KNOCKING OUT AMR

MICROBIOLOGY SOCIETY

Antimicrobial Resistance in the UK: Diagnostics and Surveillance

What is AMR?

The rise of antimicrobial resistance (AMR) is one of the most urgent global threats to public health in the 21st century. AMR refers to disease-causing microbes (also known as pathogens) evolving and gaining resistance to drugs and substances that were once effective treatments against infections (antimicrobials). It poses significant challenges to current clinical care, health economies, animal and plant health as well as the environment. Microbiologists from across the world are committed to developing innovative solutions to combat AMR and reduce its impact on global health.

How does AMR occur?

AMR occurs when microbes (bacteria, viruses, fungi and parasites) mutate and evolve to resist treatment to antimicrobial compounds. When microbes are exposed to antimicrobials, they are put under a selective pressure that forces them to develop mechanisms that enable them to survive. Resistant microbes can then multiply and share their defence mechanisms with other microbes in the population. Therefore, overuse and inappropriate use of antimicrobials increases the chance of AMR occurring.

What is the cost of AMR?

- AMR costs the NHS an estimated £180 million per year, and left unabated it could result in a cost of £66 trillion in lost productivity to the economy by 2050 [1].
- By 2050, it is estimated that AMR will kill 10 million people worldwide per year – more than cancer and diabetes combined [2].
- A systematic analysis of AMR conducted in 2019 concluded that it was the third leading global burden of disease, killing more people than both HIV/AIDS and malaria [3].
- Without strategies to control and reduce the spread of AMR, routine medical interventions such as surgical operations and childbirth could start having potentially fatal outcomes.

What does the data tell us about antibiotic use in the UK?

Antimicrobials describe the broad group of drugs that are used to kill microorganisms. Antibiotics are antimicrobials that have a specific action against bacteria. These are the most commonly used antimicrobial agents.

Human health

- Antibiotic use in humans fell by 15.1% in England [4] and 16.9% in Scotland [5], between 2017 and 2021 [6]. This means that both countries have exceeded the Government's National Action Plan goal to reduce prescribing by 15% by 2024 from a 2014 baseline [7].
- Antibiotics are not recommended for patients with coughs, colds and sore throats which are normally caused by viruses [8]. However, a survey of antibiotic prescribing in UK general practice found 50% of all patients consulted for these conditions were prescribed an antibiotic [9].
- A 2015 study found that, in almost one-third of all prescriptions in England, no clinical justification was documented [10]. This suggests inappropriate antibiotic prescribing in primary care.
- The World Health Organization (WHO) Essential Medicines List and AWaRe book outline the use of antibiotics and have recommended that at least 60% of total antibiotics used in primary healthcare settings should be from the Access group of antibiotics, which have a lower cost, a good safety profile and generally low resistance potential [8].

Animal health

Antimicrobial stewardship in animal health is improving in the UK, with sales and usage of veterinary antibiotics decreasing along with levels of AMR in livestock populations [11].

- Sales of veterinary antibiotics for use in animals decreased by 52% between 2014 and 2021.
- Usage of antibiotics follows this trend, with prescriptions decreasing by 69% for pigs, 81% for turkeys and 50% for laying hens.
- Levels of antibiotic resistance are stabilising and falling in response to this reduction in usage, highlighting the potential for improved antimicrobial stewardship to tackle AMR.
- Antibiotics in the UK are still used routinely in farm animal feed, either as prophylactics or as treatment for existing diseases [12].

Diagnostic solutions

Diagnostic tools enable healthcare professionals to identify pathogens and determine whether they are susceptible to antimicrobials, which informs appropriate antimicrobial use. They are also critical for detecting and monitoring resistant pathogens and their spread within institutions. The development of innovative diagnostic technologies and diagnostic stewardship could drastically reduce the inappropriate use of antimicrobials and help to slow the spread of AMR.

Develop new benchtop diagnostic tools

Very few diagnostic tests to detect bacteria have been recommend by the WHO on its Essential Diagnostics list [13]. Improving the specificity, speed and accuracy of diagnostic tools in laboratory settings could increase the detection of AMR, enabling interventions to be introduced to slow down the spread of AMR and helping to reduce the overuse of antimicrobials. New rapid technologies are emerging, including molecular-based, lateral flow, automated and 'lab on a chip' tests [14]. Their potential has not been fully realised however, and significantly more research and funding is required to make them a reality.

CASE STUDY:
Using Artificial Intelligence (AI) to improve diagnostic speed

Antibiogo [15] is a mobile app developed by Médecins Sans Frontières that supports non-expert laboratory technicians in low resource settings with measuring and interpreting Antibiotic Susceptibility Tests (AST) to help clinicians prescribe accurate antibiotics. This innovative diagnostic tool is based on image processing, AI technology and an existing expert system. If successfully deployed, Antibiogo could drastically reduce diagnostic time, which highlights the potential for AI to transform diagnostic tests.

Implement commercial point-of-care diagnostic (POCD) tests

Traditionally, diagnosis of resistant microbes involves collecting samples and sending them to an off-site laboratory for testing. This is a complicated and time-consuming process that delays processing, results and ultimately the onset of correct treatment. To truly curb the spread of AMR, development of point-of-care diagnostic (POCD) tests that can rapidly identify pathogens and their resistance profiles in hospitals, farms or in the community, is needed. As defined by the WHO, an ideal test should be ASSURED: affordable, sensitive, specific, user-friendly, rapid, equipment-free and deliverable to end-users [16].

POCD applications in human health

The right POCD tests used in clinical settings could smooth and speed up the route to diagnosis, accelerating patient care pathways and optimising the use of professional time. At a patient level, POCD tests could test the right spectrum of pathogens to determine which antimicrobial would be useful. This would optimise clinical decision making, reducing the inappropriate use of antibiotics and thus improving health outcomes. At a population level, POCD tests could provide high resolution detail about which microorganisms are causing which diseases in which areas, and can inform empiric antimicrobial prescribing.

CASE STUDY: 'Boots' test-and-treat service

In 2014, a sore throat POCD test-and-treat service paid for by individuals for streptococcus A (a disease which can, rarely, lead to rheumatoid arthritis) was introduced in 35 'Boots' community pharmacies. In the year that followed, only 10% of the patients who initially consulted the pharmacist were given antibiotics. 49% stated they would have gone to their general practitioner had the service not been available, highlighting the feasibility of a pharmacy-based screening service using POCD [17].

Barriers to POCD implementation

In 2014, the United Kingdom launched the Longitude Prize to stimulate diagnostic innovation, by seeking an affordable, accurate, rapid and easy-to-use test for bacterial infections that will allow the right antibiotics to be administered at the right time [18]. Nine years later, a winner has yet to be announced, highlighting the complexity of developing POCD tests in this context. While POCD tests are practical in theory, often the test detects a single cause necessitating many POCDs and multiple samples to diagnose non-specific infections such as acute fever. In addition, current technologies are expensive. A new approach, which tackles regulatory hurdles, financial incentives and improves cross-sector collaboration, is needed.

Surveillance solutions

Identifying and monitoring drug-resistant pathogens early to accurately trace outbreaks to their source is key to controlling and reducing the spread of AMR. Effective surveillance systems that enable data collection and sharing are essential to assess the spread of AMR and inform effective future policies.

Improve AMR surveillance systems

National AMR surveillance systems with monitoring and evaluation frameworks; robust laboratory infrastructure; communications expertise and quality assurance measures are critical for tackling AMR. AMR surveillance systems in the UK are currently designed around short-term goals, such as the 5-year national Action Plan for AMR. In order to be more effective, surveillance efforts need to be broader and longer, ideally with longitudinal sampling for carriage together with support for long-term capacity [19].

CASE STUDY:
The Global Antimicrobial Resistance and Use Surveillance System (GLASS)

In 2015 the WHO launched GLASS, the first global collaborative effort to standardise AMR surveillance and to support initiation of AMR surveillance and antibiotic consumption at the country level. GLASS also introduced a consistent approach to collection, analysis, interpretation and sharing of data [20]. Despite containing information about many more bacteria globally, the most recent GLASS report found that the COVID-19 pandemic had a negative impact on AMR surveillance activities, and demonstrated the continuing need for national surveillance systems able to produce data that can be shared and used to inform public health policy.

'One Health' AMR surveillance

To fully understand the global burden of AMR, surveillance data across all sectors should be integrated. This is referred to as a 'One Health' approach and recognises that resistant microbes arising in humans, animals or the environment may spread from one to the other. For example, the current AMR surveillance system used for human health in England, the English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR) [4], works across the healthcare system to inform on trends in antimicrobial resistance and prescribing. Linking this system with additional surveillance platforms from animal, agricultural and environmental sectors, such as the UK Veterinary Antibiotic Resistance and Sales Surveillance (UK-VARSS) programme run by the Veterinary Medicines Directorate [21], could work to provide a clear picture of the true extent of AMR.

CASE STUDY:
Pathogen Surveillance in Agriculture, Food and the Environment (PATH-SAFE)

In 2021, the UK Government launched the PATH-SAFE programme [22], a £19.2 million pilot project to establish a better national surveillance system for monitoring AMR in the environment and agriculture using DNA sequencing technology and environmental sampling. The pilot aims to improve environmental surveillance, building on existing initiatives to provide better, more consistent and robust data on AMR.

Conclusions

Developing solutions to AMR is a global health priority. Effective diagnostics and surveillance systems are vital to helping us monitor the spread of resistant infections and safeguard existing antimicrobial medicines. Delivery of diagnostic solutions and strong surveillance systems will require consistent government support, including: funding for research on diagnostic technologies; financial incentives for the development and commercialisation of diagnostic technology; the delivery of robust national action plans and crucially, the facilitation of cross-sector collaboration.

The Microbiology Society is taking a solutions-focused approach with the 'Knocking Out AMR' project, by working with its members to facilitate collaborations, acting as a conduit for knowledge and evidence and bridging the gap between research and policy. We have access to experts across sectors and are well-placed to support the Government in its efforts to tackle AMR.

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Microbiology Society Briefings

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