MICROBIOLOGY SOCIETY

BRIEFING

Antimicrobial Resistance

- **Antimicrobial resistance increasingly threatens the treatment of many infectious diseases and the safety of routine medical procedures.**
- **Antimicrobial-resistant infections currently cause over 700,000 deaths worldwide annually, and without action this will increase substantially.**
- **Tackling antimicrobial resistance requires reducing unnecessary use of antimicrobials and developing new antimicrobials, therapies, vaccines and diagnostics.**

WHAT IS ANTIMICROBIAL RESISTANCE?

Antimicrobials are drugs that kill or inhibit the growth of micro-organisms. These drugs, which include antibiotics, antivirals and antifungals, are essential in modern medicine for the prevention and treatment of many infectious diseases. Antimicrobials are also used in animal health, agriculture and horticulture.

Antimicrobial resistance (AMR) is when a micro-organism develops resistance to antimicrobials that were previously effective. Infections caused by antimicrobial-resistant micro-organisms are difficult to treat, resulting in poor outcomes for patients and economic impacts through increased healthcare costs and lost productivity. The incidence of AMR is rapidly increasing in frequency and geographical spread.

THE THREAT FROM AMR

Increasing levels of resistance mean that conditions such as tuberculosis, HIV and malaria are again becoming increasingly difficult, and sometimes impossible, to treat. When infections are resistant to 'front-line' antimicrobials, second- or third-line drugs are used, which can be more expensive and/or have significant side effects. Longer treatment periods also increase the risk of infections being spread and contribute to increased costs.

A major concern is the emergence of bacteria resistant to many antibiotics used to treat them, including carbapenem antibiotics that are commonly the last line of defence. This is increasingly being seen in common foodborne bacteria such as *Salmonella, E. coli* and *Campylobacter*. In 2016 the USA saw its first identified death caused by a bacterial strain resistant to all available antibiotics.

AMR also compromises the success of surgery, organ transplantation, childbirth and chemotherapy, where antimicrobials are used to prevent infection. This makes common treatments for many kinds of conditions more risky.

There is a serious shortage of new antimicrobials in development, largely because development costs are high and returns for pharmaceutical companies are low. New antimicrobials take many years to come into use due to stringent safety testing and clinical trials.

Increasing resistance to antiretroviral drugs to treat HIV is a concern, particularly for low-income countries with limited access to alternative treatments. The World Health Organization (WHO) is developing a Global Action Plan for HIV Drug Resistance.

A GLOBAL ONE HEALTH CHALLENGE

Governments, the United Nations, the WHO and other international bodies recognise AMR as a major global 'One Health' challenge – one that operates at the interface between people, animals and the environment. It threatens public health, food security and socio-economic development.

Tackling this complex challenge requires international, multisector collaboration to reduce the inappropriate usage of antimicrobials and spread of AMR in humans, animals and the environment, and to promote the discovery and development of new antimicrobials.

While sustained action remains needed to tackle AMR, existing national and international initiatives include the UN Inter-Agency Coordination Group on AMR, the WHO Global Action Plan on AMR, and European Antibiotic Awareness Day. The UK has a 5 year AMR Strategy and leads on activities including a Global AMR Innovation Fund.

Resistance to antifungal drugs is a particular threat for people with compromised immune systems, such as chemotherapy patients. Infections caused by multidrug-resistant strains of *Candida* and *Aspergillus* fungi have mortality rates as high as 40%.

The European Centre for Disease Prevention and Control estimates that just a selection of multidrug-resistant bacterial infections, including methicillin-resistant *Staphylococcus aureus* (MRSA), cause around 25,000 deaths annually in the EU and €1.5 billion in healthcare costs and lost productivity.

There is a need for much greater surveillance and data collection to prevent the spread of resistance. Without action, the human and economic costs of AMR will increase substantially. In a worst-case scenario based on widespread AMR, the UK Review on AMR estimated that global annual deaths from antimicrobial-resistant infections could rise from around 700,000 to 10 million by 2050, with cumulative economic losses of around $100 trillion.

WHAT CAUSES AMR?

AMR is a naturally occurring process, as microbes develop and exchange resistance genes, and supplant non-resistant strains. However, widespread use of antimicrobials coupled with the globalisation of travel and trade has accelerated the selection and spread of AMR, causing a global problem.

Between 2000 and 2010, human consumption of antibiotics grew by around 30%. There is considerable inappropriate medical use of antimicrobials, perhaps a result of doctors responding to patient pressure, or unavailability of rapid diagnostics that would allow more targeted prescribing. Antibiotics are often still prescribed for viral infections, against which they are completely ineffective. In some countries antimicrobials are available over-the-counter or online without prescription. Patients often fail to complete treatment courses, enabling resistant microbes to proliferate. There is also heavy use of antimicrobials in hospitals and care homes, prime locations for microbes to develop resistance.

Another key issue is the use of antimicrobials in intensive livestock and crop production, often preventative or to promote growth rather than to treat existing infections. This use of antimicrobials in sub-therapeutic doses encourages the development of AMR. In the US, over 70% of clinically important antibiotics usage is in animals. Antimicrobial use in livestock is likely to grow as demand for animal protein in developing countries increases. Environmental contamination with antimicrobials and drug-resistant microbes from human, animal and pharmaceutical manufacturing waste is an additional cause of increased AMR, as the genes for resistance are transmitted through the food chain.

Further research and surveillance is needed to increase our understanding of the emergence of AMR.

TACKLING AMR

Tackling AMR requires better stewardship of existing antimicrobials to prolong their effectiveness, and development of new antimicrobials. Key actions include:

- Improving global awareness of AMR among the public and across health, agriculture and other sectors to reduce inappropriate use of antimicrobials.
- Improving hygiene, sanitation and infection control to reduce the need for antimicrobials.
- Strengthening global surveillance of AMR and antimicrobial usage in humans, animals and the environment to better understand the problem and inform actions.
- Reducing non-essential usage of antimicrobials in agriculture through better monitoring, and research and development of alternatives to antimicrobials.
- Reducing dissemination of antimicrobials and resistant microbes into the environment from animal, human and pharmaceutical manufacturing waste.
- Providing investment and market incentives to promote research and development, to deliver new antimicrobials, vaccines, rapid diagnostics and alternative antimicrobial therapies.

These steps require strengthening the infectious disease workforce, with interdisciplinary approaches across microbiology, public health, science and industry, and need the support of policymakers and the public.

FURTHER READING

- **Microbiology Society (2015).** *Antibiotic Resistance: A Challenge for the 21st Century.* microbiologyonline.org/file/f15f639c304a25d9128d4742022f480f.pdf
- **Parliamentary Office of Science and Technology (2013).** *POSTNote 446: Antibiotic Resistance in the Environment.* researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-446#fullreport
- **Review on Antimicrobial Resistance (2016).** *Tackling Drug-Resistant Infections Globally: Final Report and Recommendations.* www.amr-review.org
- **World Health Organization (2015).** *Antimicrobial Resistance.* http://www.who.int/antimicrobial-resistance/en/
- **Nesta (2016).** *Bacteria vs. Antibiotics: The fight against antibiotic resistance across Europe.* www.nesta.org.uk/blog/bacteria-vs-antibiotics-fight-against-antibiotic-resistance-across-europe

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