002, Nichter, 2001, Adome et al., 1996), a wealth of empirical cases is now available that describes how antibiotic use practices relate to lives and livelihoods in a range of settings. For example, within primary care in rural China (Chen et al., 2020, Lambert et al., 2019) and South Africa (Manderson, 2020); public and private hospitals in India (Broom and Doron, 2020, Broom et al., 2020b); community settings in Mozambique (Rodrigues, 2020), Bangladesh (Lucas et al., 2019, Nahar et al., 2020b) and Myanmar (Khine Zaw et al., 2021). Published studies have also explored antibiotic use in Bangladeshi aquaculture (Hinchliffe et al., 2018, Hinchliffe et al., 2020) and small holder poultry production (Masud et al., 2020); dairy farmers in India (Chauhan et al., 2018); and poultry farming in rural Guatemala (Snively-Martinez, 2019).

> **Studies of medicines use illustrate the vital importance of self-care practices and informal healthcare systems to provide access to antibiotics and to alleviating suffering in settings underserved by formal veterinary and medical services**

A range of methodologies and theories from social research have helped develop our understanding of people's treatment seeking behaviour beyond a dichotomy of antibiotic use (yes/no) to include self-care, consulting a sequence of practitioners and drawing on multiple health systems. Haenssgen et al. (2018a) developed the activity space framework to support such conceptualisation of microlevel antibiotic use beyond individuals' awareness and free choice. Rodrigues (2020) described the socioeconomic and therapeutic landscapes in which people make self-medication decisions in Maputo, Mozambique. In India, Chauhan et al. (2018) traced the biography of antibiotics as they moved through formal and informal routes into smallholder dairy farms. In Bangladesh, the PAUSE project explored the plural pathways by which households accessed antibiotics for themselves and their animals (Lucas et al., 2019). They found that a lack of regulatory infrastructure, perceived consumers demand, and medical pluralism played a part in 'inappropriate' antibiotic use by both qualified and unqualified healthcare providers (Nahar et al., 2020b). This project draws upon the idea of medicines having 'social lives' (Whyte et al., 2002) to unfold how antibiotics eventually destined for human and animal consumption move through society taking on roles beyond their biomedical characteristics (Nahar et al., 2019). Recognising that medicines are social actors with their own materialities – physical characteristics extending beyond their antibiotic characteristics – is a currently underutilised avenue to support the identification of alternatives to antibiotics (Jamie and Sharples, 2020).

Together these, and other, studies of medicines use illustrate the vital importance of self-care practices and informal healthcare systems to provide access to antibiotics and to alleviating suffering in settings underserved by formal veterinary and medical services. They indicate that engagement with plural health systems and informal providers by stewardship initiatives is necessary to ensure safe, accessible routes to antibiotics (Nahar et al., 2020a). This may necessitate novel responses beyond the regulatory approaches developed in the Global North, characterised by dominant formal, biomedical health and veterinary systems (Kirchhelle et al., 2020). These studies also indicate that to improve intervention effectiveness, social science methods and theories can be drawn upon in order to develop a nuanced and sympathetic understanding of healthcare seeking behaviour and medicine use.

Another reoccurring theme across studies is using antibiotic use as a means of attempting to manage uncertainty under precarious conditions. For example, precautionary prescribing practices may be encouraged by fears of cross-infection in clinics lacking sanitation, or concerns that patients will not – or cannot afford to – return follow-up appointments (Manderson, 2020, Pearson and Chandler, 2019).

Based on observations and stakeholder interviews, Krockow and Tarrant (2019) compared how culture and the unique hospital environment in three countries – South Africa, Sri Lanka and the UK – combined to produce localised forms of prescribing dilemmas regarding antibiotic use. For example, in Sri Lanka a lack of accessible primary care, worries about missing work and loss of income resulted in patients being sicker on admission to hospital, limiting clinicians' ability to enact conservative prescribing. In a linked paper, they concluded that antibiotic prescribing decisions involve dealing with doubt, and interventions could look at providing more support for prescribers in how to manage this uncertainty (Tarrant et al., 2020).

*Photo credit: Roengit, Society and Health Institute, Ministry of Health, Thailand.*

> **Given the role antibiotics have in alleviating suffering, a starting point of equipping communities with the information they need to meet their healthcare requirements, rather than seeking to protect antibiotics from misuse, should be considered**

In their ethnographic study, Chen et al. (2020) described how antibiotic prescribing decisions in rural China encountered a complex and unpredictable environment including a lack of material resources, diagnostic uncertainty, changing healthcare policies and the necessity to engage in 'safe practice'. The circulation of sub-standard or fake medicines also means that prescribers and patients cannot rely on them to have standard effect, causing them to deviate from prescribing protocols to maximise the chances for positive outcome (Broom et al., 2019). Based on research conducted in Bangladesh, Hinchliffe et al. (2020) developed the concept of 'risk-practices' to help identify opportunities to intervene by reducing risk of disease in food production and to avoid a one-size-fits-all response to optimising antibiotic use based on norms derived from the Global North.

Through careful evaluation, they demonstrated that – by failing to understand local risk profiles derived from economic and ecological conditions – a stewardship intervention inadvertently caused increased reliance on antibiotic use (Hinchliffe et al., 2020).

Within and beyond these examples, market drivers and economic imperatives shaping forms of 'appropriate' care and antibiotic use have been observed in a number of health and veterinary settings (Broom et al., 2018, Hinchliffe et al., 2018, Kirchhelle, 2018). In Bangladesh, Masud et al. (2020) documented the dependency of small-scale poultry producers on credit from poultry dealers who supply chicks, feed and antibiotics. Echoing the findings of Chen et al. (2020), they found social and economic capital to be an important determinant of antibiotic use (Masud et al., 2020).

Social scientists have also turned their attention to knowledge production practices surrounding 'appropriate' antibiotic use and the positioning of biomedical understanding over local forms of knowledge within public health (Haenssgen et al., 2020a). In rural China, Lambert et al. (2019) described how local patterns of antibiotic prescribing resulted from specific knowledge-practice configurations that drew from both biomedicine and Chinese medicine, and were shaped by sociocultural, economic and systems drivers. By demonstrating the co-construction of medical knowledge between patients and health professionals within the social world, these findings highlight the need to move beyond unidirectional awareness campaigns that seek to impose orthodox, biomedical versions of 'appropriate' use onto local populations (Lambert et al., 2019). Given the role antibiotics have in alleviating suffering, a starting point of equipping communities with the information they need to meet their healthcare requirements, rather than seeking to protect antibiotics from misuse, should be considered.

In addition to undertaking observational research, social scientists have also been concerned with how to better engage with local communities to support changes in antibiotic use. Cooke et al. (2020) piloted community-based participatory video making in Kathmandu to explore such issues. Mitchell et al. (2019) developed a 'values and principles' tool to support multiple stakeholders in developing locally tailored interventions that are clear, creative, evidence-led, interdisciplinary, equitable, sustainable and flexible. They note, however, that community engagement is underused within interventions to modify to antibiotic use and is hampered by language barriers – emphasizing the need to decentre antibiotic research efforts from the Global North (Veepanattu et al., 2020) – and limited methodological support (Mitchell et al., 2019). Based on a mixed-methods case study set in Bangladesh, King et al. (2020) propose a transferable process based on dialogue for developing community engagement interventions. They suggest that working with existing community structures and health systems offers a means to produce culturally appropriate interventions in a sustainable and scalable manner (King et al., 2020).

## Section conclusion

The research summarised in this section helps to further our understanding of how an array of local contexts influences antibiotic use and generates hypotheses for addressing antibiotic use through pilots, policy and programmes. These studies illustrate the particular configurations of social, economic, political and historical factors in which antibiotic use is situated, moving beyond simplistic interpretations of knowledge driven practices.

They have explored formal and informal pathways through which antibiotics and other medicines move through society, and their social functions. Social sciences approaches have helped to foster more holistic understandings that consider the biographies of medicines beyond the point of prescribing. These studies have also illustrated the interconnections between factors, demonstrating the need for comprehensive and transparent evaluation, including to  detect and measure unintended harms. For example, within private healthcare settings and animal production systems, measuring the impact on profit margins will help to assess the feasibility of the implementation of interventions.

**These studies illustrate the particular configurations of social, economic, political and historical factors in which antibiotic use is situated, moving beyond simplistic interpretations of knowledge driven practices**

This group of studies is united in agreement that developing a local understanding is crucial when seeking to alter antibiotic use in a sustainable way while minimising unintended consequences. They have described contributing factors to antibiotic use far beyond knowledge deficits and psychological factors. Studies have assessed a range of mechanisms to change working environments, such as checklists and supervision models to help understand and manage risks. Further work is needed in local contexts to develop and evaluate relevant interventions. Key to this endeavour will be support for and value of such skillsets in professionals embedded in health systems.

The prevailing assumption of knowledge deficits and emphasis on supporting individuals to change their behaviour has meant that wider drivers of antibiotic use – such as inequitable burdens of ill health, fractured health systems, and entrenched poverty – have often been overlooked (Broom et al., 2020a, Denyer Willis and Chandler, 2019, Haenssgen et al., 2020b). In the next section, we describe studies investigating the structural conditions shaping antibiotic use, and reflect on the potential to of intervene via levels other than that of the individual.


## STRUCTURES

The previous section illustrated how the social sciences are contributing to a more nuanced, complicated and expanded understanding of the contexts in which antibiotic use occurs. Many of these studies have taken a classic ethnographic or qualitative approach grounded in the everyday lives of those who are typically voiceless in policy conversations. This has advantages of really 'getting at' lived realities, but it is not always well suited for teasing apart the intricacies of what happens beyond the view of those situated at the point of antibiotic use.

**In this section, we consider social science research that suggests our attention could move away from individuals, to consider the economic and political imperatives that shape modern societies and their reliance on antibiotics. Rather than seeking to 'fix' individuals, what if we sought to address the societal structures they are caught up in?**

## Political economy

Drawing on ethnographic research conducted in Tanzania and Uganda, Denyer Willis and Chandler (2019) explored the roles of antibiotics beyond their curative effects, demonstrating how they act as a 'quick fix' across settings and scales. Antibiotics were found to paper over the lasting effects of political and economic violence, manage the consequences of lacking sanitation systems, prop up fractured healthcare systems, and help to maintain productivity in humans and animals (Denyer Willis and Chandler, 2019).

> **Viewing antibiotic use as a quick fix for broken systems helps move our gaze to the structural drivers of antibiotic use and potential targets for longer term, systemic solutions**

Viewing antibiotic use as a quick fix for broken systems helps move our gaze to the structural drivers of antibiotic use and potential targets for longer term, systemic solutions. The World Bank has proposed that interventions acting indirectly on AMR – 'AMR-sensitive actions' – may have greater impact, improve equity and be more cost-effective in controlling AMR than direct interventions such as tighter controls on the sale of antibiotics without prescription (Jonas et al., 2017). A move towards antibiotic-sensitive interventions has also been indicated by evidence from the studies below.

In India, Doron and Broom (2019) described how 'geographies of vulnerability' are produced as people living in poverty are disproportionately exposed to pathogens through their livelihoods and living conditions. These conditions combine with the growing problem of AMR to increasingly divide communities, exacerbating poverty and marginalisation (Doron and Broom, 2019). Lifting their gaze from the moment of antibiotic use, they describe how environmental pollution caused by antimicrobial manufacturing by pharmaceutical companies, the policy setting landscape, and limited access to healthcare combine to create a 'precarious disease landscape' (Broom and Doron, 2020). These studies illustrate the inadequacy of educating antibiotic users about AMR under these conditions, and echoes an interdisciplinary systematic review that found addressing social determinants of poverty remains a crucial, but neglected, step towards preventing AMR (Alividza et al., 2018).

Some country-level analyses, which have compared AMR, antibiotic consumption and other quantitative indicators, have indicated that increasing access to clean water, improving sanitation, increasing public healthcare expenditure, and better regulation of the private health sector are necessary to reduce the global burden of AMR (Collignon et al., 2018, Hendriksen et al., 2019). These analyses emphasise the role of governance in prioritising such infrastructure and regulation, which they link to the incidence of infectious disease and the spread of resistant strains of bacteria and resistance genes.

Recently, a positive quantitative association between precarity – 'a condition driven by contextual factors that deprive people of predictability and stability of their lives' – and antibiotic 'misuse' has been observed using behavioural data from Thailand and PDR Lao (Haenssgen et al., 2020b).
The authors call for interventions to engage with AMR-sensitive development policy in order to address the social conditions that shape how people experience and respond to ill health. Unless precarity is addressed, sustainable changes in antibiotic prescribing are unlikely to be achieved (Chaudhuri and Pradhan, 2021).

The persistence of such structural challenges – alongside their often-invisible interlinkages – signifies, however, that systemic solutions cannot emanate under the conventional leadership of a ministry of health or the WHO. Local non-health actors including the for-profit sector, non-governmental, civil society, or faith-based organisations could potentially play a role in shedding light on the fractures in the system that are patched up with antibiotics and that the high-level policy gaze often overlooks.

## Water and sanitation

Access to clean water and sanitation infrastructure are critical to prevent infections and reduce the spread of AMR (WHO/FAO/OIE, 2020). Reducing the incidence of infection through effective sanitation, together with hygiene and infection prevention measures, is one of the five objectives of the WHO's Global Action Plan on AMR (WHO, 2015). Recognising the structural roles antibiotic use plays in standing in for clean water and effective sanitation offers an additional argument for such structural interventions (Podolsky, 2018).

> **Future social science informed research is therefore required to address knowledge gaps regarding sanitation and water infrastructures.**
>
> **This research is particularly needed in cities with large informal settlements, which currently house over a billion people worldwide**

Landecker (2016, 2019) has described how the biological and the social worlds are continually shaping and reshaping one other with regards to antibiotic use and AMR. Using a similar biohistorical approach, Kirchhelle et al. (2019) traced how a fragmentated global response to typhoid control resulted in antibiotics being used to compensate for weak healthcare and water systems in low- and middle-income countries. These conditions fuelled the development of AMR and thus this international neglect is recorded in the genes of increasingly common forms of drug resistant typhoid.

*Photo credit: Magdalena Bondos, LSHTM.*

The cost of infrastructural improvements is often considered prohibitively expensive. Instead infection prevention is reduced to behavioural changes such as handwashing, which has only short-term impacts (Naikoba and Hayward, 2001). The effectiveness of many community-focused interventions trialled in recent years has been disappointing (Cumming et al., 2019). In addition, evidence of effects on drug resistant infection of improved water and sanitation is surprisingly sparse. Pinto et al. (2020) systematically reviewed the impact of interventions designed to improve water, sanitation and hygiene (WASH) and biosecurity in agricultural communities on AMR, burdens of infection and antibiotic use. They identified a paucity of studies conducted in the Global South and those evaluating structural interventions.

Future social science informed research is therefore required to address knowledge gaps regarding sanitation and water infrastructures. This research is particularly needed in cities with large informal settlements, which currently house over a billion people worldwide. Models suggest that improvements in WASH infrastructure has the potential for large reductions in antibiotic use (Araya et al., 2016) and a significant reduction in AMR could be achieved with improvements in urban infrastructure and governance (Collignon 2018). The challenge for social science is to provide evidence of how to achieve this appropriately and equitably, and to establish the economic and health costs and co-benefits that extend beyond AMR.

An interdisciplinary study underway in West Africa involving microbiologists, clinicians and social scientists is exploring the flow of AMR genes between humans, animals and the environment (Sariola et al., 2020), addressing a clear gap in the literature (Rousham et al., 2018). Interim ethnographic work has identified the overwhelming 'stacking of lacks': the additive and compounding effects of fractured health and veterinary systems, sanitation and laboratory infrastructures, making it difficult to know where to begin to intervene (Butcher et al., 2020). The results of this study, of pilots and modelling studies, would help inform policy makers of what to prioritise when making structural improvements.

## Gender

Gender is currently under-investigated when considering the geographies of vulnerabilities with regard to AMR (Saint, 2019). Thinking through how the phenomenon – and efforts to address antibiotic use – impact people in different ways can help to avoid inadvertently increasing inequity or designing ineffective interventions (WHO, 2018).

> **Additional research is needed to understand how women might inadvertently be expected to fill the gaps in care, hygiene, and productivity if antibiotics no longer work or their use is restricted**

Men and women encounter AMR differently: A wide body of evidence demonstrates that men's need to perform to an idealised masculine norm means they often delay health seeking, choosing to self-medicate until they are physically unable to work, for example when unwell with tuberculosis (Chikovore et al., 2020). Women are more vulnerable to infections caused by resistant bacteria through their physiology – illustrated through the increased burden of urinary tract infections (Will, 2020a) - and via their reproductive role – particularly during childbirth with its associated risk of exposure to resistant bacteria (WHO, 2018).

In some occupational settings, the burden of caring for antibiotics – i.e. stewardship – is falling disproportionately on women (Tompson, 2021). Elsewhere, women are responsible for the majority of care-work as they look after children, relatives, animals (Lohm et al., 2020).

Women, therefore, have been recognised as a key audience of public AMR awareness campaigns (PHE, 2019). Such targeting fails to consider the complex ways in which intrahousehold decisions are made: gendered roles and relations mean that women may have reduced decision-making power around when or where to seek care, and may not be able access to the economic resources needed. Interventions that essentialise women's position in the household and fail to acknowledge the complex ways gendered power relations shape decision are likely to have unintended consequences (MacPherson & Tolhurst., 2021). Furthermore, additional research is needed to understand how women might inadvertently be expected to fill the gaps in care, hygiene, and productivity if antibiotics no longer work or their use is restricted.

## Health systems

The lens of antibiotics as a quick fix for fractured health systems helps us to look beyond patients and healthcare professionals 'overusing' them. A scoping review of interventions to reduce antibiotic prescribing in low- and middle-income countries found that health system quality acted with bureaucratic processes, competition between healthcare providers, cultures of care and perceived patient demand to produce the prescribing context in which antibiotics are used (Wilkinson et al., 2018).

From a systems-perspective, health systems can be imagined as interconnected building blocks which influence antibiotic use (Tomson and Vlad, 2014). These components include access to medicines and technologies, for example laboratory and diagnostic equipment to support clinical decision making. If antibiotics are one of the few medicines available, then clinicians are compelled to use them when trying to care for their patents (Jones, 2018). Health system financial arrangements shape the affordability and accessibility of antibiotics. Incentives that link medicine sales with healthcare provider incomes may foster conditions of 'overuse' (Broom et al., 2018). Addressing antibiotic use also requires an understanding of the scale of the problem and information infrastructures are needed to collect and analyse data on antibiotic use, local epidemiology and resistance profiles (Kirchhelle et al., 2020). In terms of human resources, having sufficient trained staff who are competent in infection control, diagnosis and 'appropriate' antibiotic use are needed. Finally, governance creates the regulatory conditions that foster the local patterns of antibiotic use and organisational attitudes towards antibiotic stewardship (Kirby et al., 2018). Strengthening these building blocks can help address antibiotic use (Tomson and Vlad, 2014).

> **The lens of antibiotics as a quick fix for fractured health systems helps us to look beyond patients and healthcare professionals 'overusing' them**

Social science studies have illustrated how these building blocks act together to necessitate the use of antibiotics as a quick fix for weakened health systems. An ethnographic study in the emergency departments and wards of public hospitals in Bangladesh found that understaffing, overcrowding, and lacking hygiene and sanitation hampered adherence to 'appropriate' antibiotic use guidelines when caring for patients with diarrhoea (Biswas et al., 2020). In Sri Lanka, the use of broad-spectrum antibiotics by hospital clinicians provided them with a response to missing infrastructures and patient poverty that would take huge investment and extensive regulatory and policy intervention to address (Tarrant et al., 2021). A mixed-methods study in Ghana identified how 'inappropriate' antibiotic use was driven by out-of-pocket payments limiting contact with the formal health system and the affordability of complete antibiotic courses (Afari-Asiedu et al., 2020). They concluded that interventions are needed to enhance access to healthcare insurance, healthcare and affordable antibiotics.

The provision of universal health care coverage has been proposed as a key structural intervention in tackling AMR, in part by improving access to healthcare (Bloom et al., 2017, Jonas et al., 2017, Tayler et al., 2019). Much of the discussion on how to achieve this Sustainable Development Goal has concentrated on reaching universal coverage rather than the form of care delivered (Prince, 2020). In the final section to the report, we will further reflect upon how global health architectures translocate certain models of care around the world and the implications this has on antibiotic use.

## Social security

The ways in which lives are dependent on antibiotics extend far beyond forms of 'modern' medicine, caught up in processes such as modernisation, medicalisation, urbanisation and globalisation (Broom et al., 2020a). Social scientists have also drawn attention to the contradictions between capitalism – with its inbuilt short-term imperatives of productivity and profit – and tackling AMR (Broom et al., 2020a, De Lima Hutchison et al., 2018). Based on ethnographic research conducted in an American pig farm, Blanchette (2019) traced the entanglements of human, animal and microbial bodies as they laboured under intensive, industrialised conditions and the health consequences this had not only for these workers but on the environment beyond.

Antibiotics have enabled livestock to be configured as predictable units of production, especially in highly time-sensitive, industrialised livestock farming (Kirchhelle, 2018). Bangladeshi shrimp producers described how they are forced to resort to 'desperate measures' of antibiotic use when confronted with increasingly common extreme weather events caused by climate change and disease outbreaks that would otherwise cause financial ruin (Hinchliffe et al., 2020).

Similar observations were made in Thai orange orchards, where farmers reported antibiotics saving their trees and businesses from epidemics of citrus greening disease (Urapeepathanapong et al., 2021). Research in progress in Uganda is investigating the assemblages that underpin 'quick farming': the rearing of exotic pig and poultry breeds which rely on antibiotics to maintain their health in novel conditions, and represent significant financial investments for their owners (Kayendeke et al., 2021).

A linked research project in Uganda is exploring the conditions that produce 'chronic living' in humans: in the absence of societal safety nets, workers living in informal urban settlements turn to antibiotics to manage recurring bouts of acute illness so to continue working (Nayiga et al., 2020). In South Africa, healthcare practitioners in urban health clinics give antibiotics to their vulnerable patients partly to protect them from their unhealthy living conditions or in case they are unable to afford to return to the clinic if their illness worsens (Manderson, 2020).


> **Antibiotics have enabled livestock to be configured as predictable units of production, especially in highly time-sensitive, industrialised livestock farming**

How can we support people if we remove the safety net of antibiotic provision? Wider use of deferred (or delayed) prescriptions have been proposed whereby the patient/carer/farmer are given an antibiotic prescription but only use it if the condition does not improve (Spurling et al., 2017). However, this is based on pathways of care from the Global North and so might be ill suited in settings where regular health care is not affordable. Universal health care coverage, as discussed above, might be the ultimate societal safety net, perhaps funded by a national insurance type model. Smaller-scale insurance schemes could also be offered to farmers to compensate them if they were to lose animals to disease, reducing the need for preventative antibiotic use. Other pilots could evaluate the impact of schemes to enable paid sick leave to workers, to reduce the pressure on them to turn to antibiotics use for a quick fix for their health.

*Photo credit: Andy Wilkes*

## Section conclusion

The crisis of AMR offers an inversion point that forces us to consider what a future without antibiotics might look like. In doing so, the roles of antibiotics as infrastructure in our everyday lives – that normally fade into the woodwork – are rendered visible (Chandler, 2019). Recognising the infrastructural roles antibiotics have in propping up existing operational and social structures necessitates the re-evaluation of the political, economic and moral priorities shaping societies. It opens up accountability beyond blaming individual users of antibiotics to recognise the roles of political classes, health funders, employers, investors and insurers in fostering the conditions in which infrastructural antibiotics use is necessitated (Will, 2018, Broom et al., 2020a).

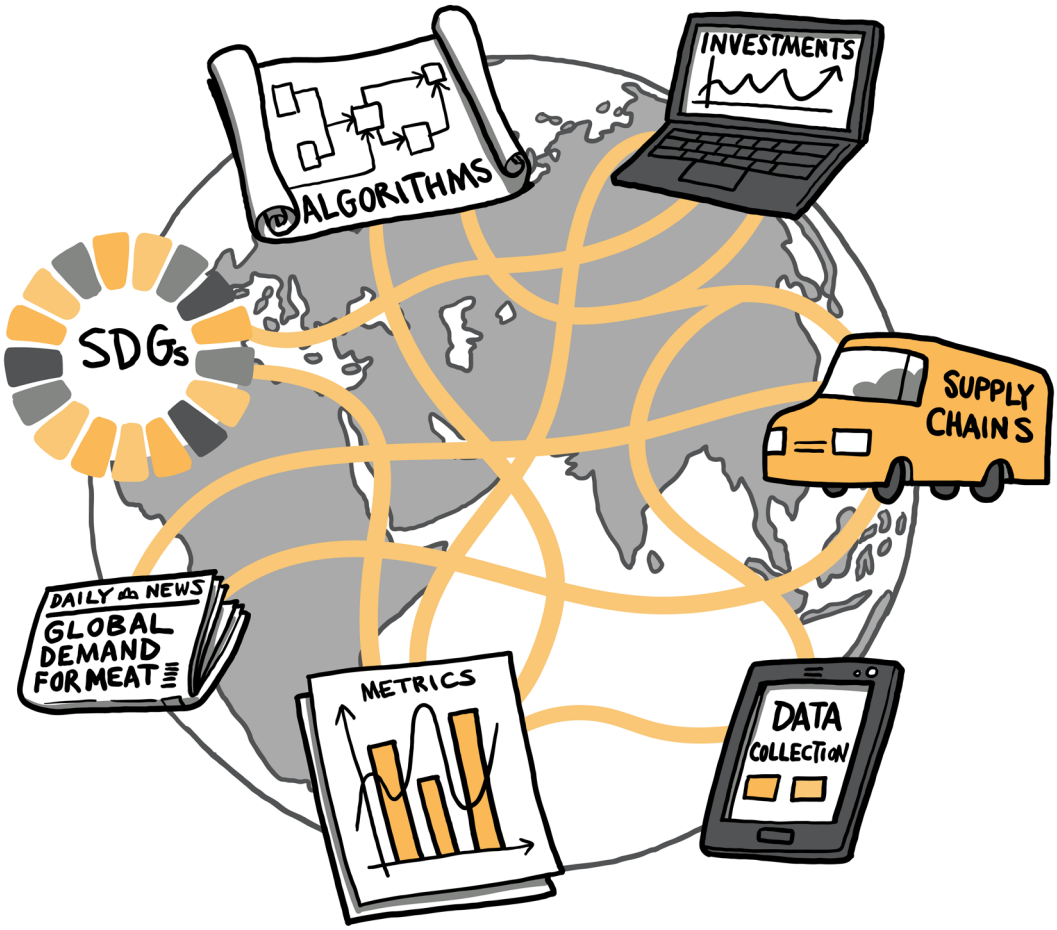
> **Antibiotics have become a lynchpin in our political-economic systems, simply removing them is not a realistic solution. Instead, interventions are needed that address the economic and political imperatives that require resort to antibiotics as quick fixes**

Since antibiotics have become a lynchpin in our political-economic systems, simply removing them is not a realistic solution (Broom et al., 2020a). Instead, interventions are needed that address the economic and political imperatives that require resort to antibiotics as quick fixes (Chandler, 2019, Denyer Willis and Chandler, 2019).

Inequity may be addressed through ensuring universal health care and strengthening social safety nets. In some settings this may mean strategies that focus on preventing hunger, in others, by enabling ill workers to excuse themselves from the social imperative of being productive by providing sick pay and allowing them time off work to recover without antibiotics.

A move towards AMR-sensitive interventions requires reconsideration of the timeframes, scale, vision and organisation of financing. It also necessitates extending an understanding of the antimicrobial 'community' beyond psychological and behavioural experts to include engineers, town planners and economists. Addressing antibiotic use through structural improvements such as improving working and living conditions, quality of care, hygiene and sanitation remains a distant goal (Manderson, 2020), and given this, it is perhaps unsurprising that the World Bank recommends a portfolio of AMR sensitive and specific interventions (Jonas et al., 2017).

Whilst reducing societal inequity will have benefits far beyond addressing antibiotic use, it is a complex challenge. In the next section, we reflect on whether there could be another scale at which to intervene, one that is less daunting than antimicrobial-sensitive structural interventions but, that is not expectant of individual-based responses.




## NETWORKS

**This third section of our report highlights work that situates current patterns of antibiotic use as a product of not only of the practices and structures of people and society, but also from the material, organisational and connective fibres into which antibiotics are stitched. Rather than being a discrete level of analysis, these networks operate with, and are co-shaped by, practices and structures.**

This research brings to the fore the often serendipitous, residual and overlooked arrangements that antibiotic use has become a part of and that may be traceable as logics, classifications, commodity flows and information routes that connect different places, matter and scales.

Many researchers whose work we have grouped here draw on approaches from Science, Technology and Society (STS) studies. Such research is concerned with how and why knowledge production and technological innovation relates to and informs social and political milieus in particular times and places. Attention in such analysis is paid not only to people and groups as social actors, but also to physical and connective actors that form material and semiotic associations (Law, 2019).

These actors may be thought of as 'networks' that may not have been deliberately designed or created, but which – when rendered visible – enable an understanding of how phenomena have emerged and persist. In the following section, we outline some areas in which social scientists have begun to consider the networks that co-produce antibiotic use.

## Agriculture and development imperatives

A growing number of studies are considering the networks of people, farm animals, microbes, living conditions, markets, value chains, supply chains and regulations that make up 'modern' farming and aquaculture, through which antibiotic use patterns emerge (Begemann et al., 2020, Fortané, 2019, Hinchliffe et al., 2020, Urapeepathanapong et al., 2018). They are helping to address calls for the unpacking of how the underpinning logics and dynamics of animal production shape drug use (Bellet, 2018).

> **As a consequence of policy focused on antibiotic use – rather than animal welfare or environmental harm – industrial and intensive livestock farming businesses were able to comply with regulations without having to fundamentally address their organisation or strategies of productivity and profitability**

Historical and sociological analyses have traced the development of industrialised forms of animal production that rely on antibiotic use. Kirchhelle (2018) tracked how, over the course of seventy years, a series of short-term, national regulatory reforms that were narrowly focused on antibiotic use did not challenge the growing structural conditions and ideals that necessitated antibiotic use across and through multinational supply chains on both sides of the Atlantic. As a consequence of policy focused on antibiotic use – rather than animal welfare or environmental harm – industrial and intensive livestock farming businesses were able to comply with regulations without having to fundamentally address their organisation or strategies of productivity and profitability (Fortané, 2020). Recognising the networks in which antibiotic use occurs can draw attention to other ways by which to improve animal health. For example, by tracing the development of intensive pig production in the UK, Woods (2019) decentres antibiotic use, placing it amidst changes in housing, husbandry and nutrition, other nodes through which to intervene.

*Photo credit: Roengit, Society and Health Institute, Ministry of Health, Thailand.*

Modified forms of intensified farming initiated in the Global North have been translocated around the world, linked to the project of development which seeks to reduce poverty and malnutrition through the provision of affordable protein (Kirchhelle, 2018). The co-enactment of 'competing' global health discourses around protein consumption and AMR is also being used as a lens through which to better understand antibiotic use in these settings (Denyer-Willis et al., 2021). These researchers draw clearer connections between the logics of development through livestock keeping, the logics of health improvement through protein, and the logics of antibiotic use reduction.

A number of social science projects are underway to develop interventions that follow these approaches. The UKRI-GCRF One Health Poultry Hub is undertaking ethnographic studies to characterise the roles and interactions of actors within poultry production and consumption networks, assessing how 'value' is created and how money circulates, in order to identify leverage points for intervening (One Health Poultry Hub, 2021). The EU-funded ROADMAP study, with fieldwork sites in Vietnam and Mozambique (Fortané and Gautier, 2020), seeks to encourage transitions towards prudent antimicrobial use along the food supply chain (Byg et al., 2020). The Swedish-led project 'On the road to reducing AMR for all' will consider the interaction of materials, competences and meanings that produce antibiotic use patterns in different animal species and countries, including Brazil. It aims to identify elements that can support the reduced use at a country, veterinary clinic or a farm level (Olmos Antillón, 2020).

Interventions are needed to address powerful business interests operating across jurisdictions with the resources to influence stewardship intervention efforts towards their organisational agendas (Kirchhelle, 2018). At the other end of the spectrum, there are numerous 'invisible' small-scale livestock producers whose precarious livelihoods are subject to the economic imperatives of global production chains, and whose voices and expertise are typically absent from efforts to address antibiotic use (Hinchliffe et al., 2018). The threat of AMR offers an opportunity to reconsider configurations of modern livestock production, economic profit distribution and meat consumption (De Lima Hutchison et al., 2018).

## Global health architectures

Tracing the shifting priorities, models and programmes that make up the architecture of global health through time and space can render visible how ideas of 'appropriate' or 'irrational' medicine have been produced. The development of technical apparatus – research methodologies, clinical guidelines, delivery chains and medical curricula, clinical spaces among many other things – and the ways in which they are manifested create 'grooves' or channels through which commodities, ideas, knowledge and investments flow. They are integral to ways of representing and intervening – part of the taken-for-granted backdrop of global health. Tackling AMR, therefore, is bound up in the networks of power, command and control operating within Global Health (Hinchliffe, 2021).

> **Future work is needed to develop and pilot interventions that build in alternative forms of care amidst these underlying architectures of global health**

One route through which antibiotics have been built-in to healthcare is in the design and layout of hospital buildings (Gradmann, 2017). Architectural analysis has revealed how the introduction of these medicines replaced alternative means of managing the circulation of microbes such as ensuring fresh air and lower densities of hospital beds (Brown et al., 2020, Buse et al., 2020). AMR – and more recently COVID19 – has led to closer attention to the physical pathways taken by patients through healthcare facilities and to spatial models of care (Brown et al., 2019, Brown, 2020).

Historians are also tracing the evolution of networks of antibiotic use, innovation, AMR and stewardship (Brazelton, 2019, Gradmann, 2016, Hobaek and Lie, 2019, Santesmases, 2018). Their analyses can help to better understand how we reached the status quo regarding accessing antibiotics, efforts to protect them and developing new agents (Podolsky et al., 2015). Interdisciplinary work underway at the University of Oslo is tracing the trajectories of active pharmaceutical ingredients and generic antibiotics as they are produced and exported from Asia to markets in east Africa, along historical and contemporary trade routes (Fjeld, 2020). Likewise, a recent historical analysis has explored how an abridged form of

biomedicine travelled to Malawi, Uganda and Zimbabwe through colonial health systems (Palanco Lopez and Chandler, 2020). Under these conditions, antibiotics enabled structures of Western medicine to be amended, for example, through reduced staffing models and healthcare professional coverage per capita. The effects of these networks and the roles of antibiotics persist in the organisation of health care systems (ibid). In Myanmar, Khine Zaw et al. (2021) investigated the gap between antibiotic use imagined by global health policy - in the form of WHO's global action plan - and its enactment amidst local modes of political governance, histories of health systems and rule of law. They propose that the overlooking of these factors by policy makers, in favour of 'template' responses, risks inadvertently widening existing health inequities and social injustices (Khine Zaw et al., 2021).

In Zimbabwe, Dixon et al. (2020) traced how twentieth century formations surrounding rational drug use (RDU) – supporting access to, and appropriate use of, essential medicines to improve population health at an affordable cost – contributed to antibiotic use being 'built-in' to everyday scripts – or models – of care followed by social actors. The more recent arrival of antimicrobial stewardship – with its sole imperative to protect medicines from 'irrational' use – brings its own pared down model of 'appropriate' medicine use. The introduction of clinical algorithms and diagnostics – in part, to ration access to medicines – can have unintended consequences (Chandler et al., 2016) and declare some patients as undeserving not only of medicines but of care (Dixon and Chandler, 2019). AMR therefore requires reconsideration of the ways in which pharmaceuticalised forms of healthcare have been worked into under-resourced health systems (Chandler, 2019, Dixon and Chandler, 2019). Future work is needed to develop and pilot interventions that build in alternative forms of care amidst these underlying architectures of global health.

A further network shaping  responses to antibiotic use is the global flow of metrics and data as part of efforts to better characterise the distribution of antibiotic use and AMR. Metrics typically emanate from influential organisations based in the Global North, whilst data are extracted from settings in the Global South as part of international attempts to quantify the magnitude of this global threat (Kirchhelle et al., 2020, Chawraingern et al., 2021).

*Photo credit: Roengit, Society and Health Institute, Ministry of Health, Thailand.*

The latter is hampered by a lack of laboratories, equipment and reporting infrastructures, resulting in datasets skewed towards settings in the Global North (Chandler, 2019). In consequence, international policy and stewardship endeavours may have limited resonance or utility in low resource settings, where frontline clinicians are more interested in the susceptibility of bacteria to their limited stock of antibiotics (i.e. what will work) than resistance (what will not) (Kirchhelle et al., 2020, Dixon et al., 2020). The Drug Bag method – developed in Africa and South East Asia – has been proposed by social scientists as a method by which to gather data on antibiotic use beyond formal healthcare settings (Dixon et al., 2019), an addition to the portfolio of existing instruments measuring the use of antibiotics across the human, animal and plant sectors (WHO, FAO, OIE, 2020).

Scholars have also considered how multiple strands of knowledge regarding antibiotic agents and their effects are produced. For example, one arm of the 'Marginalisation and the Microbe' project is considering how different ways of knowing in microbiology, epidemiology, health economics and public health interact to shape policies on antimicrobial resistant infections, and the consequences for marginalisation in health care (Will, 2020a). Another area of interest has been bacteriophage, living bacteria-eating viruses, which could possibly offer a replacement for some uses of antibiotics. Kochhar (2020) traced the history of phage to contextualise their contemporary secular and sacred understanding amongst doctors, scientists and historians in Allahabad. Brives and Pourraz (2020) considered why their development as an antibiotic alternative has not been prioritised. They concluded that antibiotics shape assumptions about what can be known in terms of norms, categories and models of scientific evidence production – for example, the randomised controlled trial (Podolsky, 2010) – and, as a consequence, discourage the investigation of phage. How antibiotics act as epistemological infrastructure requires further consideration when developing programmes, policy and pilots for addressing antibiotic use.

## Discourses of appropriate use

One-way social scientists have helped to render visible the circulating social scripts – the prevailing language and understanding – surrounding AMR and 'appropriate' antibiotic use is through discourse analysis of written and visual media, and of policy documents. By reflecting on the language, metaphors and images used, attention is drawn to how the problem is framed, who is attributed with responsibility for dealing with it, and what form these responses should take (Collins et al., 2018, Walker, 2020). These analyses help to render visible avenues for action currently obscured by these framings (Wernli et al., 2017).

> **A diversity of voices and ways are needed to represent the complexities of antibiotic use and AMR, and reflect human, animal and environmental marginalisation and injustice**

Analysis based in the Global North has identified how framings of war (Nerlich, 2009, Walker, 2020), apocalypse (Irwin, 2020, Nerlich, 2009), capitalism (Brown and Nettleton, 2018), and migration (Brown and Nettleton, 2017b) are drawn upon to explain AMR. The governments of high-income countries have been mobilised into acting partly due to high level policy documents framing AMR as a threat to economic growth and security (Khan et al., 2019, Wernli et al., 2017). However, this framing has overlooked questions of development and equity, perhaps explaining the lack of attention to structural interventions described in the previous sections.

Within the popular media, tensions between apportioning the problem of antibiotic 'misuse' to prescribers or antibiotic users or the broader community - the 'unspecified we' - have been observed (Brown and Nettleton, 2017a, Collins et al., 2018). In terms of reducing AMR, the story has been painted as one of scientific discovery with technical fixes: innovative antibiotics come to the rescue, while collective responses are downplayed (Brown and Nettleton, 2017b, Davis et al., 2020a). This framing obscures the potential of the social sciences, the arts and bioethics to contribute towards solutions in part by better understanding practices around antibiotic use (Irwin, 2020, Walker, 2020, Will and Kamenshchikova, 2020).

Analysis of UK newspaper articles and One Health policy documents concerned with AMR from a range of settings found protecting human health was the central concern, while animal and environmental health sectors were assigned responsibility for addressing this problem (Kamenshchikova et al., 2019, Morris et al., 2016). Approaches beyond the dominant values of the human health sector, which foster a broader discursive space, are proposed (Kamenshchikova et al., 2019).

As already argued, the political economic structural conditions contributing to antibiotic use has been downplayed in popular discourses, with the responsibilities of the pharmaceutical industry and multinational industrial livestock producers largely overlooked (Collins et al., 2018, Walker, 2020). Scientific enquiry into environmental AMR is underpinned by implicit assumptions that current infrastructures and environmental pollution will continue to exist, and thus that 'end-pipe' management interventions are the solution to mitigate against the resulting health risks (Helliwell et al., 2020).

The declining use of military metaphor in recent years coincides with the growing interest in the importance of symbiotic human–microbe relationships (Walker, 2020). The framing of the immune system as an army to keep out hostile invaders has been challenged as, more broadly, new ways of 'becoming' with microbes are proposed (Brown, 2019, Brives, 2021, Davis et al., 2016, Greenhough et al., 2018, Lorimer, 2019). These changing conceptualisations of human-microbial relations impact our understanding of 'appropriate' antibiotic use (Grondal, 2018). As a consequence, new forms of symbiotic public health (Sariola and Gilbert, 2020) have been proposed that recognise the microbial impact on health beyond pathogenic disease (Lorimer, 2017). Further attention is needed to find ways to live with bacteria, including resistant forms (Giraud et al., 2019), as part of a postcolonial, 'post colony' global health (Hinchliffe, 2021).

A diversity of voices and ways are needed to represent the complexities of antibiotic use and AMR, and reflect human, animal and environmental marginalisation and injustice. (Helliwell et al., 2020, Walker, 2020, Will and Kamenshchikova, 2020). Engaging sensitively with local practices and understandings of microbes, antibiotic use and AMR will foster the adoption of multiple framings, broadening our capacity to understand, communicate and act on antibiotic use and AMR (Will and Kamenshchikova, 2020).

## Section conclusion

The studies described in this section have begun to make clear the mundane routes through which antibiotics have seeped into networks that form the backdrop to our lives. By highlighting these roles which otherwise would remain hidden, and by tracing these networks through time and space, fresh targets for antibiotic use interventions can be identified beyond the individuals at the interface of their use.

# CONCLUSION

In this report we have collated insights from the growing body of high-quality social science research into antibiotic use in humans and animals in diverse settings. By bringing together research that investigates antibiotic use through practices, structures and networks, fresh perspectives for thinking and intervening emerge. These are summarised in Table 2.

**Table 2: How social science research can inform efforts to alter antibiotic use**

| Approach: | PRACTICES | STRUCTURES | NETWORKS |
|---|---|---|---|
| **Key message** | Antibiotic use practices are determined by wide social and material dimensions which must be addressed. | The structures that antibiotics are currently substituting in for must be invested in. | Existing public and global health architectures and conventions define antibiotic consumption and must be made visible for antibiotics to be designed-out. |
| **Focus of intervening** | Interventions change behaviour and practice by understanding and altering the context in which individuals make decisions about antibiotic use. | Interventions modify economic and political conditions to reduce the need for antibiotics to be used. | Interventions redesign networks and tracks that define antibiotic use. |
| **Example of interventions** | Adjusting practitioner renumeration arrangements, enhancing healthcare accessibility, improving communication between prescribers and patients, providing information on medicines, awareness/ education tailored to local understandings of ill health and treatment. | Reduce inequity, prevent infection and support wellbeing by strengthening sanitation and health systems, social safety nets, food security, improved working conditions. | Reconfiguring clinical & veterinary pathways/ protocols, strengthening supply chains and aid flows, adjusting accountability frameworks, recognising the project management orientation of global health, metaphors and words like stewardship and rational drug use. |

The health and economic consequences of AMR are known to affect poorer countries disproportionately, and therefore addressing the problem in these settings is a priority (Jonas et al., 2017). This report has highlighted a small but growing number of studies conducted in Africa and Asia that draw on social theory to better understand antibiotic use.

The studies included this report clearly demonstrate the value in drawing upon the social sciences to produce a holistic and nuanced understanding of local antibiotic use. Their approaches are ripe for translocation to other settings and for uptake into intervention design.

## Practices

The research we have grouped as collectively concerned with **practices** reiterates the importance of understanding local contexts as a starting point to resist universal approaches and policy responses to address antibiotic use (Kirchhelle et al., 2020). An important next step is using these findings when designing and piloting interventions. To assist this, social scientists could collaboratively develop practical implications of their research, together with the key actors identified in their analyses. This would align with wider moves towards locally-tailored and holistic interventions that consider broader and unintended consequences on health and livelihoods, and incorporate sustainability dimensions (OECD Development Assistance Committee, 2019).

These studies have demonstrated that, whilst knowledge and awareness play a part in antibiotic use, there are many other social, economic and political factors that intervention approaches are yet to consider. Pilot studies informed by more ecological models of behaviour that seek to adjust – or 'tweak' - the local environment would be valuable in informing efforts to intervene. They might potentially offer a more sustainable means by which to trigger longer-lasting changes to antibiotic use. The development of such an evidence-base would help to diversify options available to policy makers, especially in low- and middle-income countries hampered by a lack of information about what works (Dar et al., 2016).

Social science studies are helping to develop a more sophisticated understanding of health care seeking behaviours and the role of self-care in settings in the Global South. In better understanding the plurality of antibiotic providers, stewardship efforts need to reach beyond their historical focus of hospitals and state-run primary care clinics. Engaging with informal providers requires piloting alternative approaches beyond regulation or the prohibition of over-the-counter sales that might drive 'inappropriate' antibiotic use underground. This includes challenging the starting point of such sales as 'problematic', and recognising their essential role in providing access to medicines for vulnerable groups.

## Structures

> **A change in perspective is required in terms of ambition and scale, for example, in relation to the impact and duration of improvements that we seek to make on people's lives and living conditions**

Recognising social **structures** and the infrastructural roles of antibiotics necessitates that we, the AMR community, look beyond individuals and quick fixes. A change in perspective is required in terms of ambition and scale, for example, in relation to the impact and duration of improvements that we seek to make on people's lives and living conditions. Addressing antibiotic use through repairing the political and economic imperatives is no small or speedy task. However, providing access to clean water, sanitation and hygiene is a matter of urgency, not only in terms of tackling AMR but as a broader priority for health and development (IACG, 2019). Given this, pilot studies measuring the impact of providing clean water on antibiotic use should not be necessary. Even so, social science informed evaluations addressing less obvious structural interventions – such as creating avenues for sick pay – and how to support equitable access to high quality antibiotics in both human and animal populations will provide data with which to mobilise powerful political and policy players (Minssen et al., 2020).

## Networks

Considering the **networks** in which antibiotics are caught up in offers a novel approach through which to address antibiotic use. Understanding the connections between human and non-human components reveals the difficulties of intervening to 'simply' remove antibiotics from particular settings and situations. They may be so deeply built into pathways of care, for example, that they may be hidden and not be immediately obvious. Careful analysis of networks can help to identify counterfactuals to antibiotic use. Once obvious, interventions to address these networked uses of antibiotics might be easier to pilot than structural fixes. Tracing networks requires moving through time and space, and across country boundaries, beyond moments of consumption. Such approaches draw upon a range of research methodologies and emphasize the importance of interdisciplinary responses to address antibiotic use (Kamenshchikova et al., 2020, Macduff, 2020).

Discourse analyses on the social scripts we adopt to talk about AMR demonstrate a focus on technical answers to this 'scientific' problem. However, the research we describe has emphasized the need for a portfolio of collective, co-produced responses shaped by diverse perspectives and voices. We need to develop an architecture within global health that empowers countries to develop, implement and monitor their own approaches to address antibiotic use and support the professional development of those to undertake this work (Giles-Vernick et al., 2019, Haenssgen et al., 2020a, Veepanattu et al., 2020). Such insights and reflexiveness should be included when educating public health students, health professionals and policymakers about addressing AMR.

We have referred to 'the evidence' regarding antibiotic use interventions. As part of a networks-type approach that questions categories and classification systems, it is worth reflecting on the types of evidence that we rely on to know how things 'work'. The dominance of evidence-based medicine and of randomised controlled trials has resulted in an evidence-base oriented around what we can count (Lambert, 2006, Lambert, 2013). For example, quality of care becomes reduced to whether or not a treatment protocol was followed (Dixon and Chandler, 2019); complex health seeking pathways become whether or not an antibiotic was used (Haenssgen et al., 2020a). Fully capturing the downstream societal benefits from structural interventions or from avoiding AMR are difficult (Brives and Pourraz, 2020), and requires that we reconsider what counts in policy making and what implementation science involves.

## Going forward

**Reflecting on these three areas of focus gives rise the following questions of our ongoing research, programmes and policy:**

- Can we shift from a universalised and standardised approach to developing and defining interventions locally? What would this take for local professionals working in implementation science? What forms of knowledge sharing and professional development would this require, both locally and internationally? What benefits might there be for other areas of health in developing such approaches?
- What time horizons should we set for interventions in AMR? The O'Neill report on AMR sets 2050 as its time horizon, but our expectations from research and programmes are for very short-term impact interventions. Should we strategise for shorter, medium- and longer-term investments to reduce our reliance on AMR?
- What sorts of evidence should we make to understand changes that can impact antibiotic use? What would it take – methodologically, practically and financially – to generate such evidence in a reliable manner to feed back to investments in programmes? What lessons can be learned and synergies created with other programmes to evaluate policy impacts on health?

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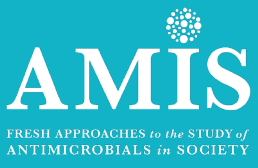
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