The Global Threat of Antimicrobial Resistance

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Introduction

Antimicrobial resistance (AMR) is a significant threat to global health (Global Leaders Group on Antimicrobial Resistance, n.d.). The World Health Organisation (WHO) estimated 1.27 million deaths were the direct consequence of AMR in 2019 (Murray et al, 2022). Worryingly, it is projected that this figure could rise to 10 million deaths per year worldwide in the next 25 years unless urgent action is taken to tackle AMR (Ahmed et al, 2024). This would mean AMR could become the leading cause of mortality across the world (Tang et al, 2023).

This article intends to highlight the importance of a global initiative to tackle AMR with a focus on a One Health approach. A One Health approach emphasises the interconnected nature of human, animal and environmental well-being and highlights the importance of all three in tackling global health challenges such as AMR (Global AMR R&D HUB, n.d.). It aims to address the problem of AMR through collaborative strategies devised by health care professionals, veterinarians, policy makers and environmental scientists to develop adequate surveillance and stewardship practices (Global AMR R&D HUB, n.d.). These practices are expected to reduce the prevalence of AMR by promoting responsible antibiotic use and supporting research into additional effective treatments such as vaccinations (Global AMR R&D HUB, n.d.).

It will also describe and evaluate global health policies introduced to combat AMR, such as the UK's National Action Plans (NAPs) and GLASS initiative. Furthermore, it intends to describe and evaluate the success of surveillance via the GLASS initiative and demonstrate how collaboration across nations can slow down the march of AMR.

Background of AMR:

AMR is when viruses, fungi, parasites and bacteria no longer respond to antimicrobial medicines that are used to prevent and treat the diseases they cause (NHS, n.d.). Antimicrobial medicines such as antibiotics work to kill pathogens by targeting specific parts of their composition or cell structure (Habboush et al, 2023). They are typically very effective at combating the spread of infections; however, their efficacy is significantly reduced by microbial mutation. Microbial mutation is a natural biological process that results in a change to the DNA sequence of an infectious microbe. This change renders the initial antibiotic ineffective against the altered microbe and causes antibiotic resistance (ABR). Consequently, this leads to AMR as the pathogen has evolved to become unresponsive to the antimicrobial treatments available.

Whilst microbial mutation is natural, it is thought to be amplified by human factors such as inappropriate prescribing across several sectors, including farming, veterinary practice, and human healthcare systems. The overprescription of antimicrobials is a key example of this and has been identified by the WHO as the main driver of AMR (WHO, 2023). Antibiotics aim to kill all harmful cells present during an infection; however, there are often resistant cells that survive and continue to multiply. Frequent exposure to antibiotics causes these resistant cells to develop until an entire colony of cells is completely resistant and no longer responds to antimicrobial treatments. In this way, overprescribing antibiotics directly promotes AMR.

Why is AMR so important?

AMR has been deemed a global health concern because it is reducing the efficacy of treatments we have relied on for decades, for example, Methicillin. Methicillin was introduced in 1959 as an alternative treatment for penicillin-resistant Staphylococcus aureus. However, just two years later, it was found that the Staphylococcus aureus bacterium had also become resistant to methicillin (Enright et al, 2002). This produced the well-known bacteria methicillin-resistant Staphylococcus aureus (MRSA) (Enright et al, 2002). In response to this resistance, a series of new antibiotics were developed, including vancomycin, which is the current recommended first-line treatment against MRSA according to UK guidelines (Purja et al, 2024). Concerningly, reports show that cases of vancomycin-resistant Staphylococcus aureus (VRSA) have emerged, which suggests that MRSA's susceptibility to vancomycin is diminishing (Selim et al, 2022). MRSA poses a significant threat to global public health. It has been placed in the high-priority category on the WHO's Bacterial Priority Pathogens List as it is highly transmissible, difficult to treat, and there are few alternative treatments in development (WHO, 2024). These factors outline MRSAs' position as a global health concern and highlight the need for increased international collaboration to eradicate it.

Factors that Drive Antibiotic Resistance:

Antibiotic misuse is driven by multiple factors, including over-prescription by health care professionals, inappropriate patient self-prescription, veterinary overuse and agricultural use (Nammi et al, 2025). The over-prescription of antibiotics by medical professionals is one of the most highlighted factors in the discourse on overcoming AMR. Research shows that the over-prescription of antibiotics is typically related to uncertainty (Lansink et al, 2024). Lansink et al (2024) highlight that health care providers tend to pre-emptively prescribe antibiotics in cases where they are unsure of the cause of a patient's illness. To change human prescribing behaviour, therefore, presents quite a policy challenge.

Additionally, it is important to recognise that the over-prescription of antibiotics is a global problem. Public Health England has stated that at least 20% of antibiotic prescriptions in the UK are inappropriate (Public Health England, 2018). Meanwhile, an average of around 30% of the world's

antibiotic prescriptions are considered to be inappropriate (Mulchandani et al, 2025). This suggests that global collaboration is necessary to devise and implement a surveillance system that is effective at tracking prescriptions across all nations to mitigate the spread of AMR.

A country's economic status determines both which factors drive AMR and the degree of impact. For example, patient self-prescription is much more prevalent in low- and middle-income countries (LMIC's) than in high-income ones (Mendoza et al, 2025). This is usually due to a structural disparity in the health care systems available in LMICs compared to higher-income countries, which tend to have more stringent surveillance and prescription measures (Chokshi et al,2019). One such example is in Egypt, where antibiotics are available at local pharmacies and can be purchased without a prescription (Kotb et al, 2018). Whereas in Finland, a higher-income country, all pharmacies are mandated by the law to provide data on prescriptions to a government agency called the Social Insurance Institution (Kuitunen et al, 2022). This requirement allows Finland to decrease its AMR levels by providing a comprehensive data set which can be used to design appropriate national action plans based on the AMR trends it identifies (Skajaa et al, 2022). In contrast, in Egypt, patients can choose to take antibiotics without consulting a health care professional (Kotb, 2018). This has resulted in Egypt having the 54th highest mortality rate associated with AMR in 2021 (Institute for Health Metrics and Evaluation, n.d.).

At face value, this example suggests that the impact of AMR in LMICs can be reduced by taking individual state action to adopt more stringent prescription policies. However, this suggestion overlooks the wealth differential that exists between HICs and LMICs. HICs enjoy the privilege of investment in adjacent areas that impact health, for example, sanitation. In many LMICs, ensuring policy changes are effective requires strengthening health care systems, increasing awareness about responsible antibiotic use and improving hygiene and sanitation (Sulis et al, 2023). The requirement for such structural change within LMIC brings with it considerable expenditure, which may not be easily met. As such, facilitating the desired changes requires global commitment, investment and coordination.

One area that is not commonly considered but largely impacts the prevalence of AMR worldwide is the agricultural sector (Nazir et al, 2025). Antibiotics are used in agriculture to increase productivity and reduce the spread of illness across animals (Sutherland et al, 2023). Like human health services, antibiotics are also overprescribed by veterinarians, especially with respect to animals in the farming industry (Shrivastav et al, 2016). This is because antibiotics are often administered as a prophylactic measure before there are any clinical signs of disease (Sutherland et al, 2023). The result of antibiotic over-prescription in the case of livestock is incredibly significant as it enables the transmission of zoonotic pathogens between animals and humans via the food chain (Ahmed et al, 2024). Zoonotic pathogens are those that can naturally be exchanged interchangeably between vertebrate animals and humans (Rahman et al, 2020). Inevitably, this promotes the spread of resistant

strains across species (Ahmed et al, 2024). It is imperative that policy action is taken to reduce the spread of such diseases, as over 61% of pathogens are zoonotic, and studies show that they are the main source of emerging illnesses (Sabour et al, 2022).

***The relationship between involvement in the global meat market and veterinary antibiotic sales**:*

Research suggests that the frequency and volume of antibiotics used by a country are linked to the extent of its role in the meat production market (Tiseo et al., 2020). India is currently the top milk producer in the world and is one of the top 5 countries for meat production (Filipenco, 2025; Singh, 2024). This rising demand has led farmers to increase their use of antibiotics as growth promoters, which in turn has boosted the number of antimicrobial-resistant livestock (Alagawany et al., 2018; Taneja et al., 2019). A study conducted by Das et al. (2017) analysed milk samples from cows and buffaloes and found that 47.5% of the Gram- negative bacteria present in the milk were resistant to a form of antibiotic called oxytetracycline. Another study analysed swab samples taken from 400 freshly slaughtered poultry obtained from 4 different areas across Jabalpur (Shrivastav et al, 2016). The results showed that 33.4% of the poultry tested positive for Extended Spectrum Beta- Lactamase (ESBL), an enzyme produced by E. Coli, that causes resistance to Cephalosporin antibiotics (Shrivastav et al, 2016). This means that 33.4% of the poultry was antibiotic resistant (Shrivastav et al, 2016).

The GLASS Initiative:

Achieving global collaboration across all the sectors that promote AMR requires the implementation of a One Health approach (Ahmed et al, 2024). One example of this approach being applied is through the Global Antimicrobial Resistant Surveillance Service (GLASS) (WHO n.d). GLASS was initially launched in 2015 to strengthen the surveillance of AMR through data collection, analysis and reporting and has since been adapted to include data on antimicrobial use (WHO, 2025).

Evaluation of GLASS:

GLASS has successfully expanded the scope of AMR data collection and increased participation in the sharing of AMR data (WHO, 2025). Between 2016 and 2023, the number of countries involved in the GLASS programme increased from 25 to 104, and it now accounts for 70% of the world's population (WHO, 2025). Surveillance coverage has also improved, with the number of reported infections with an antimicrobial susceptibility test (AST) reported to the WHO having risen across 4 infection types (WHO, 2025). This suggests that GLASS has either influenced countries to take more ASTs in clinical care or has prompted them to extend surveillance to a wider variety of facilities (WHO, 2025). However, there is little to no evidence to show that GLASS has reduced AMR cases.

The data reveals a disparity in the focus of surveillance. For example, data on urogenital gonorrhoea remained low in 2023 compared to other infections (WHO, 2025). Additionally, some countries still do not have the resources and infrastructure necessary to produce comprehensive AMR data (WHO, 2025). AMR is a threat which ignores geographical borders, making it imperative that individual countries have strong foundations developed against it for global collaboration to be effective (Padiyara, 2018). This evidence highlights why tackling AMR at a national, regional and global level is a target outlined by the WHO and why international collaboration is integral (WHO, 2023).

UK's National Action Plans:

The UK government has produced 5-year national action plans (NAPs) to complete its 20-year vision of controlling AMR by 2040 (Department for Health and Social Care, 2019). These include goals such as reducing the number of drug-resistant infections by 10% by 2025 and ensuring current antibiotics remain effective by reducing infection numbers and aiding professionals to improve prescribing practice. The plans advocate for the NHS to adopt a new payment model to address the role of pharmaceutical companies (Department for Health and Social Care, 2019). This model, known as the Antimicrobial Products Subscription model, encourages pharmaceutical companies to create new antibiotics to prevent overuse (Duddy, 2024). The model, which is part of the 2024-2029 NAP, operates such that the NHS pay a fixed annual fee to companies in return for access to new antibiotics. The NAP rules that to meet the criteria for this subscription plan, companies need to provide the appropriate certification to prove they have responsibly disposed of waste containing antibiotic remnants (Duddy, 2024). This is an important step towards reducing the release of antibiotic material into the environment.

Evaluation of NAPs:

As NAPs are a relatively new policy, only the first plan from 2019-2024 has run its course. Evaluation of this plan was conducted by the Policy Innovation and Evaluation Unit (PIRU) at the London School of Hygiene and Tropical Medicine (Gov.uk, 2024). PIRU found that the UK needs to formally prioritise AMR-related policy initiatives and invest in further development of its veterinary and One Health data systems. They state that more comprehensive data needs to be collected on the prescription of antimicrobial medicines, the relationship between the food chain and AMR, as well as data on the environment.

ANIMUSE:

With respect to AMR surveillance in the veterinary sector, the World Organisation for Animal Health (WOAH) has been tracking AMR progression since 2015. In 2022, it launched the ANImal antiMicrobial USE global database (ANIMUSE) (WOAH,. n.d). The most recent WOAH report on

ANIMUSE shows that a total of 157 participants utilised the database in the ninth round of data collection (WOAH, 2025). Their submissions exhibit an overall decrease of 5% in the milligrams of antimicrobials per kilogram of estimated animal biomass (mg/ kg) used on a global level across 2020-2022. This means the amount of antibiotic usage measured in mg per the total mass of living animals in a total area in kg fell by 5%. According to the report, this result accounts for 62% of the global living animal biomass. These findings are largely positive and suggest that policy introductions are having a valuable impact on tackling AMR. However, it is important to note that there are several barriers to data collection that still need to be addressed, for example, weak inter-agency cooperation. For data collection to become more effective, coordination between the WOAH and subregional bodies needs to be strengthened (WOAH, 2025).

Conclusion

In conclusion, AMR is a significant threat to global health, which needs urgent collaborative action (Global Leaders Group on Antimicrobial Resistance, n.d.). Policy and strategy are gaining momentum, but progress is limited due to a fragmented response both at the individual national level and the international collaborative level. The GLASS programme is showing promise, but further investment is needed to equalise its use between countries. Embracing the One Health approach is key to helping nations understand their contribution to AMR and can highlight areas to focus strategy and policy towards reducing AMR (Global AMR R&D HUB, n.d.).

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