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- Bring together existing evidence and present it in an accessible format
- Use systematic methods and make transparent how they can have confidence in the material
- Tailor the way evidence is identified and synthesized to reflect the nature of the policy question and the evidence available
- Are written by a formal and rigorous peer review process to ensure the quality and presentation of the evidence presented.

Each brief has a one-page key message section, a page of work to follow, giving a succinct overview of the findings and a full text page reviewing the evidence. The idea is to provide instant access to key information and additional resources and consideration for drafting, informing or advising on the policy.

Policy briefs provide evidence for policymakers not policy advice. They do not seek to persuade or position themselves in a particular position, nor to set out a policy position but to set out what is known about it. They may outline the evidence on different prospective policy options or implementation issues, but they are not intended to be a call to action or act as a manual for implementation.

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<td>Acquired immunodeficiency syndrome</td>
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<tr>
<td>AMR</td>
<td>Antimicrobial resistance</td>
</tr>
<tr>
<td>ARG</td>
<td>Antimicrobial-resistant gene</td>
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<tr>
<td>AMU</td>
<td>Antimicrobial usage</td>
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<tr>
<td>DALY</td>
<td>Disability-adjusted life year</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<tr>
<td>FTE</td>
<td>Full-time equivalent</td>
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<tr>
<td>G20</td>
<td>Group of 20 countries</td>
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<td>G7</td>
<td>Group of 7 countries</td>
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<tr>
<td>GBD</td>
<td>Global burden of disease</td>
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<td>GDP</td>
<td>Gross domestic product</td>
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<tr>
<td>HCAI</td>
<td>Healthcare-associated infection</td>
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<td>HiAP</td>
<td>Health in All Policies</td>
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<td>HIC</td>
<td>High-income countries</td>
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<tr>
<td>HIV</td>
<td>Human immunodeficiency virus</td>
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<tr>
<td>ICM</td>
<td>Intersectoral coordinating mechanism</td>
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<tr>
<td>IPC</td>
<td>Infection prevention and control</td>
</tr>
<tr>
<td>LMIC</td>
<td>Low- and middle-income country</td>
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<tr>
<td>MRSA</td>
<td>Methicillin-resistant Staphylococcus aureus</td>
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<tr>
<td>MSSA</td>
<td>Methicillin-sensitive Staphylococcus aureus</td>
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<tr>
<td>MAR</td>
<td>Multiple antibiotic resistance</td>
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<td>MSC</td>
<td>Minimum selective concentrations</td>
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<tr>
<td>NAP</td>
<td>National action plan</td>
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<tr>
<td>NGO</td>
<td>Non-governmental organization</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<tr>
<td>OTC</td>
<td>Over-the-counter</td>
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<tr>
<td>PNECs</td>
<td>Predicted no-effect concentrations</td>
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<tr>
<td>PPP</td>
<td>Purchasing power parity</td>
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<tr>
<td>SMA</td>
<td>Self-medication with antibiotics</td>
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<tr>
<td>TB</td>
<td>Tuberculosis</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
</tr>
<tr>
<td>USD</td>
<td>United States dollar</td>
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<tr>
<td>WASH</td>
<td>Water, sanitation and hygiene</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<td>WOAH</td>
<td>World Organisation for Animal Health</td>
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The socioeconomic drivers and impacts of Antimicrobial Resistance (AMR) – Implications for policy and research

Key messages

The policy community, international and national, recognizes the significant health and economic impacts of antimicrobial resistance (AMR) on individuals, households, health systems and society. It is seeking sustainable solutions but often neglects the socioeconomic and sociocultural drivers of AMR.

- **Socioeconomic and sociocultural factors play a critical role in driving AMR**, shaping its health and economic impacts, and influencing the effectiveness of innovations that seek to tackle it.
- **AMR policy needs to take socioeconomic drivers and impacts into account.**
- **Socioeconomic drivers of AMR in humans are complex** but understanding them can inform better interventions. The emergence and spread of AMR relate to a mix of factors including gender, living situations, educational level, healthcare access, (poor) governance, human mobility, conflict, climate change, agriculture and pollution. Policy that understands these and the way they interact with one another will be more likely to achieve its aims.
- **Building key elements into design of AMR policy can help ensure socioeconomic considerations are embedded during policy implementation, monitoring, and evaluation:**
  - People-centredness fosters an equity-orientation and encourages policies that are responsive to individuals’ needs and challenges.
  - Multisectorality recognizes AMR policy as a cross-cutting issue and brings on board various government departments and stakeholders reflecting the socioeconomic context.
  - Effective governance and leadership that are mindful of the drivers of AMR are central to coordinating multisectoral action to address AMR’s wider determinants.
  - Evidence-based policy helps ensure that policy formulation looks beyond the biomedical model and involves interdisciplinary research and surveillance to understand and tackle the socioeconomic drivers of AMR.
- **There are four policy areas that policy-makers could usefully regard as priorities:**
  - Prevention, including infection prevention and control (IPC) in healthcare; biosecurity measures in agricultural settings; and equitable, global access to clean water, sanitation and hygiene (WASH) infrastructure.
  - Access involves promoting equitable access to diagnostics and treatments for infection. This requires reducing barriers to accessing essential healthcare services, and strengthening procurement and the supply-chain.
  - Innovation, which requires investment in new technologies and incentives for research and development but which must also respond to global needs and contexts, including in low and middle-income countries (LMICs), and address access and affordability.
  - Stewardship policies are also needed to conserve pre-existing and emerging antimicrobials and to promote responsible use in ways that acknowledge the constraints and realities of different global contexts and avoid inadvertent discrimination against particular populations.
Executive summary

- AMR is one of the biggest public health challenges of our time, and was estimated to be directly responsible for 1.27 million deaths in 2019 alone, equivalent to approximately 3500 people each day. Without substantial action to tackle AMR, this number is estimated to reach 10 million per annum by 2050.
- Our understanding of AMR has predominantly focused on the biomedical model while interactions between the socioeconomic and sociocultural determinants of health and AMR have not been studied extensively.
- There are several critical socioeconomic drivers of AMR. We focused on socioeconomic drivers of AMR in humans specifically, although this captures interactions of humans with animals and the environment.
  - **Gender:** Social, cultural and biological factors mean that women are more likely than men to experience occupational exposure to AMR, and to be prescribed antimicrobials.
  - **Living situations:** The risk of AMR is increased for populations living in urban and overcrowded environments, as well as with limited access to clean water, sanitation and hygiene (WASH) infrastructure.
  - **Educational level:** Higher education is associated with greater capacity to understand the dangers of inappropriate antimicrobial use (AMU), and the risk of AMR.
  - **Healthcare access:** Limited access to healthcare can result in more inappropriate use of antimicrobials in contexts with weak regulation of access to antimicrobials. Persistent shortages of antimicrobials can also lead to prolonged infections, and substitution with suboptimal antimicrobials.
  - **Poor governance:** Implementing sustainable and effective policies to combat AMR is challenging in contexts with political instability, limited rule of law and higher levels of corruption.
  - **Human mobility:** Movement of people, due to migration, conflict or tourism, is associated with the introduction of new strains of antimicrobial-resistant microbes.
  - **Conflict:** Disruptions to healthcare systems, surveillance, supply-chains of essential antimicrobials, access to clean WASH, and populations being forcibly displaced create conditions that mean infections are difficult to treat and spread easily.
  - **Climate change:** Rising ambient temperatures increase bacterial growth rates, and also contribute to extreme weather events that can disrupt healthcare services, displace populations and reduce access to WASH infrastructure.
  - **Agriculture:** Evidence exists of animal-to-human transmission of resistant pathogens following occupational exposure and food contamination. Improper disposal of waste products and effluent are also responsible for high concentrations of antimicrobial-resistant microbes in the environment.

- **Pollution:** Waste from the pharmaceutical and healthcare industries, heavy metals from industrial and agricultural processes, airborne particulate matter, and plastic waste in water bodies can all drive AMR in the environment.
- There are several health and economic impacts of AMR for individuals and households, health systems and society.
  - **Individuals and households:** Individuals who contract antimicrobial-resistant infections are at risk of mortality, long-term disability, catastrophic health expenditure and lost income, as well as delay of effective treatment, with suffering and socioeconomic impacts for families and communities.
  - **Health systems:** AMR is responsible for increased hospitalization rates, greater length of stay, increased treatment costs and reduced ability to safely provide treatments such as chemotherapy and surgical care.
  - **Society:** Reductions in the size and productivity of the workforce, increased healthcare expenditure and negative impacts on livestock production and trade all contribute to reduced gross domestic product (GDP) associated with AMR.

- A potential policy framework to respond to the socioeconomic drivers and impacts of AMR includes four overarching principles:
  - **Effective governance:** Coordinating such multisectoral action requires significant coordination and effective leadership, which may be especially challenging in countries with governance challenges.
  - **People-centred and equity-oriented:** Policy needs to be responsive to individuals’ needs and challenges related to the prevention, diagnosis and treatment of AMR.
  - **Multisectoral:** AMR needs to be reframed as a cross-cutting issue requiring mobilization across various governmental departments and stakeholders.
  - **Evidence-based:** Moving away from a biomedical understanding of AMR requires interdisciplinary research on socioeconomic drivers and impacts of AMR, and robust and comprehensive surveillance systems.

- These overarching principles can be used to support the incorporation of key considerations of the socioeconomic drivers and impacts of AMR during development and implementation of interventions in four core policy areas:
  - **Stewardship:** Conservation of pre-existing and emerging antimicrobials requires a coherent set of actions to promote their responsible use in both human and animal health that considers the constraints and realities of individuals in different contexts globally.
  - **Prevention:** Alongside IPC in healthcare and biosecurity measures in agricultural settings, a key priority is equitable access to WASH infrastructure globally.
• **Access:** Equitable access to diagnostics and treatment of infection requires reducing barriers to accessing essential healthcare services and ensuring access to essential antimicrobials through changes in procurement policy, and strengthening the antimicrobial supply-chain in both LMICs and high-income countries (HICs).

• **Innovation:** Increased investment in incentives to stimulate research and development of AMR health technologies needs to be responsive to the needs and operational contexts of LMICs, including access and affordability.

• There is increasing evidence of the critical role that socioeconomic and sociocultural factors play in driving AMR, shaping the health and economic impacts of AMR, and influencing the effectiveness of innovations and progress to tackle AMR at the individual, health system and societal level. It is essential that AMR policy takes these socioeconomic drivers and impacts into account moving forward.
1. Introduction

The development of antimicrobials is one of the major achievements of modern medicine, and has revolutionized the treatment of communicable diseases and facilitated other breakthroughs in cancer and surgical care (Anderson et al., 2019b). AMR arises when microorganisms such as bacteria, viruses, parasites or fungi evolve to develop the ability to withstand treatments with antimicrobial agents to which they were previously susceptible. Some resistance to antimicrobials can occur naturally over time. The increasing use and misuse of antimicrobials, however, is accelerating this process as antimicrobials exert a “selection pressure” that provides micro-organisms with favourable conditions for mutations that promote resistance to survive and proliferate among hosts, the wider population and the environment (Holmes et al., 2016).

Continued growth and transmission of antimicrobial-resistant pathogens is responsible for significant mortality, healthcare costs and negative impacts on trade and economies globally. It is estimated that AMR was directly responsible for 1.27 million deaths in 2019 alone (Murray et al., 2022), which is equivalent to approximately 3500 people each day. Without substantial action to tackle AMR, this number is estimated to reach 10 million deaths per annum by 2050 (Review on Antimicrobial Resistance, 2016).

The health burden of AMR is also heavily skewed towards LMICs. It is highest in Western Sub-Saharan Africa and South Asia, where the death rate attributed to AMR in 2019 was 27.3 per 100,000, and 21.5 per 100,000 respectively (Figure 1) (Murray et al., 2022). This is significantly higher than in Western Europe, where the death rate attributed to AMR was 11.7 per 100,000, although comparable to the rate in Eastern Europe of 19.9 per 100,000. While international and national efforts are increasing (Box 1), these often fail to consider socioeconomic drivers and impacts.

Figure 1. All-age rate of deaths attributable to bacterial AMR by region, 2019

Deaths Attributable to AMR per 100,000

Note: Regions are classified according to the Global Burden of Disease (GBD) project.
Source: Authors generated this figure using data from Murray et al, 2022
Box 1. International and national action to combat AMR

International and national efforts to combat AMR have grown steadily over the last two decades, underpinned by two major landmark developments. The World Health Organization (WHO) Global Action Plan on AMR was launched in 2015, calling on all countries to develop national action plans by 2017 (WHO, 2015). In 2016 the United Nations (UN) General Assembly agreed on a political declaration on AMR, with countries committing to work at national, regional and global levels to develop and implement multisectoral national action plans in accordance with the One Health approach (UN, 2016).

Figure 2. Progress to develop and implement national action plans on AMR globally, 2022

A – No national AMR action plan or plan under development
B – National AMR action plan developed
C – National AMR action plan approved by government and is being implemented
D – National AMR action plan has costed and budgeted operational plan and monitoring mechanism in place
E – Financial provision for the National AMR action plan implementation is included in the national plans and budgets

Notes: African Region (AFR), Region of the Americas (AMER), Eastern Mediterranean Region (EMR), European Region (EUR), South-East Asian Region (SEAR), Western Pacific Region (WPR).


A critical limitation to current national and global efforts, however, is that our understanding of the drivers and impacts of AMR has predominantly focused on the biomedical model, often at individual and microbiological level. The interactions between the socioeconomic determinants of health and the emergence and spread of AMR have often been neglected. However, evidence from a range of health issues – whether HIV/AIDS, TB, COVID-19 or noncommunicable diseases – has repeatedly demonstrated that socioeconomic and sociocultural factors play a critical role in driving health behaviour and health outcomes, as well as influencing treatment and health service access and outcomes (WHO, 2008).

In a recent global review of AMR national action plans (NAPs), no NAP acknowledged the need to tailor messages regarding AMR to different audiences and there was “little to no recognition of the need for addressing cultural drivers of health-seeking and health-providing behaviours” (Charani et al., 2023). A more sophisticated and sustainable approach to the implementation of national AMR policy requires stronger understanding of the specific socioeconomic and sociocultural drivers of AMR, and taking account of these drivers in the adaptation and design of interventions for specific populations and contexts.
The policy brief is structured according to three policy questions:

- What are the key socioeconomic drivers of AMR?
- What are the key health and economic impacts of AMR for individuals and households, health systems and societies?
- How can we develop a comprehensive policy response to reflect the socioeconomic drivers and impacts of AMR?

Our overview of methods is contained in Box 2. We consider socioeconomic drivers of AMR in humans specifically, including the interaction of humans in animal and environmental health settings. We do not focus on the specific drivers of AMR within healthcare services, such as poor antimicrobial stewardship and IPC, which are covered extensively elsewhere (Anderson, Cecchini & Mossialos, 2019; Anderson et al., 2019b). In our analysis the impacts of AMR are considered predominantly from a human health perspective, including the health and economic impact on individuals and households, health systems and broader society.

The target audience of this policy brief is international, national and regional policy-makers responsible for designing and implementing AMR interventions through multisectoral national action plans. The secondary audience is health workers, academics, communities, civil society groups, professional organizations and the private sector involved in development, implementation and monitoring of AMR multisectoral national action plans.

Box 2. Overview of methods used for development of policy brief

The development of this policy brief has been informed by an umbrella literature review and semi-structured stakeholder interviews. The umbrella review identified pre-existing systematic reviews that contained quantitative evidence on socioeconomic drivers and impacts of AMR. The full details of the methods for the umbrella review are contained in the Appendix (8.1. Umbrella review methodology). An academic publication that further expands on the methodology of the umbrella review and the findings of each identified article is currently in development. The stakeholders were recruited for interviews through purposive sampling (Palinkas et al., 2015), which is a method to select participants for interviews based upon their expertise and characteristics. We selected interviews to ensure representations from policy-makers and academics from both HICs and LMICs. Snowball sampling was also used (Parker, Scott & Geddes, 2019), with interviewees asked to assist in identifying other potential subjects. Interviews were semi-structured, with a topic guide developed interactively among co-authors (see Appendix: 8.2 Interview topic guide). The full list of interviewees is also contained in the Appendix (8.3 Expert interviewees).
2. What are the key socioeconomic drivers of AMR?

A broad range of socioeconomic drivers of AMR are in play, in an interlinked and multisectoral way. Selected key socioeconomic drivers, which were identified through our literature review and stakeholder interviews, are outlined below (Table 1).

Table 1. Selected key socioeconomic drivers of AMR

<table>
<thead>
<tr>
<th>DRIVER</th>
<th>EXPLANATION</th>
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<tr>
<td>Gender</td>
<td>The relationship between gender and AMR is multifaceted and underinvestigated in the literature. Social, cultural and biological factors mean that women are more likely to be prescribed antimicrobials than men. Women have increased exposure to pathogens given they are more likely to undertake caregiving roles and work in frontline healthcare settings, presenting higher occupational risk.</td>
</tr>
<tr>
<td>Living conditions</td>
<td>Overcrowding and the number of children per household are associated with increased risk of AMR. Limited access to clean WASH infrastructure in both urban and rural contexts is also a major driver of AMR, particularly in LMICs.</td>
</tr>
<tr>
<td>Educational level</td>
<td>Higher educational levels are associated with greater capacity to understand the dangers of inappropriate AMU and the risk of AMR, but is also correlated with increased income and reduced barriers to access healthcare services. Lower education may be associated with higher levels of antimicrobial misuse in contexts with weak regulation of over-the-counter (OTC) access to antimicrobials. Therefore, there are mixed associations between educational levels and AMR.</td>
</tr>
<tr>
<td>Access to healthcare</td>
<td>Many people in situations of disadvantage and vulnerability face financial, social and practical barriers to access formal healthcare services. More people are estimated to die owing to lack of access to antimicrobials than from resistant infections. Many countries experience shortages of antimicrobials that can lead to prolonged infections, and substitution to broader spectrum antimicrobials that exacerbate AMR.</td>
</tr>
<tr>
<td>Poor governance</td>
<td>Multi-country analyses indicate better governance – including public voice and accountability, political stability, regulatory quality, rule of law and control of corruption – is significantly correlated with lower rates of AMR and AMU.</td>
</tr>
<tr>
<td>Human mobility</td>
<td>Human mobility, driven by either migration, forcibly displaced populations or tourism, appears to be associated with the introduction of new strains of antimicrobial-resistant microbes in different countries. Further research is needed to understand the extent to which this drives the transmission dynamics of antimicrobial-resistant pathogens nationally, regionally and globally.</td>
</tr>
<tr>
<td>Conflict</td>
<td>Conflict disrupts healthcare systems, surveillance of AMR and AMU, supply-chains of essential antimicrobials, and access to clean WASH. Conflict also forcibly displaces populations, resulting in overcrowded conditions in refugee camps. These consequences of conflict collectively create environments where infections are difficult to treat, and spread among populations.</td>
</tr>
<tr>
<td>Climate change</td>
<td>Climate change can influence AMR in several ways. Increased ambient temperatures can lead to higher growth rates of bacteria and therefore the dissemination of AMR. Climate change is also responsible for extreme weather events, which can disrupt healthcare services, displace populations and reduce access to clean WASH infrastructure.</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Antimicrobial-resistant pathogens can be transmitted across human, animal and environmental health interfaces. Animal-to-human transmission can occur due to occupational exposure in agricultural workers, and contamination of food with resistant organisms. High concentrations of antimicrobial-resistant microbes can also spread in the environment following improper disposal of waste products and effluents from agricultural settings.</td>
</tr>
<tr>
<td>Pollution</td>
<td>The release of several pollutants in various ecosystems can drive increases of AMR including waste from the pharmaceutical and healthcare industries, heavy metals from industrial and agricultural processes, plastic waste in water bodies and airborne particulate matter from industrial processes.</td>
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</table>

Note: These socioeconomic drivers of AMR were identified during a literature review and stakeholder interviews. We acknowledge that there may be other socioeconomic drivers of AMR not captured through these processes.
2.1 Gender

Gender refers to the characteristics of women, men, girls and boys that are socially constructed. This includes norms, behaviours and roles associated with being a woman, man, girl or boy, as well as relationships with each other. As a social construct, gender varies from society to society and can change over time. Gender has important implications for expected roles and responsibilities (including occupation), health-seeking behaviours and exposures to risk of infection. Gender interacts with but is different from sex, which refers to the different biological and physiological characteristics of females, males and intersex persons, such as chromosomes, hormones and reproductive organs (WHO, 2023a). The evidence on the relationship between gender and AMR remains limited and largely unexplored in the literature, with mixed findings that vary across contexts, organism-drug combination and parameter studied (Pham-Duc & Sriparamananthan, 2021).

Women were found to be 27% more likely than men to have an antimicrobial prescribed in their lifetimes, in a systematic review and meta-analysis of antimicrobial prescribing in the community (Schröder et al., 2016). Several factors are potentially driving this trend. Biological factors may expose women to higher rates of infection necessitating greater need for antimicrobials, for example, due to pregnancy and childbirth (Schilling, Rody & Bossung, 2022), and higher likelihood of contracting urinary tract infections (Medina & Castillo-Pino, 2019). Occupational factors, such as a greater propensity to work in the healthcare profession, may also expose women to greater risk of infections, particularly professions with high patient contact (Connor et al., 2020). Gender bias also influences antimicrobial prescribing by healthcare professionals, with some studies indicating that clinicians are more likely to prescribe antimicrobials to women than to men for the same illnesses (Eggermont et al., 2018). In many regions gender inequalities in access to healthcare and education persist. In these contexts, especially in LMICs, women frequently face obstacles that prevent them from getting appropriate and timely care and having sufficient knowledge regarding prudent antimicrobial use. Where women are often expected to carry out childcare duties, these obstacles may also affect their children. As untreated or poorly treated infections are more likely to lead to resistant bacterial strains, these discrepancies contribute to the cycle of AMR.

2.2 Living conditions

Living conditions can significantly increase or reduce the risk of contracting infections and subsequent need for antimicrobials. Poor WASH promotes the spread of infectious diseases and AMR genes (Fuhrmeister et al., 2023), and investment in improved WASH can reduce both AMR carriage rates and AMU (Ryan, Christian & Wohlrabe, 2001; Kampf, Löffler & Gastmeier, 2009). Overcrowding (Alivizata et al., 2018) and the number of children per household (Bert et al., 2022; Coope et al., 2022) are also associated with AMR and AMU, indicating that the more people in the household, the higher the risk of self-medication with antimicrobials (SMA) and AMR carriage. The relationship between number of children per household and AMU is complex. Studies analysing factors that increase SMA indicate that carers often bypass formal healthcare because SMA is a more convenient option that exposes households to lower financial burden (Bert et al., 2022; Coope et al., 2022). Child day-care attendance may also favour transmission of antimicrobial-resistant organisms such as MRSA (Chen & Huang, 2014; Chan et al., 2022). People who are unhoused or incarcerated are also at higher risk of AMR carriage, likely due to higher density accommodation in shelters and prisons (Mitevska et al., 2021).

Urban settings may be more prone to population density and overcrowding, promoting transmission of a range of illnesses including viral illnesses, leading to overconsumption of antibiotics (Duan, Liu & Wang, 2021; Chen et al., 2021; Guo et al., 2021). On the other hand, rural communities are more likely to experience geographic and financial barriers to accessing high-quality healthcare services, and thus are more likely to self-medicate (Aslam et al., 2020; Bert et al., 2022; Sun et al., 2022). In this way, urbanicity is not inherently associated with AMR directly, but in a multifactorial way.

2.3 Educational level

People’s understanding and behaviour in relation to healthcare, the use of antimicrobials and the prevention of AMR are significantly influenced by educational level (Tsuzuki et al., 2020; Wang & Ogunseitan, 2022). Firstly, people with higher education may be better able to comprehend the dangers of misusing medication, how AMR is created and how crucial it is to finish prescription antimicrobial courses. However, more educated people are likely to have higher incomes and therefore face fewer barriers in accessing healthcare services. It is therefore not surprising that the evidence on educational level and AMR is mixed and varies considerably according to country context. For instance, a systematic review and meta-analysis found that higher educational level was associated with increased risk of inappropriate antimicrobial use in Europe, but lower levels of antimicrobial usage in LMICs (Mallah et al., 2022). Inappropriate antimicrobial use was defined as any of the following practices: unsupervised use of antibiotics (self-medication), non-adherence to treatment guidelines, and storage of leftover antibiotics for future use.

2.4 Access to healthcare

Differences in access to healthcare between populations can impact AMR in several ways. Many people in situations of disadvantage and vulnerability face persistent financial, social and practical barriers to access formal healthcare services, and it has been estimated that more people die owing to a lack of access to antimicrobials than from resistant infections (Laxminarayan et al., 2016; Kariuki et al., 2022). Limited access to formal healthcare services can also lead people to engage in SMA, particularly in countries with weak regulation on OTC access to antimicrobials (Sulis & Gandra, 2021). This can result in increased inappropriate use of antimicrobials, which in turn can contribute to the development and proliferation of AMR.
This is compounded by the fact that many countries experience prolonged shortages and limited access to antimicrobials, which has several implications for AMR (ReAct, 2020). First, shortages may cause healthcare facilities to store antimicrobials longer than advisable. The use of degraded and less effective antimicrobials can lead to prolonged infections and greater risk for resistance emerging. Second, physicians often need to prescribe suboptimal broad-spectrum antimicrobials when more appropriate, narrow spectrum versions are not available, risking gratuitously exacerbating AMR. Third, insufficient supply of existing antimicrobials can encourage the supply of substandard and falsified antimicrobials that are less effective and drive resistance (Chokshi et al., 2019; Iskandar et al., 2020; Chansamouth et al., 2021; Sun et al., 2022).

2.5 Poor governance
The concept of governance is not synonymous with government; rather governance is concerned with actions by a broad range of societal organizations, how they relate to the public and how decisions are taken and implemented. Weak governance at the national level – measured through a combination of indicators such as voice and accountability, political stability, regulatory quality, rule of law and control of corruption – has been found to be significantly correlated with higher rates of AMR and AMU in several multi-country international analyses (Collignon et al., 2018; Maugeri et al., 2023). These analyses only indicate associations rather than causation. Nevertheless, they emphasize the importance of applying the principles of good governance to develop sustainable national policies to combat AMR, which require multisectoral coordination across government bodies, healthcare sectors and with industry. Greater involvement of patients and the public in the development, implementation and monitoring of these policies can create awareness and enhanced engagement with initiatives to tackle AMR.

2.6 Human mobility
The movement of people across borders can facilitate the international spread of AMR as it exposes individuals to diverse environments, including healthcare systems with varying AMR prevalence (Godijk, Bootsma & Bonten, 2022). Travellers may acquire resistant infections during journeys, which can lead to the introduction of new resistant strains to their home countries. This has been described to varying extents in international recreational tourism (Wueurz, Kassim & Atkins, 2020; Bokhary et al., 2021; Vicente de la Cruz, Giesen & Diaz-Menéndez, 2022), international migration (Nellums et al., 2018; Coope et al., 2022) and with forcibly displaced populations (Nellums et al., 2018). The increased risk of AMR in refugees and asylum seekers, and other migrant groups, is particularly well described in the literature (Nellums et al., 2018), and this is likely due to poor sanitation, overcrowding and barriers to accessing healthcare including vaccination programmes. While there is a recognized association between human mobility and AMR, further research is needed to explore the dynamics and specific contributions of different forms of human mobility to the spread of AMR in different contexts.

2.7 Conflict
Conflict can exacerbate AMR through several interconnected factors (Abbara et al., 2018; Truppa & Abo-Shehada, 2020; Kobeissi et al., 2021; Skinner, 2024). Conflict disrupts healthcare systems and can lead to a breakdown in the delivery of basic health services for many populations (Pallett et al., 2023). This can lead to challenges accessing healthcare services, limited surveillance and poor regulation of antimicrobial use (Kanapathipillai et al., 2019). Infections and injuries are common as a result of conflict and may result in overreliance on broad-spectrum antibiotics (Pallett et al., 2023). This can be due to a lack of proper medical infrastructure and trained personnel to optimize antibiotic choice, or supply-chain issues may result in shortages of essential antibiotics and restricted treatment options for infections. Conflict also disrupts essential public infrastructure, including access to clean WASH (Petrosillo, Petersen & Antoniak, 2023). This creates environments where infections continue to develop and spread among populations, increasing the demand for antibiotics and selection pressure on bacteria. Conflict also forcibly displaces populations from their homes (Nellums et al., 2018), resulting in overcrowded living conditions in refugee camps or temporary settlements that also have limited access to WASH. These environments also create conditions that encourage the spread of infectious diseases.

2.8 Climate change
Climate change influences the emergence and dissemination of AMR through multiple pathways. Increased ambient temperatures can lead to higher growth rates of bacteria, which can promote the development and spread of antimicrobial-resistant bacteria (Lio et al., 2023). Warmer temperatures can also expand the geographic range of disease-carrying vectors such as mosquitoes and ticks, which can increase the prevalence of infectious diseases, leading to higher rates of AMU and, consequently, AMR (Lio et al., 2023). Climate change also causes extreme weather events, such as wildfires, heatwaves and floods, which can disrupt healthcare systems, reducing access to care and antimicrobials, contributing to the increased disease burden and the emergence and spread of AMR (Burnham, 2021). Extreme weather events can also displace populations and reduce access to WASH and other essential infrastructure. Both factors are known to increase the risk of AMR emerging and spreading. Temperature (Collignon et al., 2018; Reverter et al., 2020) and tropical climate (Bonell et al., 2019) appear to be correlated with AMR, even when analyses adjust for potential confounders such as antimicrobial consumption and human population density. Climate vulnerability, describing the vulnerability of a country’s infrastructure to extreme weather events, is also correlated with AMR (Reverter et al., 2020).
2.9 Agriculture
Antimicrobial-resistant pathogens can be transmitted between humans and animals, as well as through shared environments (Lim et al., 2019; Ogyu et al., 2020). Animal-to-human transmission of antimicrobial-resistant pathogens has been explored in several ecological studies describing disproportionately high MRSA rates in farmers compared to the general population (Chen & Huang, 2014; Chokshi et al., 2019; Wu et al., 2019), and sometimes even temporal correlation between first use of specific antimicrobials in animals and emergence of attributable resistances in humans (Scott et al., 2018). Food can become contaminated with antimicrobial-resistant bacteria during various stages of production, processing and distribution. Several studies describe meat contamination with resistant organisms, from MRSA to MAR-Listeria (Richter et al., 2015; Chokshi et al., 2019; Chansamouth et al., 2021). It is not always clear if this is due to AMU in animal farming or post-production contamination, and further evidence is needed in this regard. However, there is evidence that poor hygiene during the food supply-chain carries independent risk as a driver of AMR (Leangapichart et al., 2017).

Worldwide, it is estimated that approximately two thirds of all antimicrobials are used in animals rather than humans (Tiseo et al., 2020). This is driven by the continued use of antimicrobials in animals for the purpose of growth promotion (Landers et al., 2012; Ramtahal et al., 2022) or mass prophylaxis (Landers et al., 2012; Phu et al., 2022), or to keep up with intensification of demand (Phu et al., 2022). This can lead to contamination of the environment, as improper disposal or handling of waste products can release resistant bacteria from animal urine and faeces into soil and water systems, facilitating the development and spread of AMR (Larsson & Flach, 2022).

2.10 Pollution
More generally, environmental sources, such as water bodies (rivers, lakes, sediments), sewage, soil, air and wildlife, can act as reservoirs and conduits for the spread of AMR agents within ecosystems (Zheng et al., 2021; Larsson & Flach, 2022). The disposal of waste from healthcare facilities and the pharmaceutical industry can introduce high levels of antimicrobials into waste water supplies, potentially contributing to the emergence and spread of resistance (Singer et al., 2016). The release of several other pollutants in various ecosystems is known to influence microbial communities and facilitate the development of AMR. Heavy metals, such as mercury, arsenic and lead, are often released from industrial activities and agricultural runoff (Edet, Bassey & Joseph, 2023). This can drive AMR because exposure to heavy metals can induce stress responses in bacteria, leading to the activation of resistance mechanisms that also confer resistance to antimicrobials (Baker-Austin, 2006). Airborne pollutants, such as particulate matter and pollutants from industrial processes, may also contribute to the spread of resistant bacteria by acting as carriers for these microorganisms (Zhou et al., 2023). There is also emerging evidence that plastic pollution can harbour resistant bacteria and serve as a reservoir for antimicrobial-resistant genes (ARGs) (Zadjelovic et al., 2023). The buoyancy and recalcitrance of plastics also mean these reservoirs of ARGs are particularly persistent in the environment. More research is needed to understand the risks of environment-to-human transfer of antimicrobial-resistant pathogens from these important reservoirs of antimicrobial-resistant pathogens in the environment (Stanton et al., 2022).
3. What are the key health and economic impacts of AMR for individuals and households, health systems and societies?

The health and economic impacts of AMR affect individuals and households, health systems and broader societies in different ways. A range of different indicators that map these impacts is described below (Table 2). In our analysis the health and economic impacts of AMR are considered predominantly from a human health perspective (see Chapter 1 for a discussion on the structure and scope of the policy brief), although we acknowledge that further research is needed to map the health and economic impacts of AMR in the animal and environmental health settings, and through a One Health perspective.

3.1 Increased mortality and disability

AMR is responsible for considerably increased risk of mortality and morbidity. An estimated 4.95 million deaths were associated with bacterial AMR in 2019, including 1.27 million deaths directly attributable to bacterial AMR (Murray et al., 2022). AMR is also responsible for worse health outcomes and long-term disability for patients who survive their illness, through delay of effective treatment (Zasowski et al., 2020), longer hospital stays (MacKinnon et al., 2015; Parisi et al., 2018; Serra-Buriel et al., 2020; Poudel et al., 2023) and higher complication rates following medical procedures (Dadgostar, 2019). The potential long-term health outcomes from AMR are vast, encompassing anything from kidney failure to amputation (Kobeissi et al., 2021). Bacterial AMR is associated with reductions of 192 million disability-adjusted life-years (DALYs), including 47.9 million DALYs directly attributed to AMR (Figure 3). Furthermore, this health burden is unequally distributed globally, with reductions in DALYs per 100 000 population approximately seven times higher in Sub-Saharan Africa compared with HICs (Figure 3).

Table 2. Key health and economic impacts of AMR

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>IMPACT</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals and households</td>
<td>Increased mortality</td>
<td>Contracting an antimicrobial-resistant infection significantly increases risk of death.</td>
</tr>
<tr>
<td></td>
<td>Increased morbidity</td>
<td>AMR is associated with longer and more severe illnesses. Once recovered from an antimicrobial-resistant infection, there is also increased risk of long-term disability.</td>
</tr>
<tr>
<td></td>
<td>Treatment delay</td>
<td>Individuals who contract antimicrobial-resistant infections are more likely to experience delay in appropriate treatment.</td>
</tr>
<tr>
<td></td>
<td>Financial costs</td>
<td>Antimicrobial-resistant infections are a significant cause of catastrophic health expenditure and lost income, which can push households into poverty.</td>
</tr>
<tr>
<td>Health systems</td>
<td>Increased hospitalization</td>
<td>AMR is associated with increased risk of hospitalization, and therefore increased burden on hospitals.</td>
</tr>
<tr>
<td></td>
<td>Increased length of stay</td>
<td>Treating antimicrobial-resistant infections is associated with increased length of stay, and therefore increased burden on hospitals.</td>
</tr>
<tr>
<td></td>
<td>Increased treatment costs</td>
<td>AMR is associated with higher treatment intensification, including greater use of critical care, and higher risk of surgery, which increases overall treatment costs.</td>
</tr>
<tr>
<td></td>
<td>Reduced enablement value</td>
<td>Ineffective antimicrobials limit the ability of healthcare services to safely delivery chemotherapy and provide surgical care.</td>
</tr>
<tr>
<td>Societies</td>
<td>Productivity losses</td>
<td>AMR can negatively impact the size and productivity of the labour market, which results in productivity losses.</td>
</tr>
<tr>
<td></td>
<td>Reduced livestock production</td>
<td>Limited access to effective antimicrobials can result in inability to treat infections and increased animal mortality and morbidity, which reduces overall production.</td>
</tr>
<tr>
<td></td>
<td>Reduction in GDP</td>
<td>The combined impact of productivity losses, aggregate healthcare costs and reduced livestock production can significantly reduce GDP.</td>
</tr>
</tbody>
</table>
3.2 Increased household poverty

Not only can lower socioeconomic status act as a driver for AMR, but AMR can also significantly impact individual and household poverty, in particular through increased healthcare utilization and disability. When healthcare costs are incurred, people with low income have to spend a greater proportion of their money than their higher-income counterparts. As a result, there is a higher risk for any healthcare costs incurred through AMR to push individuals and their households below or more deeply past the poverty threshold. This will threaten the achievement of the UN Sustainable Development Goals, which include the commitment to eradicate extreme poverty for all people, everywhere, by 2030 (UNDP, n.d.). Up to 28.3 million additional people could be pushed into extreme poverty by 2050 due to AMR, with the vast majority (26.2 million) living in low-income countries (Ahmed et al., 2018).

3.3 Increased healthcare utilization

Patients with antimicrobial-resistant infections experience drastically increased healthcare utilization. Antimicrobial-resistant infections are associated with increased hospitalization rates, increased length of stay per admission, and a higher readmission rate (Chiang et al., 2017; Parisi et al., 2018; Poudel et al., 2023). Increased healthcare utilization happens in two ways. Firstly, resistance to first-line antimicrobials may lead to delays before the patient receives effective antimicrobial treatment, leaving longer for the bacteria to cause tissue damage and resulting in more severe infections, and thus increasing the risk of needing hospitalization. For instance, one systematic review found that patients with multi-drug resistant Salmonella were 2.51 times more likely to need hospital admission, compared to those with pan-susceptible Salmonella infections (Parisi et al., 2018). Secondly, studies also indicate the possibility of an additive effect of AMR on disease incidence, where the resistant strains create a new burden of disease, while the incidence of the original sensitive bacterial strains remains stable. It is thought that this mechanism is prevalent in MRSA for instance, where it has been found that an increase of MRSA cases is not associated with a reduction in Methicillin-Sensitive Staphylococcus Aureus (MSSA) (Mostofsky, Lipsitch & Regev-Yochay, 2011). It is possible that both mechanisms coexist in the wider population of AMR organisms, thus creating higher healthcare utilization through both increased disease incidence and increased disease severity.

3.4 Increased healthcare expenditure

Antimicrobial-resistant infections are responsible for significantly increased treatment costs and healthcare expenditure, because of the increased healthcare utilization. While there are variations according to pathogen and infection type, additional treatment costs associated with AMR are driven by additional costs owing to longer duration of illness, additional diagnostic tests, longer hospital stays, the need for more expensive drugs and greater intensive care utilization (Gandra, Barter & Laxminarayan, 2014). In a recent review of 29 studies quantifying the additional costs of antimicrobial-resistant infections, the attributable cost of resistant infection ranged from -USD 2371.4 to +USD 29 289.1 (price adjusted) per patient episode, with a mean excess length of stay (LoS) of 7.4 days (Poudel et al., 2023). The additional treatment costs associated with AMR significantly increase healthcare expenditure (Figure 4). The annual cost of treating complications caused by AMR is estimated at more than USD 28.9 billion across 34 OECD and EU/EEA countries, equivalent to almost USD PPP 26 per capita (estimates adjusted for purchasing power parity; PPP) (OECD, 2023). The same OECD analysis estimated that an additional 32.5 million days are spent in hospital each year in these countries to treat the consequences of AMR, which is approximately equivalent to using the entire acute hospital bed capacity of Spain for a whole year (OECD, 2023).
3.5 Reduced enablement value

The advent of antimicrobials marked the start of the age of modern medicine. With many infectious diseases now curable, healthcare was able to perform hitherto unimaginable therapies. Surgery, organ transplant and cancer chemotherapy are examples of therapies that are possible today thanks to the existence of antimicrobials. AMR poses a fundamental threat to this, as the prospect of incurable infections may lead to reduced survivability from, and ultimately reduced availability of, surgery. It is estimated, for instance, that a 30% reduction in the efficacy of perioperative prophylactic antimicrobials could lead to an additional 120 000 surgical site and post-chemotherapy infections per year in the USA (ranging from 40 000 for a 10% reduction in efficacy to 280 000 for a 70% reduction in efficacy), and 6300 infection-related deaths (ranging from 2100 for a 10% reduction in efficacy, to 15 000 for a 70% reduction) (Teillant et al., 2015). While the healthcare and societal cost of this is significant, the loss of the therapeutic options enabled by effective antimicrobials threatens to make the world a much deadlier place.

3.6 Loss of productivity

The impacts of AMR on mortality and morbidity can also have significant economic impacts because of productivity losses. The largest driver of productivity losses is reductions in the size of the working population because of mortality or long-term disability. Other drivers include absence from work due to ill health (i.e. absenteeism) or lost productivity that occurs when employees are not fully functioning in the workplace due to illness or injury (i.e. presenteeism). The OECD has estimated that AMR could cause a decline in the labour market output of about 734 000 full-time equivalents (FTEs) in the working population every year across 34 OECD and EU/EEA countries (Figure 5) (OECD, 2023). These economic losses cost in total USD PPP 36.9 billion each year, equivalent to approximately one fifth of GDP in Portugal in 2020 (OECD, 2023). As mentioned above, projected reductions in the global workforce associated with AMR could reach up to 10.2 million working-age people per year under a 100% resistance scenario, compared with a loss of 2.1 million per year under current levels of resistance (Taylor et al., 2014).
The use of antimicrobials on animals is a recognized driver of AMR, be it for therapeutic, prophylactic or growth promotion purposes (Dewulf, Sternberg-Lewerin & Ryan, 2020). Antimicrobial use in animals has been harder to curb than in human health, but little has been made of the potential impact on the agriculture business of AMR, when antimicrobials no longer work. Ineffective antimicrobials result in increased livestock mortality and culling, leading to overall lower agricultural productivity of animal farming. At the current rate of AMR, it is expected that the world will see an 11% reduction in livestock by 2050 (World Bank, 2017). This is likely to have significant impacts on food supply and food cost, in an environment of increased demand and agricultural intensification, but as yet this has not been sufficiently quantified.

3.8 Reduced GDP

The combined aggregate effect of the above costs in terms of healthcare and loss of productivity, trade opportunities and agricultural productivity illustrates the varied landscape of economic impacts born to AMR. Many models have adopted a macroscopic GDP lens to estimate the macroeconomic impact of AMR. Individual countries are likely to experience differing costs to their GDP depending on the diversification of their economy, but most estimates agree that LMICs are likely to face a higher proportion of GDP loss due to AMR. This is because international trade and agriculture represent a larger segment of their national economy. Nevertheless, all countries are expected to feel an impact in their economy, with the World Bank estimating a drop of 1.1% in global GDP by 2050 in the best-case scenario of low AMR rates, and a decrease of 3.8% when modelling a worse scenario of high rates of AMR (World Bank, 2017).
4. What are the principles that should underpin a comprehensive policy response to the socioeconomic drivers and impacts of AMR?

Developing sustainable and impactful national and international responses to AMR will require policies that consider the socioeconomic drivers and impacts of AMR for different population groups and contexts. Drawing upon insights from 13 stakeholder interviews and reviewed literature, we have developed four overarching principles that should underpin a comprehensive policy response to the socioeconomic drivers and impacts of AMR (Figure 6).

The overarching principles are intended to be key considerations that are essential to mitigate against the socioeconomic drivers and impacts of AMR when designing and implementing policy. They are interrelated principles that should be embedded within actions taken by key stakeholders within the four core policy areas described in the next section (access, prevention, stewardship and innovation).

4.1 Effective governance is needed to promote sustainable implementation

Developing and implementing multisectoral, people-centred and equity-oriented policies to tackle AMR require significant coordination and effective leadership, which may be particularly challenging in countries with weak or complex systems of governance. Therefore, it is important that national AMR policy embodies the principles of “good governance” to promote sustainable implementation. It is also important that policy-makers and leadership prioritize the socioeconomic drivers and impacts of AMR throughout policy design, implementation and evaluation. Strengthening governance has been framed as a key enabler to health system strengthening over the last few decades, but the concepts that underlie effective governance are applicable to most areas of public policy. A review of health system governance frameworks identified several common principles of good governance, including strategic vision, participation, coordination, responsibility, accountability, transparency, sustainability, equity, monitoring and evaluation. Anderson et al. (2019a) incorporated these key concepts alongside specific policy actions relevant to AMR to develop a governance framework specific to AMR policy (Figure 7).
Strategic vision refers to the extent to which there is effective leadership and oversight of national AMR strategies. This requires a clear statement of objectives and goals, and should include acknowledgement that addressing socioeconomic drivers of AMR needs to be integrated within AMR national action plans and broader public policy. Targets can be useful mechanisms to help mobilize people and define more concrete action on socioeconomic issues, even if the first target is to get more data on such issues through situational analysis, robust surveillance or complementary studies.

Effective leadership should also facilitate the inclusive participation and engagement of relevant stakeholders in policy development and implementation. This includes all relevant ministries (Table 3) and One Health sectors. Many countries now use a national intersectoral coordinating mechanism (ICM) for this purpose, but it is important that this involves representation from population groups, especially those in situations of marginalization that can put them at increased risk of AMR and inappropriate AMU.

Effective coordination of policy both between and within sectors is also critical. For example, coordinating activities across different levels of the healthcare sector, such as ambulatory, hospital and long-term care, is particularly important. Such coordination can provide more meaningful understanding about what socioeconomic drivers and impacts are operating in which levels and contexts, and how they are acting as barriers for effective AMR action and outcomes.

Responsibility and accountability can be promoted by outlining specific, measurable, achievable, relevant and time-bound (SMART) objectives within AMR national strategies, combined with designated clear roles for relevant institutions and individuals. Setting SMART objectives is also part of strategic vision, as is facilitating the monitoring and evaluation phase of national AMR strategies.

Transparency can be understood as ensuring that AMR policy development, implementation and evaluation occur in an open and accessible manner. This also relates to participation, including ensuring there are mechanisms within national ICMs for open channels of feedback and discussion on what is working well, and what is not working for different stakeholders and population groups. This can help identify gaps and differential unintended impacts of policy, as well as instances where socioeconomic drivers of AMR are influencing the process and effectiveness of policy implementation.

Sustainability is needed to ensure any positive change is consistent and maintained, and requires that policy actions are appropriately costed and granted a dedicated budget for implementation. The sustainability of a national AMR strategy may also be dependent upon its legitimacy, which can be achieved through a formal agreement from all relevant sectors to implement policy through a socioeconomic lens, and the ongoing support of an interdisciplinary technical group to ensure policy is evidence-based and thoroughly evaluated.
Equity is concerned with minimizing unfair, avoidable or remediable differences among groups of people (whether defined socially, economically or otherwise – see details in next principle on equity-orientation), in terms of access to essential health services and effective antimicrobials, and the health burden of AMR.

Effective governance of national AMR policy requires a cyclical process where progress is continuously monitored and evaluated, and priorities and activities are adjusted. This requires investment in research and evaluation of existing and novel policy interventions to inform prioritization. This also requires a sophisticated understanding of the socioeconomic drivers of AMR and how policies can be designed and implemented to mitigate against them, including through education and capacity building of AMR stakeholders (see “Information & Intelligence Generation”).

4.2 AMR policy should be people-centred and equity-oriented

The WHO defines a people-centred approach as an approach that “consciously adopts individuals’, carers’, families’ and communities’ perspectives as participants in, and beneficiaries of, trusted health systems that respond to their needs and preferences in humane and holistic ways” (WHO, 2023d). Equity is defined as the “absence of unfair, avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically or by other dimensions of inequality (e.g. sex, gender, ethnicity, disability, or sexual orientation)” (WHO, 2023c).

In the context of AMR, the WHO emphasize that developing a people-centred approach includes “not only engaging and empowering people and communities to be AMR champions and to promote responsible use of antimicrobials but also to prioritize people’s needs and values and ensure equitable access in the design and delivery of health care services from prevention to diagnosis, treatment and care of infections, including drug-resistant infections” (WHO, 2023d). Equity in relation to AMR is concerned with minimizing unfair, avoidable or remediable differences among groups of people in access to essential health services and effective antimicrobials, and the health burden of AMR. From a practical perspective, this approach requires policy-makers to develop national action plans that do not neglect the people-based challenges that drive AMR, such as individuals’ living situations, access to clean WASH, barriers to accessing healthcare services, or understanding of AMR as an issue. The WHO has contextualized the differences between system and people’s challenges across “the AMR people journey”, including prevention of infection, access to health services, diagnosis and treatment (Figure 8). Achieving this goal will require multisectoral approaches to address AMR challenges.

Figure 8. Challenges faced on the AMR people journey

Note: Infection prevention is important in both communities and healthcare facilities and continues throughout the journey. Treatment includes the continuous care that might be required for an AMR infection. The list of challenges may not be exhaustive or applicable to all countries.

Source: WHO, 2023d
with involvement of multiple government ministries and agencies (see next paragraph titled “AMR policy needs to take a multisectoral approach”).

**4.3 AMR policy needs to take a multisectoral and inclusive approach**

International, national and regional AMR policy needs to be framed as a cross-cutting and multisectoral issue requiring mobilization across various government departments whose interests and objectives are also impacted by, or are impacting, AMR. There has been some progress in this regard, and there is now consensus that tackling AMR requires a One Health approach integrating policy and a diverse range of actors across human, animal and environmental health sectors. However, it has been argued that a One Health vision of AMR can increase tendencies of policy-makers and researchers to focus on the specific interfaces that increase risk of contamination and transition of pathogens, rather than on the socioeconomic and sociocultural drivers that influence zoonotic disease risk and health-seeking behaviours (Hinchliffe, 2015).

Looking to the future, AMR policy needs to draw lessons from other public health problems such as tobacco use, obesity, TB and HIV/AIDS that acknowledge that poor health is driven by a variety of factors both inside and outside the healthcare sector, and requires interdisciplinary and equity-focused approaches to policy, such as a “Health in All Policies (HiAP)” approach (Leppo et al., 2013). For AMR, such an approach should recognize that addressing the socioeconomic determinants of AMR requires multisectoral and integrated approaches that address health inequalities, with important roles for most government ministries (Table 3). However, multisectoral approaches to tackle AMR require actions from not just government, but also the private sector and non-governmental organizations (NGOs). There is a particularly important role for civil society organizations, which can contribute to tackling AMR by advocating for policy change, lobbying industry and promoting awareness of AMR (Ranganathan & Ranjalkar, 2023). In many respects, there are synergies between actions taken to address AMR and strategies for the management and control of communicable diseases more generally, and achievement of the UN Sustainable Development Goals (Jasovský et al., 2016).

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Table 3. Key actions by government ministries to address socioeconomic drivers of AMR

<table>
<thead>
<tr>
<th>GOVERNMENT MINISTRY</th>
<th>KEY ACTIONS TO TACKLE AMR AS PART OF A MULTISECTORAL APPROACH</th>
</tr>
</thead>
</table>
| Department of Health | • Invest in ensuring affordable and accessible healthcare services for all based on clinical need and not on ability to pay.  
• Involve disadvantaged and marginalized communities in developing policies and strategies (i.e. stewardship, infection prevention and awareness campaigns), considering their unique socioeconomic challenges.  
• Invest in surveillance systems that monitor inequality in AMU and AMR patterns across the population, disaggregated by characteristics such as gender, ethnicity, age, deprivation, occupation and living conditions.  
• Fund interdisciplinary research into socioeconomic factors contributing to AMR, leading to targeted policy interventions. |
| Department of Agriculture | • Invest in research and dialogue to understand the structural and socioeconomic challenges for actors in the agricultural setting at different levels, from individual farmers and veterinarians to large industry.  
• Establish robust data collection and surveillance systems to monitor AMU in agricultural settings, and collaborate with surveillance systems in human health to generate data on the risk of AMR in agricultural staff working in different contexts and surrounding populations.  
• Build the economic case for investment in good animal husbandry practices, biosecurity measures and vaccination to prevent infections and promote their use through guidelines and evaluations.  
• Regulate the use of antimicrobials in livestock and aquaculture to reduce inappropriate use, such as for growth promotion purposes, and evaluate policies to monitor livestock yields and financial impact for farmers. |
| Environmental Agencies | • Implement monitoring systems for antimicrobial residues in waste water treatment plants and soil to identify sources of contamination.  
• Enforce regulations on antimicrobial residue concentrations on pharmaceutical manufacturing and hospital waste disposal to limit the release of antimicrobials into the environment.  
• Advocate for eco-friendly agricultural practices that reduce the use of antimicrobials in crop and livestock production, which can contribute to environmental contamination.  
• Invest in research to understand linkages between AMR and climate change, and opportunities to create policy alignment to address both issues. |
| Department of Education | • Develop education curricula for healthcare professionals that promote non-discriminatory antimicrobial prescribing practices and understanding of the socioeconomic, gender and other factors that influence health behaviour and healthcare access and outcomes.  
• Develop agricultural and environmental education curricula that emphasize benefits of responsible antimicrobial use and improved biosecurity, and dangers of AMR for livestock, crops and the broader environment.  
• Integrate education on responsible antimicrobial use and the consequences of AMR into school, university and training curricula in related subjects to raise awareness of AMR as a cross-cutting issue and promote interdisciplinary and multisectoral exchange and collaboration across a range of fields relevant to AMR policy. |
Realizing multisectoral approaches requires that policy is developed in an inclusive manner that considers the needs and perspectives of all stakeholders, including representation from diverse and marginalized communities. This is particularly important as certain aspects of policy to tackle AMR, such as increased regulation of antimicrobials, may have trade-offs in relation to access to healthcare services and medicines that could exacerbate health inequalities (Kirchhelle et al., 2020). Therefore, it is important that “Information & Intelligence Generation” is focused on policy evaluation that considers the intended and unintended impacts on socioeconomic drivers of AMR for different population groups, using interdisciplinary research.

### 4.4 Evidence-based policy requires continuous intelligence generation and evaluation of interventions

This principle encapsulates the importance of ensuring that policy design is evidence-based and driven by continual intelligence generation and evaluation of different interventions, including their differential impact in different sociocultural and socioeconomic contexts and for different groups, both within and between countries. Policy design and evaluation also need to be informed by a much broader investigation and understanding of complex, multifaceted phenomena related to socioeconomic status and AMR, and how this manifests at structural, societal, household and individual level. Drawing upon unmet research needs frequently identified within the literature and in expert interviews, we outline major research priorities to understand and mitigate against the socioeconomic drivers of AMR (Table 4).

Moving away from a predominantly biomedical understanding of the socioeconomic drivers of AMR requires information and intelligence generation from a broad range of different disciplines, and using a range of theoretical and methodological approaches. For example, sustainable and consistent implementation of antimicrobial stewardship programmes often requires frameworks, theories and methods from behavioural and psychological sciences at an individual level (Borek et al., 2022). Considering the One Health approach also draws upon social sciences to address AMR from the societal, historical and economic perspectives (Lu, Sheldenkar & Lwin, 2020). There is also a need for implementation science approaches to capture the relevant organizational, regulatory, financial and behavioural enablers and barriers to the consistent implementation of AMR policy interventions in different socioeconomic and sociocultural contexts (Khurana et al., 2023).

From a quantitative perspective, surveillance data on both AMR and AMU need to be routinely disaggregated according to different socioeconomic characteristics such as gender, race, ethnicity, age, deprivation, occupation, socioeconomic status and living conditions (Charani et al., 2021). However, it should be acknowledged that existing system-level inequities create vulnerable situations and can exclude populations from surveillance data, for example for undocumented migrants, people who do not speak the dominant language, and those with poor literacy skills (Frost et al., 2021). Therefore, surveillance studies need to routinely consider which populations may be excluded, and what additional efforts can be made to ensure they are captured in surveillance exercises. Alongside this, longitudinal cohort studies are needed that collect demographic, social, economic and lifestyle information over time to truly understand the lived experiences of different individuals and how this relates to risks and impacts of AMR (Collignon & Beggs, 2019).

<table>
<thead>
<tr>
<th>GOVERNMENT MINISTRY</th>
<th>KEY ACTIONS TO TACKLE AMR AS PART OF A MULTISECTORAL APPROACH</th>
</tr>
</thead>
</table>
| Department of Housing | • Promote urban planning that encourages equitable access to green spaces, reduced pollution and access to clean WASH for all populations.  
• Invest in access to affordable housing, which can reduce overcrowding and unsanitary living conditions that may contribute to the spread of infections, including those resistant to antimicrobials. |
| Department of International Development | • Allocate resources to international interdisciplinary research initiatives focused on understanding the socioeconomic factors contributing to AMR in LMICs, where the burden of AMR is often higher.  
• Support capacity-building programmes to enhance healthcare infrastructure, surveillance systems, access to WASH, improved housing, training and awareness of AMR in countries with limited resources.  
• Utilize international platforms, such as the WHO, UN, G7 and G20, to advocate for policy action and to implement a coordinated global response to AMR. |
| Department of Industry and Trade | • Work with pharmaceutical companies and other actors to develop and adopt sustainable manufacturing practices that reduce the environmental impact of antimicrobial production and minimize antimicrobial concentration residues in waste effluent.  
• Invest in research and innovation to incentivize the development of novel antimicrobials, alternative treatments and diagnostics for AMR that include terms and conditions for equitable access in LMICs. |

>>> Continued from previous page

*Policy brief*
Developing a better understanding of how the transmission of antimicrobial-resistant pathogens is influenced by the interfaces between human, animal and environmental health is crucial to identify targets for policy action. This will require metagenomic studies that analyse the transmission of antimicrobial-resistant genes across different interfaces and settings (de Abreu, Perdigão & Almeida, 2021). However, there is also an unmet need for interdisciplinary research that draws upon political and social science approaches to map different stakeholders involved in One Health transmission dynamics and the relevant behavioural, regulatory and economic incentives that may enable or prevent the implementation of policies to limit the spread and emergence of AMR. There is also a need to undertake more sampling studies to establish to what extent antimicrobial-resistant genes and microbes exist in different environmental settings, for example, waste water, soils, discharge effluent from industry and healthcare settings (Wellcome Trust et al., 2018). Once established, standards need to be established regarding acceptable levels of antimicrobial concentrations in different environmental health settings (Vestel et al., 2022).

Table 4. Research priorities to understand and mitigate against the socioeconomic drivers of AMR

<table>
<thead>
<tr>
<th>RESEARCH PRIORITY</th>
<th>TYPES OF INFORMATION REQUIRED</th>
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</table>
| Understand trends and drivers for inappropriate AMU in different populations | • Qualitative data (from diverse disciplinary perspectives) on the socioeconomic and structural drivers of inappropriate AMU in different populations and contexts, at individual, community and societal level.  
• Surveillance data on AMU disaggregated according to prescriber and patient characteristics, such as gender, race, ethnicity, age, deprivation, occupation and living conditions.                                                                                                                                                                                                                     |
| Understand trends and drivers for inappropriate AMU in animal health | • Qualitative data (from diverse disciplinary perspectives) on the socioeconomic and structural drivers of inappropriate AMU in animal health, including a variety of settings including smallholdings, larger farms, veterinarian practices and the food industry.  
• Surveillance data on AMU disaggregated according to different animals, agricultural setting and farm characteristics (e.g., size, location and function).                                                                                                                                                                                                                     |
| Identify enablers and barriers to uptake of technologies and behavioural interventions in different contexts | • Qualitative data (e.g., from interviews, observations, surveys and focus groups) to identify the different organizational, regulatory, financial and behavioural enablers and barriers to uptake of technologies (e.g., rapid diagnostics and vaccinations) and impact of behavioural interventions (e.g., awareness campaigns, stewardship policies and incentives) in different socioeconomic and sociocultural contexts.                                                                                       |
| Understand the relative risk of AMR in different populations | • Surveillance data and other complementary studies on AMR in different population groups, disaggregated by socioeconomic and sociocultural factors such as gender, race, ethnicity, age, deprivation, occupation and living conditions.  
• Longitudinal cohort studies that collect information on a range of demographic, socioeconomic, sociocultural, lifestyle and behavioural factors that follow individuals, households or neighbourhoods over time and establish their risk factors for AMR.                                                                                                                                                         |
| Understand the relative risk of AMR in different populations | • Metagenomic studies that analyse the transmission of antimicrobial-resistant genes across different interfaces and settings, such as healthcare settings, animal contacts and water sources.  
• Interdisciplinary research that maps stakeholders involved in One Health transmission dynamics and the relevant behavioural, regulatory and economic incentives that influence policy implementation.                                                                                                                                                                                                 |
| Understand the relative risk of AMR in different populations | • Sampling studies of antimicrobial concentrations from waste water, soils and discharge effluents from manufacturing and healthcare facilities, and investigations of the health impacts for surrounding communities.  
• Define minimum selective concentrations (MSC) and predicted no-effect concentrations (PNECs) for antimicrobials in waste water, soils and discharge effluents from manufacturing and healthcare facilities.                                                                                                                                                                                                 |

Note: Minimum selective concentrations represent the lowest concentration of antimicrobials that gives the resistant strains a competitive advantage based on growth rates. The predicted no-effect concentration is the concentration of a chemical which marks the limit below which no adverse effects of exposure in an ecosystem are measured.
5. How can considerations of socioeconomic drivers and impacts of AMR be incorporated into key policy areas?

Developing policy responses to the socioeconomic drivers and impacts of AMR will require embedding the aforementioned principles (i.e. effective governance, people-centred and equitable, multisectoral and evidence-based) into core policy areas familiar to policy-makers working in AMR (Figure 9). We focus on four key policy areas: stewardship, prevention, access and innovation. These broadly align with the key policy domains contained within the WHO global action plan on AMR (WHO, 2015), with the exception of surveillance, which is captured within the “Evidence-based” principle described above.

5.1 Actions to promote sustainable use of antimicrobials need to consider the constraints and realities of individuals in different contexts globally

Antimicrobial stewardship can be defined as a “a coherent set of actions which promote using antimicrobials responsibly” (Dyar et al., 2017). However, a balanced approach is needed to ensure that antimicrobial stewardship policies do not discriminate against or inadvertently have disproportional negative impacts on population groups in situations of vulnerability. Diverse stakeholder engagement, including involvement of different patient groups, is essential from the very start of processes to develop a policy. Public awareness campaigns also need to adapt materials and content for different population groups to be understandable, culturally sensitive and applicable for their lived realities (Price et al., 2018). Education and training can be provided to healthcare staff on the importance of unbiased decision-making and avoiding discrimination in antimicrobial prescribing, and regular audits and monitoring mechanisms can be used to detect significant disparities in antimicrobial use.

From the animal health perspective, antimicrobial stewardship requires investment in improved biosecurity and hygiene, better use of vaccination and alternative treatments, and changes in animal housing and husbandry practices (Gozdzielewksa et al., 2020). There is also a need for strengthened regulation of inappropriate use of antimicrobials for prophylactic and growth promotion purposes (Pokharel, Shrestha & Adhikari, 2020), with a particular emphasis on critically important antimicrobials for human medicine (Umair et al., 2023). However, it is also important that policies and education campaigns to limit antimicrobial use in animal health are designed to reflect the constraints and realities of agricultural workers and veterinarians operating in different contexts globally. Insurance schemes could be used to protect farmers’ incomes and mitigate any potential losses if they commit to avoiding the use of antimicrobials for preventative purposes, but research is needed to understand the optimal arrangements of such insurance models (Lhermie, Gröhn & Raboisson, 2017).

Figure 9. Policy framework on socioeconomic drivers and impacts of AMR
5.2 Prevention of infection requires action outside the healthcare sector, with investment in equitable access to clean WASH—an urgent policy priority

Developing a comprehensive strategy for the prevention of infection requires multilevel approaches that acknowledge the relationships between living situations and housing, occupational exposure, access to clean WASH, climate change, and displacement of populations and risk of communicable disease (Fouque et al., 2020; Fieldman, Mossialos & Anderson, 2023). These broader issues need to be considered alongside the implementation of IPC programmes in healthcare settings that include interventions such as standard hygiene measures (i.e. hand washing), the isolation of infected patients and environmental cleaning, as well as active screening of incoming patients (Tacconelli et al., 2014). However, IPC programmes need to be co-designed with broad involvement of all relevant stakeholders to ensure they consider organizational, socioeconomic and behavioural barriers and facilitators for implementation (Lacotte, Årdal & Ploy, 2020).

It is also important to develop policies that consider transmission pathways of antimicrobial-resistant pathogens across human, animal and environmental health settings. There are several pathways via which this occurs, including poor sanitation, sewage and waste effluent from humans, waste effluent from pharmaceutical manufacturing, waste effluent from healthcare facilities, use of antimicrobials and manure in crop production, and waste effluent from animal production (UNEP, 2022). For these reasons, the AMR policy community has emphasized the need for coordinated and multilevel action to strengthen access to clean WASH. This will not only prevent the transmission of communicable disease but improve overall population health, narrow health inequalities and reduce demand on healthcare services (Amebelu et al., 2021).

5.3 Sustainable and equitable access to antimicrobials for all populations is needed to avoid prolonged infections and suboptimal treatment regimes

Unfortunately, many disadvantaged populations experience barriers to accessing healthcare and therefore appropriate antimicrobial treatment. This results in a disproportionately higher burden of disease for disadvantaged populations associated with infection (Alividza et al., 2018; Nellums et al., 2018). In LMICs there are often competing narratives regarding antimicrobial use. On one hand, there is a pressing need for improved and equitable access to antimicrobials to address significant mortality and morbidity associated with communicable disease (Resman, 2020). On the other hand, there are concerns about unrestricted access to antimicrobials and calls for strengthened regulation of access to antimicrobials. Overcoming this will require reframing antimicrobial stewardship as a key component of health system strengthening.

Alongside this, there need to be specific policies targeted towards sustainable and equitable access to antimicrobials in both HICs and LMICs. It is known that health systems in both LMICs and HICs encounter challenges to secure consistent access to antimicrobials and experience persistent shortages (Laxminarayan et al., 2016; Edwards et al., 2023). For example, a report on shortages in EU Member States found that systemic anti-infectives were the third most frequent class of medicines for which shortages were reported in 2020 (European Commission et al., 2021). Similar data do not exist in LMICs, but shortages of essential antimicrobials are known to be a major issue with weak forecasting systems and absent or underdeveloped systems for pooled procurement identified as significant drivers (Shafiq et al., 2021). Securing sustainable access to antimicrobials internationally would require a global strategy and policy actions that target multiple stages of the antimicrobial supply-chain (Box 3).

Box 3. Policy actions to secure sustainable access to antimicrobials

Joint procurement exercises between countries can be used for antimicrobials used in small volumes or for countries with smaller populations that have limited purchasing power. Conditions can be included in contracts to improve security of supply, such as requirements that more than one supplier is contracted, and longer-term purchasing commitments to build the economic case for investment in manufacturing capacity. There is also scope to pilot annual revenue guarantees in both HICs and LMICs in exchange for predefined available supply volumes. This has been used effectively by Sweden to secure consistent access to antimicrobials of important public health value (Public Health Agency of Sweden, 2023), and could be replicated elsewhere. Physical and virtual stockpiling could be used to ensure sustainable access during surges of demand that occur seasonally or because of disease outbreaks. There is also a need for greater transparency across the supply-chain and mapping of production capacities and product availability. This information can be used to forecast misalignment between future supply and demand. International institutions such as the WHO also need to engage with industry to identify vulnerabilities across the supply-chain and to build the business case for investment in diversification of manufacturing capacity internationally. This is important as a global analysis of 40 antimicrobials found that close to 70% of the manufacturing sites for antimicrobial active pharmaceutical ingredients (APIs) are found in India (35%) and in China (34%) (BCG, 2021). In some cases the production of APIs for specific antimicrobials is dependent on a few suppliers in these countries, and the supply-chain is particularly vulnerable if there are any issues with these suppliers.

5.4 Innovation in the research and development of novel AMR technologies needs to be responsive to the needs of, and accessible and affordable for, LMICs

Constant innovation is required to achieve access to novel antimicrobials of public health value, diagnostics, vaccines and alternative treatments for AMR (Anderson et al., 2023). However, the WHO has described the current antimicrobial pipeline as insufficient to meet public health needs (WHO, 2022a). Despite growing health and economic impacts, market failures mean that the antimicrobial pipeline remains insufficient to tackle AMR (Renwick & Mossialos, 2018; WHO, 2022a). Overcoming these market failures for
antimicrobials will require investment in push incentives, such as direct funding and grants, in the pre-clinical and early clinical stages of development (Brogan & Mossialos, 2016; Renwick et al., 2016). This will also need to be combined with investment in pull incentives, such as annual revenue guarantees or market entry rewards, which can help create a viable market for antimicrobials (Anderson, Panteli & Mossialos, 2023).

To avoid further exacerbating socioeconomic inequities in the health burden of AMR, increased investment in research and development of antimicrobials by HICs needs to consider the needs of LMICs, including issues such as affordability, accessibility and ease of administration. There is also a need for research into how new health technologies to tackle AMR are disseminated and used across populations (between and within countries), with a focus on potential socioeconomic drivers and impacts of AMR, to help ensure that technical innovations are used to maximum effect to reduce the health burden of AMR (Olliaro et al., 2023; Ondoa et al., 2021).

One potential policy option is to combine investments in research and development with terms and conditions related to global access and affordability (Anderson, Panteli & Mossialos, 2023). For example, pull incentives deployed by G7 or G20 countries could include requirements that antimicrobial developers supply new antimicrobials to LMICs at the marginal cost of production. This is of mutual benefit for all countries as without comprehensive access to pre-existing and new antimicrobials in LMICs, certain countries may become reservoirs for multi-drug resistant infections. The Center for Global Development has developed a set of proposed commitments by HICs, LMICs, the pharmaceutical industry and international organizations to address antimicrobial market and access failures globally (Figure 10). These include commitments by HICs to adequately fund research and development, and facilitate global access to antimicrobials, by LMICs to prevent unnecessary use of antimicrobials and adequately fund national action plans, and by the pharmaceutical industry to undertake research and development in critical areas that meet all countries’ needs and to manufacture antimicrobials in an environmentally sustainable way.

Figure 10. Overview of the proposed Grand Bargain to Improve the Antimicrobial Market for Human Health

---

**High-income country governments**

In return for a system that ensures sustainable access to effective antimicrobials:

- Adequately fund research and development
- Collect and report data on resistance
- Facilitate global access to essential diagnostics and antimicrobials
- Protect drugs from unnecessary use
- Adequately fund National Action Plans domestically and in low-income countries
- Support the creation of a sustainable access hub for antimicrobials

**Low- and middle-income country governments**

In return for a system that ensures sustainable access to effective antimicrobials:

- Support and conduct clinical trials
- Collect and report data on resistance
- Protect drugs from unnecessary use
- Reduce unnecessary barriers to access and stewardship
- Adequately fund national action plans
- Support the creation of a sustainable access hub for antimicrobials

**Pharmaceutical industry**

In return for a system that adequately remunerates research and removes barriers to selling antimicrobials in LMICs:

- Undertake research and development in critical areas that meet all countries needs
- Protect drugs from unnecessary use
- Manufacture antibiotics in an environmentally sustainable way
- Improve production standards and supply chains globally
- Ensure drugs are available in all countries

**International organizations**

- Coordinate between countries and ensure commitments are followed
- Set global targets for access, innovation and stewardship of antimicrobials
- Monitor resistance rates and antimicrobial consumption
- Provide finance and technical advice to governments to implement goals

Source: Reproduced with permission from Center for Global Development, 2023
6. Conclusion: A call for action to address the socioeconomic drivers and impacts of AMR

Until recently, the relationship between socioeconomic determinants of health and the emergence and transmission of antimicrobial-resistant pathogens has not been a focus of the policy and academic community. There is now increasing acknowledgement of the critical role that socioeconomic factors play in driving AMR, shaping the health and economic impacts of AMR, and influencing the effectiveness of innovations and progress to tackle AMR at the individual, health system and societal level.

Addressing the socioeconomic drivers and impacts of AMR will require policy-makers to move away from the biomedical model of AMR when designing and implementing national action plans to develop people-centred, equity-oriented and multisectoral responses to AMR. Increased investment in evidence generation is also needed to leverage interdisciplinary approaches to build a more comprehensive understanding of socioeconomic drivers and impacts of AMR, and how the uptake and effectiveness of technologies and behavioural interventions vary across populations. Crucially, this information needs to be conveyed to those who develop and implement policy to ensure that policies and actions are evidence-based and incorporate socioeconomic considerations moving forward.
7. References


Connor J et al. (2020). Health risks and outcomes that disproportionally affect women during the Covid-19 pandemic: A review. Social Science and Medicine, 266:113364.


Dyar OJ, Huttner B, Schouten J, Pulcini C, ESGAP (ESCMID Study Group for Antimicrobial stewardship) (2017, 4 September). What is antimicrobial stewardship? Clinical microbiology and infection (the official publication of the European Society of Clinical Microbiology and Infectious Diseases), published online. DOI:10.1016/j.cmi.2017.08.026.


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Tacconelli E et al. (2014). ESCMID guidelines for the management of the infection control measures to reduce transmission of multidrug-resistant Gram-negative bacteria in hospitalized patients. Clinical Microbiology and Infection (the official publication of the European Society of Clinical Microbiology and Infectious Diseases), 20(S1):1–55.


8. Appendix

8.1 Umbrella review methodology

We performed an umbrella review of reviews, and focused specifically on quantitative evidence on socioeconomic drivers and impacts of AMR. Drivers were conceptualized as having a direct association with either a metric of AMR (such as aggregate indices, prevalence rates or resistance rates) or behaviours with a well-established causality (such as antibiotic use [ABU], or self-medication with antibiotics [SMA]). Evidence on drivers of AMR in animal and environmental health settings were captured if studies estimated the relationship between these drivers and the increased risk of AMR in humans. An impact of AMR was defined from a strictly human domain, and included both health and socioeconomic factors.

We performed systematic searches in four scientific databases: MEDLINE, Embase, Global Health and the Cochrane Database of Systematic Reviews. The scientific search was supplemented with a non-systematic search for grey literature using Google Scholar (first 200 hits). The full query for the scientific databases is shown in Table 1 below. An information specialist at the London School of Economics and Political Science Library further validated the search strategy.

Studies were included based on the following criteria: (1) studies should be systematic reviews, rapid reviews, umbrella reviews, scoping reviews, or any review where an explicit methodological search strategy was employed; (2) studies should explicitly report on AMR; (3) the identification of drivers and impacts was allowed to remain implicit; (4) studies needed to contain quantitative data relating to either drivers or impacts of AMR; (5) studies needed to either relate to the human dimension alone, or discuss either the animal-human interface or the environment-human interface; and (6) studies should be written in English and published on or after 1 January 2010. The complete screening process was performed by one reviewer (GL), and a second reviewer (RVK) screened a subset of approximately 20% of identified articles to improve the methodological robustness of the literature review and inter-rater reliability scores were computed. Any disagreements between the reviewers were resolved by an independent third reviewer (MA).

Table Annex 1. Overview of the search string for the literature review

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<th>DATABASE</th>
<th>SEARCH STRING</th>
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</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>3</td>
<td>or/1-2</td>
</tr>
<tr>
<td>4</td>
<td>(socio?economic* or social* or economic* or inequalit* or inequit* or poverty or corrupt* or financ*),ti,ab.</td>
</tr>
<tr>
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The socioeconomic drivers and impacts of Antimicrobial Resistance (AMR) – Implications for policy and research

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37
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8.2 Interview topic guide

1. Can you tell us briefly how your current role is related to the management or study of infections and AMR?

2. Thinking about the key drivers of antimicrobial resistance (AMR), in your opinion what are the key factors that drive AMR?

3. Where do you think the impacts of these drivers are greatest, in human health or other parts of One Health space, e.g., environment, agriculture, etc? Why do you think this?

4. Which specific sociocultural characteristics of individuals do you think would increase their likelihood or risk of contracting drug-resistant infections? Do you think this varies by geographic and social boundaries? If yes, how so?

5. Which specific factors that define and position people in society do you think would influence their infection-related behaviours?

6. (If knowledgeable regarding animal/environmental health) Within the One Health space, specifically farming and agriculture, what current practices do you think increase risk of contracting or spread of resistant infections amongst the livestock? What are the risks of this leading to spread of AMR to other fields within One Health, e.g. into human populations?

7. Which societal factors do you think contribute most to the spread and dissemination of drug-resistant infections within human populations? What about in animal and environmental health settings?

8. Where in One Health do you think is the biggest economic burden of AMR? Why is that?

9. Do you think we have sufficient data on the economic consequences of AMR? What do we need to change to create more knowledge in this subject?

10. (If not already discussed) How do you think economic factors (such as income, employment and procurement practices) influence the spread and dissemination of drug-resistant infections within human populations? What about in animal and environmental health settings?

11. (If not already discussed) Which cultural factors influence the spread and dissemination of drug-resistant infections within human populations? What about in animal and environmental health settings?

12. (If not already discussed) Which health system factors influence the spread and dissemination of drug-resistant infections within human populations? What about animal and environmental health settings?

13. What policy actions do you think need to be prioritized at the national level to address these societal, economic, cultural and health system factors that are driving AMR?

14. What policy actions do you think need to be prioritized at the organizational level (hospital, primary care practice, farm, veterinary practice) to address these societal, economic, cultural and health system factors that are driving AMR?

15. What policy actions do you think need to be prioritized at the individual level (patient, companion animal owner, farmer, veterinary surgeons) to address these societal, economic, cultural and health system factors that are driving AMR?

Thank you for your time, is there anything else you would like to add to what we have discussed?
### 8.3 Expert interviewees

<table>
<thead>
<tr>
<th>EXPERT NAME</th>
<th>AFFILIATION</th>
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<tbody>
<tr>
<td>Professor Timo Minssen</td>
<td>Director, Center for Advanced Studies in Biomedical Innovation Law (CeBIL), University of Copenhagen (UCPH), Copenhagen, Denmark</td>
</tr>
<tr>
<td>Professor Robert Leo Skov</td>
<td>Scientific Director, International Centre for Antimicrobial Resistance Solutions (ICARs), Copenhagen, Denmark</td>
</tr>
<tr>
<td>Jeremy Knox</td>
<td>Head of Policy, Infectious Disease, Wellcome Trust, London, United Kingdom</td>
</tr>
<tr>
<td>Dr Michele Cecchini</td>
<td>Lead, Public Health, Health Division, Directorate for Employment, Labour and Social Affairs (ELS), Organisation for Economic Co-operation and Development (OECD), Paris, France</td>
</tr>
<tr>
<td>Dr Danilo Lo Fo Wong</td>
<td>Programme Manager, Control of Antimicrobial Resistance (AMR), WHO Regional Office for Europe, Copenhagen, Denmark</td>
</tr>
<tr>
<td>Dr Esmita Charani</td>
<td>Associate Professor, University of Cape Town, Wellcome Trust Career Development Fellow, Cape Town, South Africa Reader in Infectious Diseases and Global Health, University of Liverpool, Liverpool, United Kingdom</td>
</tr>
<tr>
<td>Dr Andrew Singer</td>
<td>Principal Scientist, UK Centre for Ecology &amp; Hydrology, Lancaster, United Kingdom</td>
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<tr>
<td>Dr Ramanan Laximinarayan</td>
<td>Founder and President, One Health Trust, New Delhi, India</td>
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<tr>
<td>Professor Kevin Outterson</td>
<td>Executive Director and Principal Investigator, CARB-X, Boston, United States</td>
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<tr>
<td>Professor Clare Chandler</td>
<td>Professor of Medical Anthropology; Co-founding Director, LSHTM Antimicrobial Resistance Centre, London, United Kingdom</td>
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<tr>
<td>Professor Susan Rogers Van Katwyk</td>
<td>Managing Director, AMR Policy Accelerator; Research Director, Global Antimicrobial Resistance, Adjunct Professor, York University, Toronto, Canada</td>
</tr>
<tr>
<td>Professor Sabiha Essack</td>
<td>South African Research Chair in Antibiotic Resistance, Pharmaceutical Sciences Antimicrobial Research Unit, University of Yakwazulu-Natali, Durban, South Africa</td>
</tr>
<tr>
<td>Dr Faisal Sultan</td>
<td>Former Special Assistant to Prime Minister/Minister of Health, Ministry of National Health Services, Regulations &amp; Coordination, Islamabad, Pakistan</td>
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What is a Policy Brief?
A policy brief is a short publication specifically designed to provide policy makers with evidence on a policy question or priority. Policy briefs:
• Bring together existing evidence and present it in an accessible format.
• Use systematic methods and make these transparent so that users can have confidence in the material.
• Tailor the way the evidence is identified and synthesised to reflect the nature of the policy question and the evidence available.
• Are usually a one-page or two-page structured presentation of the evidence presented.

Each brief has a one page key messages section, a two-page evidence summary giving a succinct overview of the findings, and a two-page review setting out the evidence. The idea is to provide instant access to key information and address specific questions or gaps in drafting, informing or advising on the policy.

Policy briefs provide evidence for policymakers not policy advice. They do not seek to explain or advocate a policy position but to set out clearly what is known about it. They may outline the evidence on different policy options and on implementation issues, but they do not imply that they are endorsed or recommended by the WHO or the European Observatory on Health Systems and Policies.

The responsibility for the interpretation and use of the material lies with the user. The designations employed and the presentation of the material do not imply the expression of any opinion whatsoever on the part of the WHO and the European Observatory on Health Systems and Policies or any of its Partners in preference to or in competition with any third party.

The evidence presented in these policy briefs is derived from a wide range of sources. It is summarised to draw out common points and themes. The authors of the briefs are accountable for the views expressed in these policy briefs. Where authors do not have any affiliation with a Partners, they act as a manual for implementation.

How to make sense of health system efficiency comparisons?

How can health systems respond to population ageing?

How can chronic disease management programmes operate across care settings?

How can the migration of health service professionals be managed so that it acts as a manual for implementation?

What are the key priority areas where European health systems can learn from elsewhere?

What steps can improve and promote investment in health and care workforce?

How can gender equity be addressed through health systems?

How can European health systems support investment in health care reform?

Where are the patients in decision-making about their own care?

How can knowledge brokering be better supported across European health systems?

How to support integration to promote care for people with chronic conditions and multimorbidity?

How can the socioeconomic drivers and impacts of Antimicrobial Resistance (AMR) be addressed?

How can provider competition improve health care quality and efficiency?

What is the experience of decentralized hospital governance in Europe?

What can intersectoral governance do to strengthen the health and social care systems in Europe?

How to support integration to promote care for people with chronic conditions and multimorbidity?

How can knowledge brokering be better supported across European health systems?

Policy Briefs

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The European Observatory on Health Systems and Policies is a partnership that supports and promotes evidence-based health policy-making through comprehensive and rigorous analysis of health systems in the European Region. It brings together a wide range of policy-makers, academics and practitioners to analyse trends in health reform, drawing on experience from across Europe to illuminate policy issues. The Observatory's products are available on its website (www.healthobservatory.eu).