



Addressing Antimicrobial Resistance through Social Theory

An Anthropologically Oriented
Report

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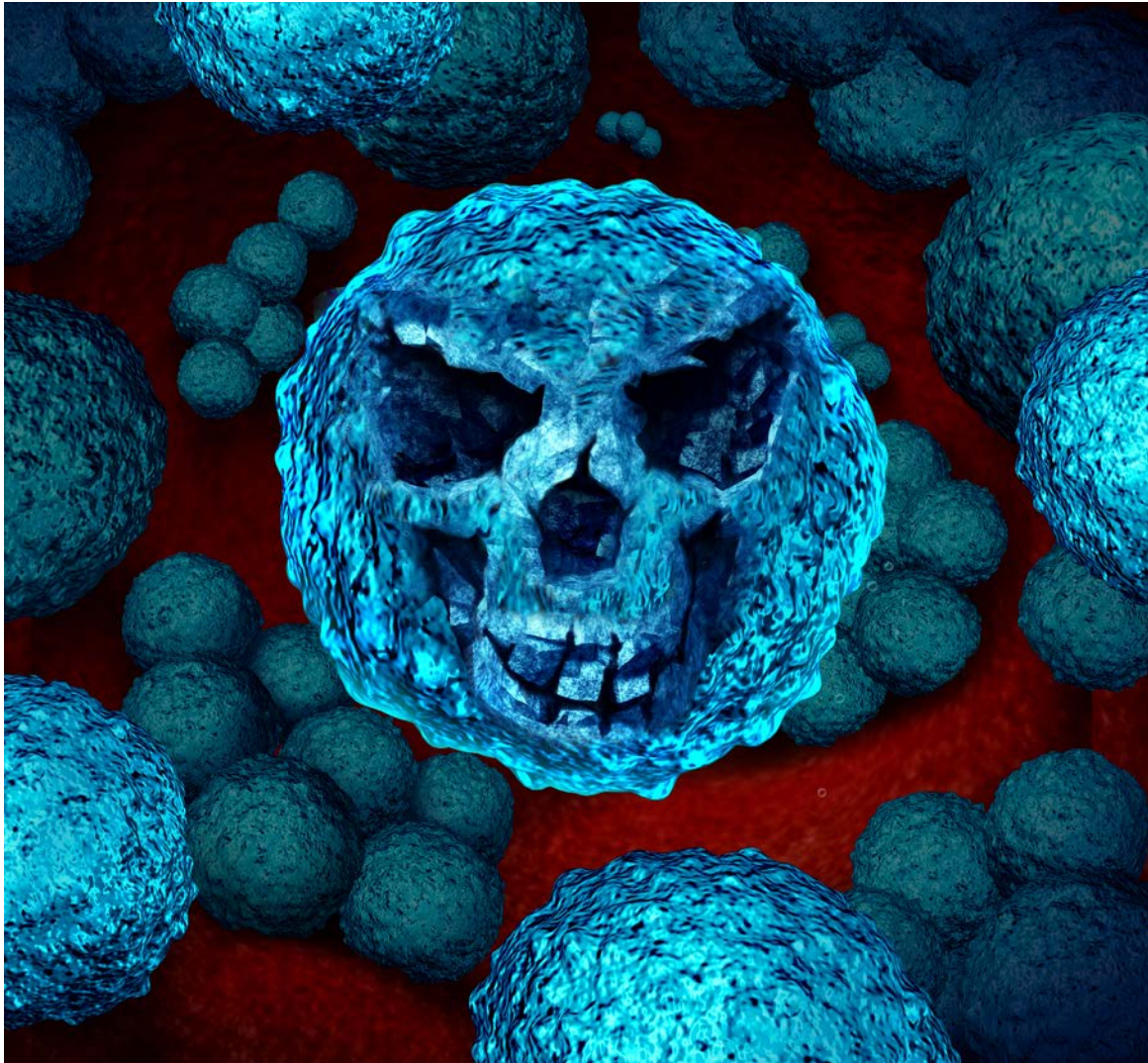
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Introduction

Applying Social Theory
to the Study of AMR in three Domains:
Practice, Policy and Science



Antimicrobial resistance (AMR) has been identified by the global health community, in particular within the European Union and in the United States, as one of the greatest threats to life as we know it. The impact of antimicrobial resistance could be dramatic (Jasovsky, Littmann, Zorzet, & Cars, 2016). Action taken to counter-act AMR could be equally dramatic. In both cases AMR is set to re-configure our relationship with medicines and therefore to have a profound impact on the possibilities for care and health around the globe.

Despite the social and political nature of pharmaceuticals and their use, there has been a surprising lack of input from the social sciences in informing courses of action (Smith, 2015). Without such active engagement, effective means of addressing AMR may be missed, and risks of

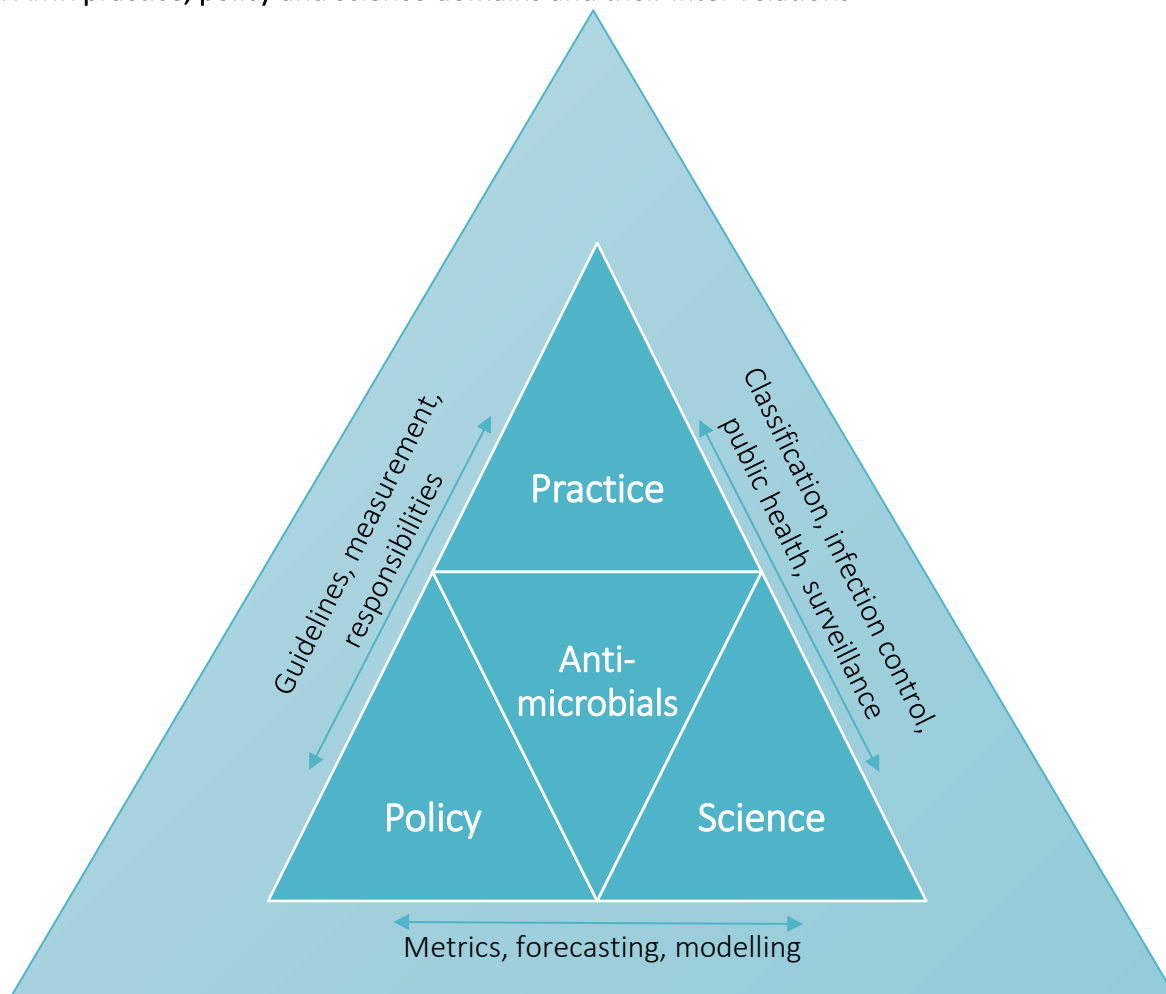
adverse consequences of policies and programmes may be increased if they lack sensitivity and responsiveness to global and local entanglements with antimicrobials.

There is great potential to learn from the considerable theoretical work across the social sciences, so as to provide a broader and richer conceptual map through which effective strategies to tackle AMR could be created. In this report we review social theories that may be relevant to AMR, with a focus on an anthropological perspective, and set out how these theories may usefully be applied to understanding AMR and identifying responses to AMR. In so-doing, we hope to engage the reader in thinking about the social dimensions of this issue within and beyond the framing of 'behaviour'.

This report addresses three domains for the study of AMR: practice, policy and science. Each deserves attention as objects for analysis, although the three

domains are inter-related, with concepts, framings and expectations travelling between all three.

Figure 1: AMR practice, policy and science domains and their inter-relations



The domain most often associated with social research in relation to a topic like AMR is *practice*: *how, when and why medicines are used* in different contexts. This is a core concern for social theory, looking at the ways in which antimicrobials are embedded in our societies. However, in this report we also reflect a wider range of social theory that can be applied to the domains of policy and science: *how, when and why AMR policy objects and scientific facts are produced*. In all three domains, we hope to enable readers to move beyond the remit of ‘behaviour’ of patients, prescribers and farmers, to explore wider social, material and other lives that make up the field of AMR, and to open these up to social analysis.

To do this, we ask ‘what is at stake’ as AMR is enacted (debated, discussed, identified and acted upon) and what forms therefore emerge as AMR in different settings.

Recent anthropological approaches that seek to take into account the material as well as the cultural and which shift the concern of ethnographic research away from questions that are mostly about knowledge (what and how do we know about the world?) - to ones that are more concerned with the nature of the world - are particularly pertinent for research on AMR. They often place forms of categorization and objects at the heart of the analysis and demonstrate that what appears to be static, singular and fixed is often better understood as multiple and dynamic

in nature, shaped by both material and social/cultural forces in which it is embedded. For AMR, this means that rather than starting with questions that ask about human behaviour the interest revolves around interrogating concepts (for example what constitutes the 'rational', 'irrational' or 'prudent' use of antibiotics in different settings, how and why this changes); scientific practice and debates; guidelines, legal frameworks and regulations; infrastructures, training and capacity building strategies that emerge when AMR is in play (as a discourse, social practice and natural fact). Through such analyses it is possible to explore AMR as an assemblage that is as political, social and cultural as it is biological and to examine the shape that it takes in different settings.

The perspectives of the authors of this report draw on Jensen's interpretation of Deleuze (Jensen, 2012) and on Marcus (Marcus, 1995): we are interested in constructing a theoretical framework

to engage anthropology as a following science concerned with the ways in which AMR gets made and remade, how different elements of the social and material world labelled AMR become more or less important as it enters different settings and the ways in which AMR is held together as an object and rendered coherent.

There are thus three Parts to the report: Part 1 Practice; Part 2 Policy and Part 3 Science. In each, we begin with a review of theory of potential relevance to investigating AMR, and then move to illustrate application of some of these theoretical approaches in relation to AMR. Our intention is both to bring to life these approaches for the benefit of readers new to the integration of social science and AMR practice. In addition, we provide new insights into thinking about and addressing AMR, which summarise findings that are developed in more detail and presented elsewhere.

Part 1

Applying Social Theory to Antimicrobials in Practice

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Anthropologists have been studying medicines and the ways in which humans relate to them for the past century. Such work is informative for interpreting the role antimicrobials have in health and healthcare, looking at the range of places and spaces in which these medicines enable particular forms of life, social worlds and infrastructural arrangements. This empirical and theoretical work can provide insights into how reliance on antimicrobials might be reduced and the potential consequences of doing so. Here I summarise anthropological work that has focused first on the *use* of medicines, by consumers and prescribers, and second on the *meanings* of medicines, for patients and providers. This section will draw primarily from anthropological theory but will also draw on sociological theory to a lesser extent. Readers are directed to a summary of sociological perspectives on AMR by Wood (Wood, 2016).

Review of relevant theory

Use of medicines

Throughout the history of the sub-discipline, medical anthropology research has drawn attention to cultural, social, political and economic structures that shape the distribution of disease as well as access to biomedical treatment. In this line of research, anthropologists have recognised the importance of antimicrobials in alleviating suffering, and have worked (primarily in Low and Middle Income Countries (LMICs)) to understand how access to and use of essential medicines could be improved (Manderson, 1998).

Use of medicines by consumers

The Essential Medicines movement, championed by the World Health Organisation after its publication of the first essential medicines list in 1977, enlisted anthropologists into multi-disciplinary teams to identify ways to increase access to and rational use of medicines considered vital tools to improve and maintain health (World Health Organisation, 1985). With rational use defined by biomedical science, anthropologists provided evidence of consumers' own **rationalities** for use of medicines. These studies have shown for example how medicines were used to treat symptoms rather than a particular disease

(Feierman, 1981); to self-medicate common or 'ordinary' illnesses such as fever (Kamat, 2006); and to take medicines until symptoms have ceased (Nichter, 2008). Numerous studies also sought to characterise how people would identify medicines as particularly efficacious, or compatible. For example, colour, taste and appearance as well as form such as injection, intravenous fluid or oral tablets, could all indicate the efficacy, strength and tolerability of drugs (S.R. Whyte, Van der Geest, & Hardon, 2002). These accounts have illustrated diversity in perceptions of particular medicine types or characteristics, both between and within settings. In many cases, medicine efficacy has been found to be locally or individually **contingent**; what works for one person might not for the next, and different dosages, timings and ways of taking medicines would need to be experimented with on a case by case basis (Nichter, 2008). These findings often draw contrasts with international standardised guidelines, demonstrating a gap between local and global perspectives of what was 'appropriate', 'rational' and 'proper'.



Beyond the focus on characteristics of medicines themselves, anthropologists have also highlighted their use in reference to local conceptualisations of causality of illness as well as locally correct modes of healing. This could be depicted through **explanatory models**, which describe cultural ideas about illness and were proposed in the 1970s as ways to understand and negotiate different perspectives of ill-health and misfortune (e.g. Kleinman, Eisenberg, & Good, 1978). This would enable anthropologists to work with biomedical practitioners to bring together local aetiologies and priorities with biomedical knowledges and resources (e.g. Helman, 1984). Such models can still be informative. For example, Mark Nichter's ethnographic work in the Philippines provides a

rich description of preventive and protective antibiotic use by patrons of sex workers, who variously took antibiotics before sex, after sex, occasionally or routinely depending upon their own situations and familiarity with the particular sex worker (Nichter, 2001). His analysis demonstrates how the use of these medicines can be interpreted in terms of **vulnerability** and 'streetwise attempts to exercise agency' in reducing harm, p117). However, in casting these behaviours as 'misguided', there appears an assumption that there is a 'correct' way to use these medicines. In the light of shifting biomedical knowledge over time, and between scientific disciplines, this assumption has been called into question, especially when there is an implicit dichotomy of biomedical knowledge as 'true' and local knowledge as 'belief'. As anthropologists increasingly drawn attention to the complex set of beliefs embedded in biomedical science and practice itself, the proposal to 'convert' local populations to the 'correct' way of thinking became seen as problematic (Bibeau, 1997). Anthropologists have also questioned whether the focus on such **beliefs**, which may not relate to behaviours, is the reason why knowledge or education based programmes have often been unsuccessful in changing health practices (Yoder, 1997).

The early 1990s saw a shift in focus away from beliefs of individuals or local 'cultures' (the characterisation of which had come under scrutiny, see Clifford & Marcus, 1986) and anthropologists began more commonly to document wider social, political and economic structures affecting, amongst other things, access to medicines for infectious diseases. The inequalities shaping occurrence of disease as well as access to treatment were increasingly documented (Singer, 1990). The concept of '**structural violence**' gained traction in anthropological analyses, referring to the injury caused by inequitable regulations and categories imposed upon people by structural systems or governing institutions (Galtung, 1969). Paul Farmer popularised the concept in relation to health (e.g. Farmer, 2005), and this has been influential in shifting responsibilities, for example for HIV treatment from citizens to states, with antiretroviral treatment becoming conceived as a

human right. In many ways this underscored the centrality of medicines in development efforts and programmes such as the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) and the Global Fund to Fight AIDS, Tuberculosis and Malaria, made the delivery of antiretrovirals, antibiotics and antimalarials the cornerstone of philanthropic aid. Despite this push to increase availability of these *essential* medicines, anthropologists have drawn attention to realities on the ground of continued disparities and interruptions in access to medicines through these programmes as well as through collateral damage to health systems of narrow interventions (Pfeiffer, Nichter, & Critical Anthropology of Global Health Special Interest, 2008). Rather than addressing structural violence, it has been argued that such programmes can reinforce these problems (Cameron, 2011). With regards to drug resistance, concerns around poor and marginalised groups as most vulnerable to infectious diseases carry over to those most vulnerable to resistant infectious. Farmer has proposed that the concept of structural violence is useful to understand both access and adherence to therapy (Farmer, Nizeye, Stulac, & Keshavjee, 2006), which affects the development of resistance and ability to manage resistant cases. Furthermore, if access to medicines is to be restricted through efforts to halt resistance, then in many cases where access is already poor, this may exacerbate these problems. The impact on this in terms of cases and costs has been approximated (Mendelson et al., 2015) but the **social costs** remain unexplored.

Use of medicines by prescribers

As early as the 1950s there was substantial discussion over when antimicrobial use should be classified as inappropriate, misuse or abuse. Consensus has not been easily reached, with physicians at the time making recommendations at the extremes: to restrict antibiotics to 'emergency therapeutic crutches to be used only in seriously threatening conditions' versus to use penicillin or a combination of antibiotics to treat flu or severe viral infections (Podolsky, 2015 p115 citing Arthur Lawrie Tatum and Henry Sweany respectively).

Concerns of over-use of antibiotics appear in some historic and anthropological analyses to be

tolerated because of the apparent lack of choice for physicians. Even when a majority of antibiotic uses were classified as 'irrational', this critique could be countered with arguments of insufficient diagnostic testing (Podolsky, 2015). Unlike diagnostic tests, which can raise more **uncertainty** when negative, empirical treatment allows for both the possibility of the treatment to be effective and for time to improve the patient. It also prevents the situation of a worse outcome due to not treating. Anxiety over the potential consequences of missing a case requiring an antimicrobial have loomed large since these substances have been available for widespread use. Historian Robert Bud summarises accounts of doctors thus, 'Whatever the probable diagnosis, were something to go unexpectedly awry then other people, and perhaps even they themselves, would ask why antibiotics had not been tried' (R. Bud, 2007b p153). The

uncertainty over when antibiotics are required has persisted. This ambiguous response to increasing concerns over risks posed by inaction can be interpreted in the light of increasingly risk-aware '**risk societies**' of the modern era (Beck, 1992). Anthropologists and sociologists have continued to document the triad of diagnostic uncertainty, demanding patients and the fear of untreated serious disease as central to prescribing practice through the decades since the 1950s (e.g. Cabral, Lucas, Ingram, Hay, & Horwood, 2015). (Cabral et al., 2015). Nonetheless, the notion of 'rational therapeutics' has persisted, with 'a sceptical, as well as a moral, tone, to be juxtaposed to the influences of commerce, ignorance, or intellectual lassitude' (Podolsky, 2015 p113). This area is ripe for further anthropological analysis.



Clare Chandler. Routine antimicrobial treatment at a Ugandan health centre

Meanings of medicines

Beyond the use of medicines for their biological functions, anthropologists have examined how these objects take on other meanings and roles in different arenas, considering pharmaceuticals as entities that operate beyond their curative

properties. This body of work is instructive for interpreting how antimicrobials are used, prescribed, marketed and integrated into agendas from patients to prescribers to pharmaceutical companies to governments and global bodies. This can provide insights into the challenges faced by

attempts to reduce or target medicine use, given their values beyond biological function.

The charm of medicines

Even amongst biomedical scientists, these substances have an enigmatic air, for example in the way they are referenced as ‘magic’ bullets. The use of this term provides an invitation for anthropological analysis, given the way magic has been a central analytic in classical anthropology (see for example Evans-Prichard, 1937; Malinowski, 1948). In reference to antimicrobials, ‘magic’ evokes both the power and potential super-power of such substances and their relations to our material and social realities. Moving this further, anthropologists Sjaak van der Geest and Susan Reynolds Whyte have described medicines as having ‘charm’, providing a concrete solution to ill-health, and one that can be separated from a therapeutic encounter. This distinguishes medicines from other forms of healing such as surgery, which cannot be separated from a surgeon. Medicines are democratic and exoteric, they are ‘widely believed to contain the power of **healing** in themselves. Anyone who gains access to them can apply their power’ (Van der Geest & Whyte, 1989 p346). The same authors extended this perspective to incorporate a wide range of places and spaces where medicines flow, are exchanged as commodities, are prescribed and consumed. After Appadurai’s *The Social Life of Things*, they invoke an analytical framework of the ‘**Social Lives of Medicines**’, proposing that as *things*, medicines have biographies (S.R. Whyte et al., 2002). The authors trace the careers of medicines, often antimicrobial, and provide useful context for the ways in which these substances travel beyond the enclave of professional control and are made common. In drawing together a range of anthropological works, through which they illustrate how people in different settings, roles and industries, employ these substances for various endeavours, this volume is compelling in arguing that medicines should be understood beyond their capacity to cure (or poison).

The charm of pharmaceuticals, as concrete entities with wider symbolic, economic and political value, is a useful lens through which to consider how antimicrobial resistance may arise as well as how it

may be tackled, especially in relation to the drivers of antimicrobial use. We can look at the value of antimicrobials for different actors in order to gain insights into the status quo, important to consider if intervention is to be undertaken, both to design effective interventions and to anticipate potential consequences beyond impact on AMR.



Clare Chandler. Antimalarial medicines

Meanings and contexts of medicines for patients

The anthropological literature on the use of antimicrobials by patients is vast. Some concepts that may be useful in considering the appeal of antimicrobials, even when their use is termed ‘irrational’ or ‘inappropriate’ for a particular case, are reviewed here including their **symbolic** value, their role in rituals of care, what has been termed the ‘placebo’ effect, and fourth the ability to tailor purchases according to affordability.

First, the concreteness of antimicrobials as a solution, helps to define the problem in a more concrete manner – it enhances the perception of illness as something tangible, which may be manipulated (Van der Geest & Whyte, 1989). This adds to the observation that a doctor’s prescription serves a legitimising function, allowing an individual to take on a **sick role** (Parsons, 1951). A

crucial distinction with this earlier theory, however, is that medicines can be detached from the professional encounter. In many settings they can be purchased. However, more than simple commodities, medicines (especially of the antimicrobial variety) carry built-in associations with knowledgeable doctors and with technological sophistication. Following ideas from classical anthropology about the symbolic value of apparently every-day goods, antimicrobials carry with them the characteristics of biomedicine as a broader system.

Second, leading from the semi-autonomous nature of these medicines, antimicrobials can be adapted and adopted within other medical systems, sold outside of medical settings, and used as self-medication. For example, capsules can be opened and sprinkled on wounds; tablets can be mixed with others into 'cocktails', and can form part of a process of care involving other traditions and **rituals** (Haak & Hardon, 1988; S. R. Whyte, 1992). Self-medication has been a fascination of the public health research community, assumed to be undesirable as consumers are believed not to have correct knowledge (Haak & Radyowijati, 2010). Anthropologists have applied frameworks from comparative **medical systems** work (such as the three sectors: popular, professional and folk) to understand antimicrobial use in lay networks, medicine sellers, pharmacies and so on (see Whyte et al. (2002) and Haak & Radyowijati (2010)). Anthropological documentation of the every-day practices of informal providers and their clients (such as Sringeriyuang, 2000; van der Geest, 1982, 1987), have opened up for investigation and intervention a wide range of locations in which antimicrobials were being traded and consumed (S.R. Whyte et al., 2002).

Third, the experienced effects of a drug may not align with biomedical expectations of its active ingredients; an 'inert' pill may have a positive impact on the patient. This has been termed a **placebo** (literally, 'I shall please') effect. Anthropologists have studied this as part of the human healing process, in which the pill has become a symbol carrying meaning within particular events, relationships and histories (see Moerman (2000) and Whyte et al. (2002)). The

confidence and expectation built into a pill, which reflects a wider set of relations and experiences, is enacted in a biomedical encounter with some self-awareness on behalf of both prescribers and patients. In Cameroon, clinicians openly recognised that they were providing 'psychological treatment' to patients in the form of pills, as well as diagnostics (Chandler et al., 2012). The authority and power of such biomedical commodities appears an important part of such processes of healing.

Fourth, medicines are appealing for every day economic reasons. These include the possibility to start and stop treatment at will, including to save or share drugs; to purchase the amount that can be afforded (van der Geest, 1987) and also the anticipation that by taking these medicines one can return to work rather than requiring time to recover (Chandler et al., 2011; Vuckovic, 1999). Each of these issues is important to consider in scenarios where medicines require out-of-pocket-payments and where day-wage labour is common.

Because of these different charms of medicines, they may be integrated into multiple forms of healing. There is a vast anthropological literature on **medical pluralism** – where multiple systems of healing are seen to exist as alternative or inter-related systems where patients access care. This work is informative in contextualising access to antimicrobials, which may be sourced in small shops, by a range of healers, in market places, pharmacies, private and public biomedical practitioners. In heterogeneous health sectors, patients may easily switch between providers depending upon the success with one or the other during a particular episode, called '**medical syncretism**'.

In sum, patients can be seen through anthropological studies as experts on how to elicit and accomplish the healing that they regard will be most likely to 'work' for them. 'Just as men and women infrequently behave as the rational, economic actors envisioned by health planners and policymakers, what they know to be true about health, illness, disease and medicine is often not what biomedical clinicians want them to know' (Foley, 2010 p6).

Meaning and contexts of medicines for providers

Research into the rational use of medicines has identified that prescriber 'irrational' use of antimicrobials is at least in part due to matters beyond the perceived medical suitability of a particular drug for a particular patient.

The context of care shapes the meaning of medicines for both providers and patients. Kleinman's professional, folk and popular sectors model in which different social relations as well as clinical realities were key characteristics (Kleinman, 1980) has been developed further particularly with empirical studies of informal medicine sellers. Whyte and colleagues draw attention to drug shops as a common feature in many health systems but which fits uneasily into this model. They highlight that a key characteristic of such sources of medicines is that 'going to a drugstore to seek health care allows one to retain more control while still taking advantage of the **knowledgeability** of the retailer, whether certified pharmacist or experienced drugstore attendant.' (2002 p100). Cross & MacGregor (2010) additionally examine the way informal providers are portrayed in global health literature. They highlight the ways in which descriptions such as 'irrational' are 'deeply entwined with prejudices and pre-conceptions based on **hierarchies** of caste, class, gender or ethnicity' (p1595). They expand, 'the portrait of irrational village practitioners and their fatalistic rural patients also marks a social hierarchy between agents of development and the people they target, so that lay knowledge or practice comes to be defined by and against the rational, educated, elite cosmopolitan'. These practitioners then, can be seen as 'those against whom the educated and rational self is defined' (Pinto, 2004). This **relativist** perspective of the placings of different actors by those operating in global health is crucial for interpreting medicines use studies – their findings and their framings.

Anthropological research, then, has attempted to situate medicines as they are prescribed, sold, traded within local networks of relations embedded in particular histories, legacies and political economies. This body of research and its legacy allows us to see medicines as a central



Justice Police Officer inspecting a Pailin pharmacy's display cabinet. WHO/Moeun Chhean Nariddh (2011)

symbol of biomedical and other forms of care provision. The concrete nature of medicines, or in their stead a medical prescription, is seen as crucial to their charm for providers as much as for patients. Thus, anthropological studies have revealed the ritual elements of consultations that providers employ with their clients or patients, with medicines as a closing ritual.

The need to provide a 'strong' medicine, such as an antimicrobial, rather than a 'simple' medicine such as paracetamol has been contextualised in anthropological studies by the importance for prescribers of maintaining status as a gatekeeper for biomedicine. For medical professionals, their **authority** can be maintained by their ability to write prescriptions and provide access to medicines patients are 'not supposed' to obtain from others (S.R. Whyte et al., 2002). It may also relate to the 'placebo' effect described above, whereby faith of both the practitioner and the client in the medicine can result in an improvement in outcome even if the medicine does not contain the properties biologically required (Moerman, 2000). Thus, even if guidelines suggest a particular management of for example diarrhoea with oral rehydration solution (ORS), there may be numerous reasons why antimicrobial treatment is instead or additionally provided, including the devalued **status** of ORS by comparison (Howteerakul, Higginbotham, Freeman, & Dibley, 2003).

The reasons that medicines or prescribing has become the desired outcome are also of interest to anthropologists. Historically, antibiotics enabled a

new basis for authority of physicians, and became woven into the consultation process. With time pressures and high patient numbers, antibiotics often replaced the time that a patient may have once received from a doctor. Pressured doctors could speed up throughput by writing antibiotic prescriptions (R. Bud, 2007b). Another reason anthropologists have described for consultations culminating in medicines or a prescription is as a way of dealing with uncertainty and emotional concern; 'prescription fits the impulse of modern

man to control his own destiny, to take the problem in hand and conquer it with technology' (Pellegrino, 1976 p626). Here, we can see how the matter of medicines use or prescription, moves well beyond the biological needs for a particular drug in a particular case. It has become an expected part of the clinical encounter, embedded in the rituals of providing care, as well as a **technological solution** during health encounters where there is limited time to provide care for each individual patient.



Application of theory

This section illustrates how the social (primarily anthropological) theory introduced in the preceding pages can be drawn upon to see something different in our landscapes of antimicrobial use. Specifically, two areas will be developed, to attend to the complex realities of attempting to target antimicrobial medicines and to consider the multiple functions antimicrobials have in society as they form a part of our infrastructure. These perspectives allow us then to

consider what may be at stake when shifts come about in our ability to use these medicines.

The complex realities of targeting antimicrobial medicines

Targeting antimicrobial medicines is central to the rhetoric of preserving their efficacy (see for example, Wellcome Trust, 2016). Targeting has been attempted through regulation, such as prescription vs over-the-counter access to medicines, implementation of clinical guidelines on

prescribing, use of diagnostic testing in combination with clinical guidelines and other incentive schemes to drive reduced prescribing. Drawing on the perspectives outlined in the theory review above, it is possible for us to apply different theoretical lenses to the lived experiences of targeting in order to interpret why often these measures have limited impact on the outcomes they strive to achieve. We can come to see how the idea of targeting, which carries an idea of improving access, can in the event be experienced as the inverse, as rationing or denial of medicines. This has been well documented in the field of antimalarial targeting. Revised clinical guidelines and new point of care rapid diagnostic tests (RDTs) have been implemented widely in order to reduce overuse of antimalarial medicines, but in many cases antimalarials have continued to be prescribed even when RDT results are negative for malaria (for an overview, see Rao, Schellenberg, & Ghani, 2013). Anthropological work alongside the implementation of these tests has highlighted how both prescribers and patients see these tests as qualifying and disqualifying patients from getting medicines (Beisel, Umlauf, Hutchinson, & Chandler, 2016). In the knowledge of these disqualifying technologies, patients have been documented to avoid health centres that use these tests where their established modes of care are disrupted (Umlauf, 2017).

These scenarios where targeting medicines is experienced as denial, raise the question of what is provided in healthcare in the absence of medicines. Furthermore, patients, carers and health workers are alert to the limitations of care beyond medicines – they may replace one antimicrobial with another (antimalarials substituted for antibacterials for example, see Hopkins et al., Forthcoming), or there may simply be no care. To manage the latter, health workers have been observed to shift their role and allegiance, becoming a limb of a prescriptive state/donor entity rather than an ally of the patient for whom the health worker can do little (Hutchinson et al., 2015). The patient may then be cast as not ‘deserving’ of care altogether when not qualifying for particular medicines, as was reported by Ugandan health workers (Chandler et al. forthcoming). This aligns with critiques of Western

medicine as having moved from a pre-modern era of holistic healing to ‘modern’ in which other aspects of care are stripped away in an attempt to cure (Gray, 1999). Elements stripped away are then sought elsewhere for example in other healing systems. Reflecting on this scenario in which care is based on specialties rather than on the person, there have been high profile calls for ‘integrated medicine’ that again resituates the patient rather than technologies at the heart of services (His Royal Highness The Prince of Wales, 2012).

Why do we resist this suggested ‘integrated medicine’? Initial responses revolve around cost, and cost-effectiveness. This contextualising of care as operating within limits of affordability, perspectives on rationality and promise of technology highlight that targeting of medicines occurs within health care systems that are embedded in particular economic and political frameworks, that have an interest both in providing care to ensure wellbeing and productivity of populations, but also to securing the economic position of a given country which usually relies on a capitalist business model, in which Big Pharma is to be courted (Katz, 2005).

When considering how targeting initiatives travel to other settings, we are also then aware of how the nature of these initiatives relates not only to improving health in the most effective way but to also achieve other goals, priorities and mandates of donors.

Antimicrobials as infrastructure

The fear that a threat to antimicrobials signifies the end of modern medicine demonstrates how important these medicines are understood to be: across a breadth of medical practice from infectious diseases to surgery, such as hip replacements or caesarean sections. This also provides a useful opportunity for us, to see what is taken for granted in the current infrastructure into which these medicines are woven. Drawing on Star and Bowker, who work to make infrastructure apparent, in a ‘struggle against the tendency of infrastructure to disappear’, it is possible to identify the characteristics of an effective infrastructure through technique of inversion (Bowker & Star, 2000). By looking closely at

technologies and arrangements that, 'by design and by habit, tend to fade into the woodwork (p34), we can begin to see what things in our material and semiotic networks support this position of antimicrobials and make them so difficult to remove.

Three examples are: how antimicrobials are intertwined with our infrastructure through ideas of productivity, such as expectations around time to recovery. An inversion would be convalescence, which provides a counterfactual through which to explore existing (often invisible) infrastructure. A second example could be how antimicrobials are interwoven into our food infrastructure through standardisation. An inversion could be the artisanal movement which throws up the material and immaterial hooks upon which our food infrastructure hangs. A third example could be how antimicrobials are interwoven into our sanitation practices across scales from disgust responses to vast spaces frequently in receipt of antimicrobial spraying. An inversion could be faecal transplants or the increasingly popular dirt hypothesis. In all of these cases, the inversion allows us to see our oft unseen infrastructure.



"Every Minute Lost on this Job may Mean.. (Unknown, 1941- 1945)."

These cases then may prompt us to ask whether this infrastructure can change? We can ask individuals to change – to stop taking antimicrobials, to stop using them in food chains and to increase exposure to microbes – but we know this is difficult to do. By paying attention to the infrastructure that these behaviours are embedded in, we can begin to see what it would take to achieve these behaviours, or at least to state more clearly what is at stake.

Possibilities for change have provoked a question of 'what would a postmodern medicine' look like? Some observers suggest that this era is already here (Gray, 1999). These processes may well dovetail with demands for reducing reliance on antimicrobials. Infrastructure, however, may require deliberate intervention to change, specifically attending to values of productivity and time, of standardisation, and of sanitisation. When we see deeper societal, economic and international relational pillars that support this infrastructure, we can begin to see the scale at which shifts would be required to make a substantial difference to antimicrobial use. The view then renders the current emphasis on cognitive awareness and behaviour change as somewhat limited in potential to impact upon antimicrobials. It could even be proposed that by focusing on this tip rather than the iceberg, the status quo of pharmaceuticalisation is secured and reinforced, as is seen with the desire and investment in further medicine alternatives (see Part 2 AMR Policy).

To conclude, this part of the report has described theories used to understand antimicrobial usage in practice, and has provided illustrations of how these theories can be applied. In so doing, it has raised observations that allow for different perspectives to be taken to the ways we consider the 'problem' and potential solutions. In summary, a focus on human behaviour in understanding antimicrobial use is just the tip of the iceberg.

Part 2

Applying Social Theory to Antimicrobial Resistance Policy

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Review of relevant theory

The anthropology of policy

Since the beginning of modern anthropology, anthropologists have provided knowledge for policy-makers including analyses of the impact of particular policies upon different groups of people (Cochrane, 1980; Hinshaw, 1980). Such tasks remain a central part of the work done by many applied anthropologists whose instrumental interactions with policy means that they see their task as making development policy more effective and equitable. Their work has had a significant influence enabling concepts of participation, empowerment and social capital to become part of the lexicon of development. Yet, fundamental shifts in the discipline in the 1980s, meant that a new approach to policy as a human endeavour that was both historically and culturally embedded emerged (Shore & Wright, 1997). This 'anthropology of policy' grew out of anthropological analyses of organisations (Wright, 1994, 2004), influenced by the interest in "studying up" (Nader, 1972).

Anthropological accounts of policy offer useful insights into how to conceptualise policy as a process and as a means of managing **social change**. As they follow the formation of formal and informal social relations and the real life situations of those seeking to formulate policy, anthropological accounts tend to reject what has been described as an **instrumentalist** view of policy as a technical, top down means of managing society (Shore & Wright, 2011). Instead, heavily influenced by Foucault, they suggest that accounts of bureaucratic influence in society, policy discourse and narrative such as those around AMR must be examined as a means of extending **power** through late modern forms of governance. These policy discourses locate problems in particular spheres by defining the ways in which they are perceived of, to be acted upon and the ways in which particular forms of **governmentality** come about (Hyatt, 2011). New policies often shut down other ways of thinking through the issue at hand as they formulate their response to the problem thus limiting how we can act on a problem (Shore & Wright, 1997). In relation to AMR, the literature suggests that we should critically evaluate the focus on individuals

(doctors, patients, drug sellers and their customers) as the locus of problematic behaviour that drive of AMR. Instead or alongside this, we should also critically assess why the problem is identified at this level and examine how the social, medical and political structures within which these individuals live and work, how it is that these structures are excluded from relevant **discourses** and the consequences of this exclusion.

Analyses of policy by anthropologists have also been concerned with the metaphors and symbols that are contained within policy narratives and the way in which these are implicated in the construction of new forms of **moral personhood** (the creation of new subjects and new kinds of subjectivity) in policy discourse and in its translation into practice (Nielsen, 2011). Such an approach asks us to consider how policy works as an actant, that is how it comes to be productive in ways not necessarily considered by those who have drawn it up.



United Nations Global Health Assembly September 2016, Shutterstock

Accounts of the anthropology of global health that look closely at policy and its implementation within bureaucratic settings (Storeng, 2014; Storeng & Mishra, 2014; Taylor & Harper, 2014) remain relatively rare. In contrast, a critical ethnographic gaze has been brought to bear on powerful actors working in **bureaucracies** and development organisations who formulate policy and those who reinterpret it into other settings (Mosse, 2004, 2011) (Müller, 2013).

These ethnographic studies of policy and governance go beyond documentary analysis and complement constructivist accounts of global

policy-making and governance from international law and in policy studies. In both subjects, political and legal negotiations are understood as messy and contingent, subject to complex bargaining, negotiations, issue-linkage, trade-offs, and sometimes coercion (Cortell & Davis, 1996; Finnemore & Sikkink, 1998). For both, the accounts of the ways in which international, local and national processes are intertwined, often raises questions about the legitimacy of **global norms** (Müller, 2013). Applied to global health policy, these analyses raise questions about how political or policy objects (such as AMR) move into different national and local levels. It also draws our attention to the ways in which the legitimacy of the topic under discussion is constructed and contested must be taken into account and raises questions about the absence of civil society actors, state actors from low-income African settings, in particular.

Studies of policy by anthropologists are attentive to the relationships between politics and policy making and running throughout the anthropological accounts of different policy worlds and their impact is a concern with the ways in which policymakers and processes of policy making are involved in action that seeks to **render technical** political questions and concerns (Ferguson, 1994; Li, 2007). This process of rendering technical is not always successful and takes a good deal of on-going work but when it is a success then it can obscure a number of powerful forces shaping the problems under debate. Drawing on Foucault, development has been described as an '**anti-politics machine**', making particular formulations of problems to be one of common sense rather than one formed in and from a particular historical moment (Li, 2007). How AMR policy works on more politicised elements of global public health, in particular claims to health-based human rights discourses around access to medicines will remain of particular concern.

Anthropologists concerned with the relationship between global or international policy and practice have interrogated (ontological) questions about what policy is, how it is made and the effects that it may have. In his seminal and challenging account of international development policy, for example,

Mosse argued that what makes good development policy is not its ability to provide a blueprint for effective action at grassroots level but rather its ability to legitimise practice and mobilise other actors to support it (Mosse, 2004). This means that the needs of the organisations that are implementing policy are likely to come first as the policy is made and discussed. According to Mosse, much of the work of **enacting policy** revolves around translating and representing their on-going work and its outcomes as part of this new policy domain. In this way, practice has been said to make policy rather than the other way around and the interpretative abilities of these policy/practice actors are shown to be critical. Yet, Mosse's most controversial contribution to the literature is his argument that what is important in defining success within international development is not the inherent success of the project but the ways in which success itself is **socially constructed**. According to his account, we must always attend to the ways in which policy fails – which is likely to be not because it is ineffective or fails to enable change in the way that it prescribed but rather because the **interpretive community** around it falls apart or fails and with it an effective interpretation and narrative of success is also lost.

One of the key ways in which policies on AMR are able to circulate and be a successful policy object is through its establishment as an issue for the globe rather than nation-states. The development of antibiotic resistance (ABR) is the key concern for most high-income settings and has been connected to concerns for the efficacy of medicines for malaria and HIV/AIDS under the broader category "AMR". This definition of the **policy object** as AMR rather than ABR is therefore central to its success as an object of global, rather than regional or national policy. Nonetheless, the temptation to only act on ABR remains powerful for actors from high-income settings. Whether the problem remains AMR or whether the term AMR is practiced as a set of activities against ABR remains to be seen. How these tensions between AMR and ABR impact on the policy problem and its ability to travel and provide an effective object around which action can take place will be of critical concern over the next years.

Anthropological accounts of policy are therefore likely to draw our attention to who makes the policy, how it reflects the immediate needs of the policy makers, how **power relations** effect what can be said and the construction of an interpretive framework through which others can be recruited. For AMR, the concern becomes then not "how well does AMR reflect real concerns in the world?" but rather what are the political and economic concerns that underpin and emerge through AMR policy, how are different projects and processes made to cohere as AMR, how is success constructed and how will these shape the ability of other political actors to become part of the interpretive community that will support the policy? What are the political processes (access to medicines, care, the role of markets and the state for example) that are likely to be rendered a technical matter that gets formulated in neutral language? What are the new forms of **subjectivity** that arise within this (people who waste, misuse or abuse antimicrobials), what new forms of morality and immorality are implied in these interventions? Tracing the debates that take place within global policy forums, understanding which elements of these discourses 'echo' effectively in different policy arenas and are taken up, the multiple concerns are made to cohere under the AMR, will be important research activities. Through analysing these, we will be better able to address who wins and who loses as AMR policies are drawn up and enacted and how it is that these winners and losers are positioned in this way (Gardner & Lewis, 2015).

Anthropology of global public health

Recent anthropological accounts of global public health as a field of practice have focused on indicators, on the ways in which care has been formulated and accessed in middle or low income settings in the last 15 years (Adams, 2016; Geissler, Rottenburg, & Zenker, 2012). Some have identified global public health as a collection of practices that placing a priority on improving health and achieving equity in health for all (Bozorgmehr, 2010). Others, however, in attending to practices reveal a field that revolves around neoliberal

formulations of public policy. For them, it is characterised by the targeting of public resources to particular diseases or recipients, governing health workers and patients from a distance, using projects and short-term programmes. These often rely on the circulation of commodities to achieve their aims and using indicators as a means to monitor and evaluate action are characteristic of global public health (Adams, 2016; Janes & Corbett, 2009). Just as the earlier literature described the symbolic power that medicines carry in many societies, in global public health pharmaceuticals appear at certain moments to have charm. They appear to be imbued with such power, so that they appear a magical solution to some of the most complex problems within and between societies. In relation to policy, the claims made of medicines is that their circulation will lead to an elimination of incurable diseases (Granich, Gilks, Dye, De Cock, & Williams, 2009) and perhaps most startlingly will be able to "make poverty history", a claim that has been roundly challenged by Allen and Parker (Allen & Parker, 2012).

Drawing on political economy, anthropologists concerned with how as the state has been rolled back and the institutions in which citizens can secure services have been hollowed out (Pfeiffer & Chapman, 2010), medicines have continued to circulate. This has led some to argue that in many settings public health has been reduced to the provision of pharmaceuticals, in other words, that is it has been pharmaceuticalised (Biehl, 2007). For Nguyen, the persistent asymmetrical access to resources between those seeking and those providing treatment for HIV, the availability of pharmaceuticals in the absence of other forms of public health have led to a re-forming of citizenship claims around medicines and a new form of therapeutic citizenship emerges (Nguyen, 2010).

How these forms of action among policy makers and these forms of citizenship are challenged when medicines are rendered less efficacious or access is further restricted will be an important area for anthropological investigation and analysis.

Application of theory

AMR reinforces and reanimates the role of pharmaceuticals in global health

In the field of science and economics, there is evidence that AMR has become a spur for innovation (the creation of new medicines), the cracking open old, Darwinian ways of thinking about the world, startling researchers and creating moments of reflexivity. For global public health policy makers, researchers, programme implementers, AMR could be a profound challenge to pharmaceuticalised forms of care that rely on the circulation of medicines to act on health. It could be part of a process through which the limits of medicines to travel (and be used without significant consequences to their efficacy) is revealed and in so doing could new ways to act on health could be imagined and come into being. What is striking in the current policy discourse is that despite these challenges AMR does not work to decentre medicines and it has yet to open a space in which new practices or indeed more traditional public health practices emerge. Instead, policy documents continue to focus heavily on medicines, on finding ways to invest in order to increase the range of antimicrobial medications available and improve their use through the introduction of new health commodities - rapid point of care diagnostic tests - and through the improvement and upgrading of laboratories.

It seems, therefore, that AMR is a new *discourse of* rather than a *challenge to* pharmaceuticalisation: it enables medicines to take up more ground in the policy discourse and re-animates their desirability as objects that deliver health around the world. If we take Foucault's argument that discourse is productive, then in turn, the questions must be asked of what becomes of this, what are the effects of simultaneously maintaining the central role of medicines to manage ill-health and disease and tackling AMR, what are the new forms of power that arise, how are they manifest?

AMR narrows the goals and broadens the means of global public health

In global public health, discussions of AMR and antibiotic resistance revolve almost exclusively around medicines and as they do, the discussion of

medicines expands, vulnerable people seem to disappear and instead vulnerable medicines take their place. If we attend to the means and the ends of development, as Mosse (2004) suggests, we should then we see how under different agendas these means and ends of global health get reconfigured. Just as is the case in many development projects, the goals of action become increasingly limited and the means through which they are to be achieved expand. The aims of global health endeavours around AMR are rarely presented in terms of improving the health of people. Startlingly, improving health shifts to become a means - reducing cases of childhood diarrhoea, for example, is presented as a good opportunity for combating AMR, because fewer cases of childhood diarrhoea means that people are less likely to use antibiotics (O'Neill, 2016).



Clare Chandler. Slum area Kampala, Uganda

Discourses of AMR delink health and politics in novel ways

As concerns of AMR are discussed, new processes are emerging that further delink health and politics as debates and access to medicines is rendered technical in novel ways. The space for political discussion around rights and access that has been central to the scaling up the use of antimicrobials

in low income settings, gets curtailed by concerns about AMR. In the World Health Organisation's Global Action Plan on AMR, for example, the most politicised debate in the field, - access to medicines - is acknowledged and then bracketed (World Health Organisation, 2015). But, there is more debate about the relationship between access to medicines and AMR than the WHO GAP suggests, and certainly those who can then lay claims to technical approaches to ensure better targeting seem likely to have taken them up.

“Antimicrobial resistance is a drain on the global economy with economic losses due to reduced productivity caused by sickness (of both human beings and animals) and higher costs of treatment. To counter it, long-term investment is required, such as financial and technical support for developing countries and development of new medicines, diagnostic tools, vaccines and other interventions, as well as health system strengthening to ensure more appropriate use of and access to antimicrobial agents.”

(World Health Organisation, 2015)

Discourses of AMR are laying the foundations for new forms of morality

A good deal of emphasis on the management of AMR is through the provision of knowledge (about AMR) as a means through which people should reduce their use of antimicrobial medicines. These new discourses of AMR have the potential to lay out what it means to be a good, (productive) member of the body-politic and a member of its respectable citizenry - that is someone who does not 'abuse' medicines, who does not destroy a "public good" through their own use. As is common in economic theory, in these discourses many of these pit the needs and desires of the self-interested, rational individual against society - and the idea that AMR is a form of tragedy of the commons has emerged as key trope in the narrative (Porco et al., 2012). These discourses about respectability do not only relate to individuals, the mapping of national actors in relation to AMR has also become a way of differentiating between national level governments. Rates of AMR have, for example, been correlated with levels of corruption, and those with high levels of resistance emerging as

likely to be those with high levels of corruption (Collignon, Athukorala, Senanayake, & Khan, 2015). It seems likely that this will be extended to different state actors through potential legal agreements on reduction of antimicrobial resistance and there is an already emerging discourse differentiating between African governments who are "left behind", that is those that fail to act by refusing to take on particular policy objects.



AMR/ABR Consolidates Euro American concerns and norms at the heart of global health

AMR is a central policy object around which global health itself is being remade. It is facilitating new political alliances between industry, international organisations and governments, but access to these spaces or the debates has been restricted, and only those with a place around the table, with the finances and time to attend meetings are able to be part of these negotiations and discussions.

The formal and informal discussions about antimicrobial resistance at global level have, been driven by a largely top-down process by European actors - UK, Scandinavian and German governments and the Europe, along with Australia and the United States and with little input from civil society (with the exception of Medicines sans Frontiers). The lack of involvement of African national governments, for example (with the exception of the governments of South African, Ghana and Kenya) and lack of statement by the African Union means suggests that their voices, so

far, have not been heard in terms of formulating global AMR agendas.

In terms of documentation, the O'Neill reports commissioned by the British Government were specifically devised with the aim of presenting AMR as a global problem to influence global debates, and be released in time for the 2016 World Health Assembly. While the accuracy of the figures presented in the reports has been questioned and senior members of O'Neill's team continue to provide public reassurance that their startling statistics are accurate (Audi, 2016), these numbers and the formulations of the problems that they

underscore have echoed in the most important global health meetings in Geneva (the 2016 World Health Assembly), and in New York (at the United Nations General Assembly (UNGA) high-level meeting held later in the year). The central role played by the UK government in placing AMR on the global agenda was also reflected in the claim of the UK's department for international development's press office, "UK secures historic declaration on antimicrobial resistance" following the meetings successful outcome. (Department of Health (UK), 2016b).

Part 3

Applying Social Theory to Antimicrobial Resistance Science

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Review of relevant theory

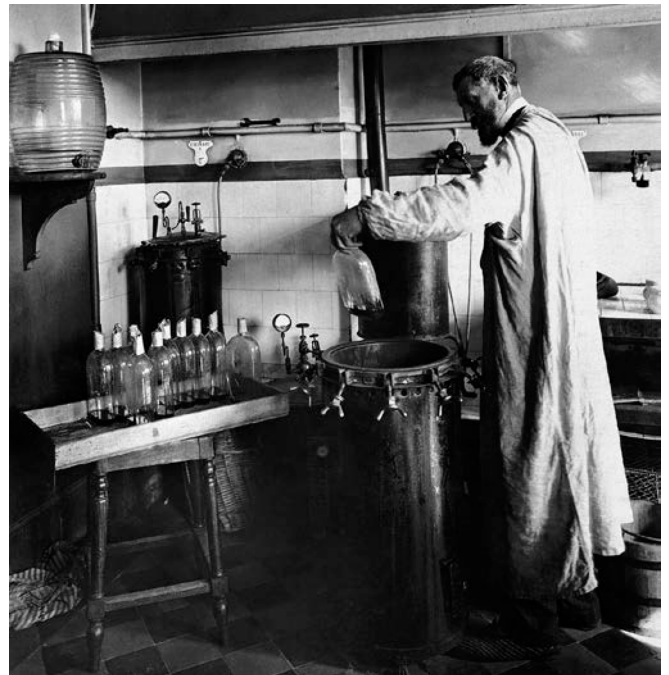
Studies of science and its associated technologies, as well as their relation to practice, politics and society are a relatively recent area of research for anthropology. In spite of this, anthropological studies of the ways in which science and technologies are made and practiced is informative for reflecting on our understanding of AMR as a problem. Following in the footsteps of anthropologists who have shed new light on the construction of scientific facts such as human reproduction and women's menopause (Lock & Kaufert, 2001), the formulation of AMR as a scientific object can be reviewed in the light of the linguistic and relational accounts within science, policy and society. Such work allows us to reconsider the ways we imagine AMR, and allow for the emergence of alternative ways to construct AMR as problem, offering other possible avenues for future intervention.

A variety of fields have contributed to the development of current approaches to the study of science and technology within anthropology. A closer look at some of these contributions, in light of the current limited work by anthropologists on the science of AMR, will help highlight some potentially relevant empirical work and draw attention to theoretical, conceptual and methodological literature, which could benefit future AMR research and policy development.

Science in practice

The emergence of anthropologies of science in the 1990s, was part of broader shifts – postcolonial, feminist, geopolitical, economic, political, cultural and intellectual -, which gathered momentum in the latter half of the twentieth century and challenged the exemption of the Western scientific establishment from political and cultural critique (Franklin, 1995). Previously, anthropologists had reserved the focus of their fieldwork for the study of cultures of non-European and North American societies. European and North Americans (except for First Nations and Native Americans) were largely exclude from anthropological work, since science was claimed as an exclusively Euro-American practice. Contemporary anthropological approaches rather than accord science any special privilege, instead engages with it, as it does any

other socio-cultural-material field. Latour and Woolgar's (Latour & Woolgar, 1979) work on a biological laboratory in the US is exemplar of this. It is the first anthropological study to explore empirically the mundane practices, people and objects involved in the construction of scientific facts. This required them to extensively observe how scientists conducted their work in their laboratories, finances, paper writing, questions of scientific prestige, the roles of objects in their work and the complex relations between all of these in the **production of scientific life and facts**. It is this focus on the production and use of scientific research and facts, as well as technologies attributed to science – in laboratories, hospitals, government offices and everyday life – that allows anthropology to **go beyond official and published accounts of science** (Bertoni, 2016).



Louis Pasteur conducting an experiment (Britannica Online for Kids, 2016).

The development of a focus on practice in anthropologies of science owes much to the recent work of Annemarie Mol and colleagues, such as John Law (2004), Andrew Pickering (1992), amongst many others. In her work on atherosclerosis in a Dutch hospital, Mol (2002) shows that atherosclerosis is more than a textbook description of the *'gradual obstruction of the arteries.'* Rather, what atherosclerosis *is*, differs with the practices it is bound up in, each practice, whether it is observing, measuring, discussing, treating or operating, does a different **version** of

atherosclerosis. The implication is that the apparent singularity and coherence of atherosclerosis is an effect of a range of **techniques and activities that coordinate** different practices, such as conferences, medical images, forms and metrics, and doctor-patient consultations. This close focus on the **practices of science and the objects involved in it**, is essential to understand how science, technology, politics and society continually shape one another and the different forms they come in. A focus on how AMR is

practiced across different spheres, will offer insights into what techniques are required to maintain it as an apparently, globally coherent object, and in doing so, also reveal what different practices are concealed. For example, what accounts of the importance of AMR are not being discussed by policy-makers, or what alternative forms of care to antimicrobials are already being practiced.



Milk pasteurisation system

Science, networks, histories, discourse

History of science has further contributed to the methodological and conceptual development of anthropologies of science. Work, such as Shapin and Schaffer (1985) book on the 17th century Hobbes-Boyle debate on the air-pump experiment as a method to demonstrate the existence of a vacuum (space without air) or Haraway's *Primate Visions* (1989), have illustrated how a focus on the **socio-cultural-material** conditions that scientific research are embedded in, reveals the **contingency** of the knowledge produced, and how the society and science **co-construct** each other (Fischer,

1999). A relevant development of this method and example for public health and microbes, is Latour's book, *The Pasteurisation of France* (1993, published in French in 1984). In it, he demonstrates how the 'victory' of microbial theory of disease (over miasma theory) and the attribution of its success and development to Louis Pasteur cannot be reduced – purely - to his genius as a scientist. Rather, for Pasteur's theory to triumph, he had to rely on the mobilisation of **networks** of a diversity of actors, including: public health hygienists, private and military medical professionals, farmers, industrialists, various technical equipment, the

French Academy, newspapers, journals, Louis Bonaparte and microbes, themselves. In other words, a focus only on the heroism of Pasteur, obscures the essential role that these other actors and activities (e.g. hygienist movements, colonialism and government deliberation) had in the success of his laboratory work in changing scientific understanding of disease and society in relation to hygiene practices, such as the pasteurisation of milk.

A focus on **networks**, or **actor-networks** as labelled by Latour (ANT) (2005), allows us to describe the material-semiotics required to practice and produce science, with particular attention to the connections beyond the boundaries of scientific laboratories, illustrating the **dependence** of sciences on society and politics, rather than its independence. When combined with historical analysis, this allows us to reveal the contingency of networks and practices the role of shifting biological and social **ideas** in determining particular scientific understanding and technologies. Landecker's (2015) work on antibiotics or Paxson's on cheese and microbes (2012) provide relevant examples for anthropological approaches to the science of AMR. They can help us understand how the meanings associated with terms such as 'antibiotic resistance' or 'microbes' can shift both historically, but also in different **contexts**, demonstrating the effects of scientific knowledge on the world, its potential limitations and the way alternatives can be side-lined or ignored as a consequence. For other historical work that have explored entanglements between science, politics, companies and publics, see for example the works of: Robert Budd (2007); Scott H Podolovsky (2014); and Quinn (2013). These works also touch on public, political, corporate and scientific discourse, which offers fruitful insights into popular perceptions about science, the political and **partial mobilisation** of scientific evidence and language (such as metaphors) that influence scientific concepts. For contemporary applications of discourse analysis relevant to antimicrobial resistance, see: Brown and Crawford (2009) and Nerlich, Brigitte and James, Richard (2009) on war metaphors and catastrophic discourse; Brown et al (2009) on biosecurity, hygiene and superbugs;

Brown and Nettleton (Forthcoming-a) on blogs, immunity and xenophobia.

Anthropology beyond humans

Anthropology's focus on science, is now accompanied by increasing interest and exploration with other nonhuman organisms and our relations with them. This shift in focus has been referred to as the 'species turn,' indicating a growing number of anthropologists' attempts to go beyond humans and take the lives of other species seriously. In this sense, it has become a sub anthropological genre in its own right, and is broadly grouped under the term 'multi-species ethnography' (see for example S. E. Kirksey & Helmreich, 2010 and others in the same Cultural Anthropology special issue for some discussion of its emergence and examples of relevant texts).

Multi-species ethnography builds on the insights on the multiplicity of objects in practices and other critiques of the nature/culture dichotomy. In doing so, it seeks to contribute to better understanding how we **live with and against** other species (e.g. mammals, insects, fungi and microbes), their conceptual and material **relations** with humans and the ways that economic, political and cultural processes shape them. Donna Haraway's work with and on dogs as 'companion species' offers a key starting point for understanding how the power of a multi-species approach troubles questions of human exceptionalism, agency and the nature/culture dichotomy (Haraway, 2008). Her focus on the **co-existence** of humans and dogs through processes of domestication, co-evolution and training amongst many others, shows how these processes have (and continue to) shape and transform not only dogs, but also their owners, as well as the way they **co-produce** niches and ecologies (Haraway, 2008; Kirksey & Helmreich, 2010). Anna Tsing's recent work on Matsutake mushrooms (Tsing, 2015), in addition to Donna Haraway's (2008), demonstrates what Kirksey (2014 p3) identifies as an important aspect of much multispecies work, which is a focus on what it means for humans to live with and against other species, rather than grappling with the difficult question of how to speak for other species. In addition, such a focus also benefits from

examining, 'Who benefits, when species meet?' (Kirksey & Helmreich, 2010). Multispecies work has also extended to human microbial relations, which may be of special interest to work on antimicrobial resistance: see for example Heather Paxson's (2012) work on cheese production and pasteurisation or Cecila Lowe's (2010) work on the influenza virus in Indonesia.

Drawing on the multispecies literature and some of the concepts it offers, will provide fruitful avenues for studying the many ways that antimicrobial resistance comes into being, is spread and the multiple species that may be involved in these processes. Here, anthropologists employ concepts in common with scholars of science and technology, "the earthy and muddled and tenacious engagements afforded by 'ecologies', 'infrastructures' and 'entanglements' have brought new sources of analytical vitality and valence to anthropological theory. These are

languages of description that conjure worlds of material and biotic interdependencies, human and non-human agencies weaving themselves into and around filaments of energy, matter, history and decay" (Jiménez, 2017).

Multi-species ethnography offers anthropology of science and interdisciplinary research more broadly, a way to empirically explore the contingency of human-nonhuman-antibiotic-microbe relations in the production and movement of AMR, the specificity of contexts where it arises and the different responses mobilised. In addition, multispecies ethnography may also provide a fruitful source of inspiration for diverse ways of, not only living with and against microbes (as well as other animals), but also the ways we talk about relating to them in the first place (i.e. beyond discourses of war against bacteria and apocalypse).



Cheese made from human bacteria. Image from: Wainwright, O. (2013). "Grow Your Own: where scientists and artists are shaking up creation." Retrieved 1 August, 2016, from <https://www.theguardian.com/artanddesign/2013/oct/28/grow-your-own-synthetic-biology>.

Application of theory

Antibiotics transformed human and bacteria, and back again

The discovery of antibiotics has transformed human societies through their incorporation into daily health care practices, from treating previously fatal infections to increasing the possibilities of safe surgical operations, as well as also increasing agricultural food productivity (see for example, Amyes, 2001). However, their mass adoption and use has in turn led to significant transformations. The work of the sociologist and anthropologist, Hannah Landecker's (2015) proves insightful, particularly her paper, *Antibiotic resistance and the biology of history*. She draws attention to how the promotion and use of antibiotics for human and animal health (and growth) is now evident as **biological fact**, not only in bacteria that they were designed to target (i.e. through creating selection pressures for resistance strains), but also the biology and ecology of soils, water, and animals, as well as our own guts (Landecker, 2015). This is both, in the form of an increasing prevalence of antibiotic resistant genes in microbes in different settings (Knapp, Dolfig, Ehlert, & Graham, 2009; Zhu et al., 2013), but also shifts in the presence, abundance and diversity of different microbes due to antibiotic use (Cleary et al., 2016; Gutiérrez, Watanabe, Harter, Glaser, & Radke, 2010; Matsuura & Garrison, 2011; Paterson, 2004). In other words, antibiotics have transformed human-bacteria **relations** and associated infections, which has also changed the biology of bacteria (resistance or death), potentially rendering the sustainability of current antibiotic-related practices, ineffective. In short, antibiotics transformed humans and bacteria, which has consequently, required humans to transform their relations to antibiotics; and also, potentially, to bacteria.

Human ideas transformed humans and bacteria, and back again

It is not only the biology of bacteria that has changed since the adoption of antibiotics, but also the very **ideas** about antibiotics and bacteria (Landecker, 2015). A clear example of these changes is in the scientific knowledge of the development bacterial resistance to antibiotics.

The work of multiple scientists in the nineteenth century (such as Pasteur and Koch) meant that beginning in the mid-nineteenth century it was possible to blame bacteria as infectious pathogens, for many of human ills, and later envisage antibiotics as '*wonder*' drugs that could come to our rescue (R. Bud, 2007a). A number of scientists, including Fleming, raised questions of bacterial evolution of resistance to antibiotics as a potential obstacle to their mass adoption. However, these warnings went largely unheeded (Nathan & Cars, 2014). At the time, bacterial resistance was **believed** to evolve due to antibiotics acting as selection pressures for resistant genes in bacterial populations, which were then only inherited vertically during bacterial replication (Landecker, 2015). However, a number of developments in genetics, evolutionary biology and microbiology means that these ideas are now partial, if not largely obsolete. Firstly, the discovery and characterisation of the horizontal transfer of genetic material between bacteria, shifted understandings of bacterial mechanisms for the dissemination of resistant genes, including across species lines, and their evolutionary change. This challenged previous **ideas** of antibiotic induced bacterial evolution, where some assumed that vertical inheritance – and judicious use of antibiotics – was sufficient to avoid AMR becoming a matter of public health concern. Bacteria's ability to transfer genes carrying resistance to antibiotics both horizontally and vertically outstripped previous scientific ideas of bacteria-antibiotic relations.

The second development is the discovery and increasing understanding of the human microbiome, which has accelerated dramatically in the last two decades (Dave, Higgins, Middha, & Rioux, 2012; Grice & Segre, 2012). This has led to a growing number of scientists drawing attention to significant shifts in our gut microbiota, as a consequence of continued exposure to antibiotics (Abeles et al., 2016; Liu, Wu, Ying, Luo, & Feng, 2012; Matsuura & Garrison, 2011; Paterson, 2004; Yassour et al., 2016); typically in the form of direct intake of antibiotic medication, but with increasing attention to the ingestion of antibiotics residues in food or water (Darwish et al., 2013; Sanz et al., 2015; Sapkota et al., 2008). Microbiology, and

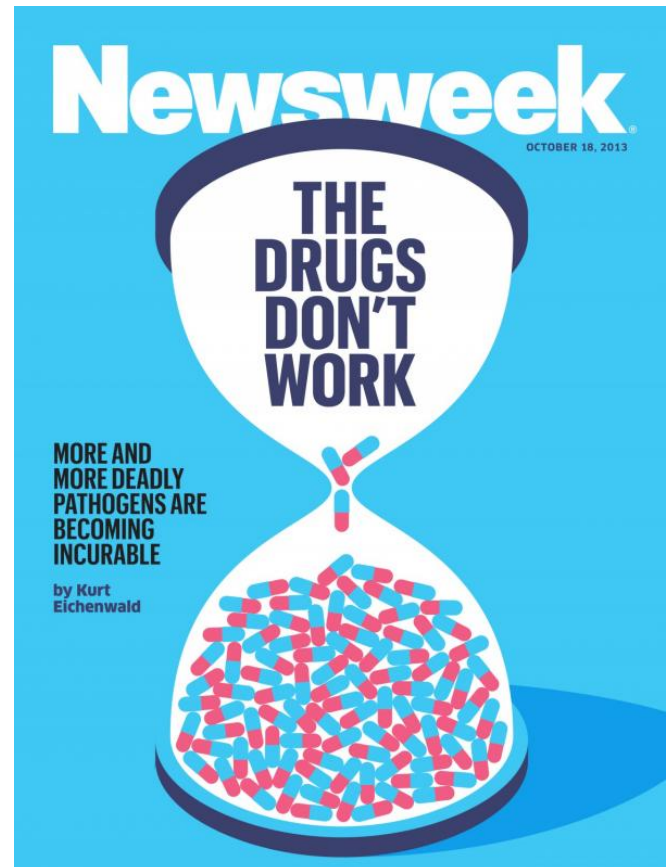
genetic epidemiology research is beginning to elucidate associations between exposure to antibiotics and negative consequences for our health, with potential links to increases in obesity, diabetes, asthma and irritable bowel syndrome, amongst others (Bennet, Ohman, & Simrén, 2015; Cox & Blaser, 2015; Mikkelsen et al., 2016).

The deficiencies of previous scientific knowledge and perhaps, some would say, myopia, are a central determining factor for the scale of present reports of global AMR prevalences and emerging fears of a post-antibiotic apocalypse, as well as potentially contributing to observed increases in some negative health outcomes. Thus, human ideas changed the biology of bacteria and our microbiota, now it is humans' ideas that are having to change in response to AMR.

A failed antibiotic future

Scientific knowledge was insufficient in-itself to mitigate the current AMR predicament. Fleming and others' early warnings of the risks of bacterial resistance to antibiotics fell on deaf ears (Podolsky et al., 2015). They lacked the strong social **networks** that other scientists, governments and large corporations could mobilise to sell antibiotics, inform policies and regulation, and influence publics. Fleming and other scientists' politics of antibiotics use (i.e. care to mitigate against the development of resistance) had little immediate impact. Instead, other scientists were involved, together with health professionals and pharmaceuticals in actively developing and promoting antibiotics as '*miracle drugs*' (Bud, 2005, 2013; Podolsky, 2014) and a future where bacterial pathogens would be completely controlled (Paxson, 2008), if not eradicated.

The reasons that the realisation of this twentieth century vision of future failed, in retrospect appears obvious. Firstly, the limitations of scientific knowledge at the time meant important bacteriological properties were overlooked (e.g. horizontal transfer of resistance genes was not on the radar nor was the human microbiome).



Newsweek cover, October 17, 2013.

Second, myopic speculations based on existing knowledge at the time, failed to account for the **partiality** of scientific facts (their fallibility and historical contingency) and the inability to mobilise complex social, political, cultural and economic factors to attempt to successfully enact such a future. Lastly, antibiotics and scientific knowledge of bacteria, were not mobilised for purely health ends, but for multiple, but not always mutually exclusive ends, such as financial profits, military campaigns and political agendas etc. This last point is all the more pertinent now, as antibiotics have emerged again in public and political arenas. Rather than an explicitly emphasising health-**ends**, these cries focus on saving antibiotics (Alliance to Save Our Antibiotics, 2016). A focus on these cries, raises questions as to what **rationalities** motivate them and what new antibiotics futures are they attempting to conjure.

The post-antibiotic apocalypse: A selective image of science

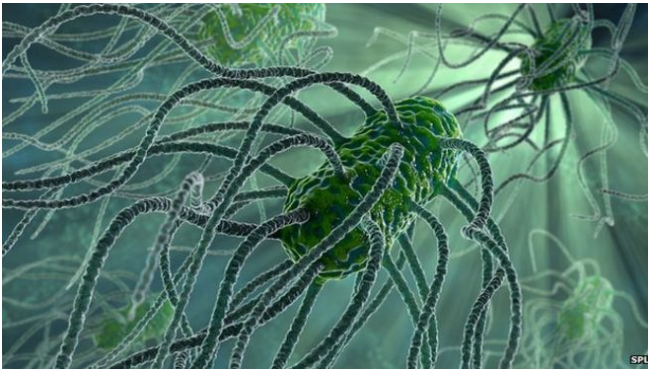


Image from: Gallagher, J. (2015). "Analysis: Antibiotic apocalypse." Retrieved 20 October, 2016, from <http://www.bbc.com/news/health-21702647>.

The relatively recent re-emergence of antibiotics in public and policy spheres, as AMR, has occurred amidst wide deployment of war metaphors and catastrophic discourse. Fear and warnings of antibiotic resistance have existed since the discovery of penicillin. However, these **metaphors** and tropes have increasingly become common mantras in popular science, policy and media circles, warranting analysis (e.g. B. Brown et al., 2009). Some scientists, policy-makers and politicians have even begun prophesying a return to a 'pre-antibiotic dark ages' or 'post-antibiotic apocalyptic' future, if immediate action is not taken (Chan, 2012; Department of Health (UK), 2016a; Harbarth et al., 2015; Walsh, 2014). At face value, these catastrophic prophecies may appear innocuous, even necessary to draw attention to the perceived urgency of AMR, garner funding, political support and catalyse action to save antibiotics from bacterial resistance (B. Brown et al., 2009). However, the reduction of bacterial resistance biology to war metaphors and catastrophic discourse and the frequent, absence of discussion of social, political and economic factors from many accounts, in order to grab attention and motivate action, depends on **partial** and selective use of scientific facts.

While the science of antibiotic resistance undoubtedly provides the impetus for action (i.e. in the form of so-called evidence-based medicine), its reduction to war and catastrophic discourse is deemed necessary to convey the so-called 'essence' of complex problems to lay people (for a

reflection on scientific reduction and simplification of science, see Yates-Doerr, 2012, work in relation to nutritional education), especially when they need to compete with other subjects in public and political spheres. However, what scientific knowledge is left out, can have significant consequences, such that the selective use of the 'facts' of AMR, facilitate its ability to become subservient to political and ideological agendas, so as to forward particular political, economic and social **ends**. For example, Brown and Nettleton (Forthcoming-a) shows how AMR is employed as political arena for passing blame in Labour-Conservative party politics or used as a xenophobic device to denigrate immigrants and attempt to justify why they should be kept out of the UK. Similar, blame-games are popularly levelled in media and political discourses, framing doctors as over prescribers and patients as, misusers and over-consumers of antibiotics, with selective and/or limited attention, intentional or not, to contributions of socioeconomic inequalities and inequities, demographics and differences in exposures to infectious diseases, let alone the pharmaceutical industries role in the levels of antimicrobials sold (see Ravelli, 2011, for an analysis of pharmaceutical marketing of antibiotics to doctors in France). Here, blame is passed down hierarchies of political and economic power, side-stepping governments, scientists and pharmaceutical companies, to those prescribing and consuming them (whether human or livestock), with low and middle income countries, in general, consistently reported as lacking requisite knowledge and resources; hence, described as acting irrationally and 'still' overconsuming antibiotics (Lambert, 2016).

This selective engagement with antibiotic science and bacteriology is also evident in the proposed solutions to AMR, two of the most commonly cited are (AMR Policy Team, 2016): to reduce antibiotics use and increase investment and incentives for further drug development. These solutions appear as seeds of particular visions of a future, where science, medicines, society and economics are deeply entangled – a fact, which is perhaps, not untrue of the antibiotics past and present. There communication amidst war metaphors and catastrophic discourse, as well as national and

global security fears, perpetuates a partial view of microbes as a unilateral source of danger to human society. Here, war is popularly presented as one, if not the *only* technique and discourse of 'choice' to engage with microbes, if we are to avoid a post-antibiotics apocalypse and prevent the end of the modern medically-enhanced world as we know it (Chan, 2012; Department of Health (UK), 2016a). However, the science of antibiotics and bacteria casts doubt on the ability of reducing antibiotics to mitigate AMR and raises questions about whether producing new medicines is not just another way of perpetuating this problem in the name of future financial gains for pharmaceuticals (N. Brown & Nettleton, Forthcoming-b). At present, what often seems to be missing from high-level political discussion and public debates of antibiotic science are serious engagement with: the implications of

horizontal gene transfer for persistence and spread of AMR; consideration of the negative consequences of antibiotics on our microbiomes and health; and the serious inequalities and inequities tied up with antibiotics resistance, access to antibiotics and health care, more broadly. Perhaps this is a drawback of the assumed separation of politics and society from science – the former is inadequately prepared, and perhaps unwilling to fully engage with some emerging developments in the latter. Whatever the reasons, more serious space should be given to the above factors, so that any attempt to imagine a medical future does not reduce it only to saving medicines and greater investments in them, but also seeks to take seriously questions of microbial ecology (e.g. collateral damage to microbiomes) and socioeconomic inequalities and inequities.

Conclusion

Does AMR represent the end
of modern medicine?

In this report we have set out a framework of three arenas in which it can be productive to apply social theory to AMR: antimicrobials in practice, AMR policy and AMR science. Through our reviews we have introduced a range of theory applicable to each arena, in particular from anthropology, and we have then provided worked examples as illustrations for applying this theory to stretching our conceptualisations of AMR as a problem and potential ways to address it.

A central tenet to all these approaches is the making visible of what we take for granted as established. Theories help us to take on new perspectives when attending to what is said, whether in the media, policy, science, literature or in public, what is observed in practice, and the imaginings, expectations, relationships and materialities that link the two.

Antibiotics are one of the most commonly used groups of medicines globally, and are undoubtedly a lynch pin of many contemporary medical and healthcare practices. They have not only been able to treat and cure many previously deadly infections, but they have also enabled surgical procedures, which would have previously not been carried out for fear of infection. The recent emergence of AMR on national, and increasingly on global agendas, in a large part, spawns from fears of losing the health gains that antibiotics have contributed over the last sixty plus years. These fears have been expressed as doomsday cries of returning to the *'dark ages of medicine'* (Walsh, 2014), a pre-antibiotic past, or in the form of apocalyptic prophecies of entering a *'post-antibiotic era'* (BBC News, 2015). These statements, on a number of occasions, have been accompanied by predictions that a post-antibiotic era, which AMR is deemed to spell, will mean *'...an end to modern medicine as we know it'* (Chan, 2012; Department of Health (UK), 2015), leading some to call for antibiotics and by proxy, modern medicine to be *'saved'* (Holpuch, 2016).

While the effects of AMR on treatment outcomes is unquestionable, such broad scale predictions about the end of modern medicine suggest more is at stake, both for people and for biomedicine itself and the systems with which it is interdependent.

The approaches outlined in this report prompt us to ask, 'what matters' and to whom. Attending to this question, and drawing on some of the theoretical perspectives outlined in this report can provide insights into what 'modern medicine' means to different involved parties (e.g. those in need of antibiotics, policy-makers, health care professionals and pharmaceutical companies) and therefore what is perceived to be lost and why it is of concern. It also then allows us to ask what is believed should replace it – whether it is more medicines and/or other forms of care.

By applying techniques of counterfactuals (such as **inversions** in Part 1, analysis of **means/ends** in part 2 and **science in practice** in Part 3), this report has shown how we can map out different ideas of what the future of medicine could be and for whom, what different scientific knowledges may be relevant and how they could affect politics and society. What would, for example, a post-modern medicine look like, and how can and will our framings shape it?

In summary, this report has presented a series of applications of social theory to understanding and addressing antimicrobial resistance, in the practice of medicines, in AMR policy and AMR science. This has allowed us to see the multiplicity of the topic of AMR, and how we can come to see what is often obscured from view in our current framings, and to see how different versions of AMR and the problems it poses can come to the fore through the application of different theoretical perspectives.

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