

ANTIMICROBIAL RESISTANCE

- Antimicrobial resistance is threatening to make many diseases, including tuberculosis, HIV, malaria and gonorrhoea, untreatable.
- Antimicrobial resistance is a particular problem in hospitals and other healthcare settings but is now also found in the community.
- We can reduce the spread of antimicrobial resistance through careful use of antimicrobials and by practising good hand hygiene.

WHAT ARE ANTIMICROBIALS?

Antimicrobials are chemicals that kill or inhibit the growth of micro-organisms and are used to treat microbial infections. Some are produced naturally by microbes but many are synthetic. Antimicrobials include antibiotics, antivirals, antifungals and other drugs such as antimalarials.

WHAT IS ANTIMICROBIAL RESISTANCE?

Micro-organisms are termed 'antimicrobial-resistant' or 'drug-resistant' when they are no longer inhibited by an antimicrobial to which they were previously sensitive. Such resistance is called 'acquired resistance' and is encoded by resistance genes in the DNA of the microbe.

Resistance genes can arise through spontaneous mutations in the microbial DNA, but some have evolved over many years due to natural selection by natural antimicrobials in the environment. These genes can

also transfer from drug-resistant microbes to drug-sensitive ones.

THE RISE OF ANTIMICROBIAL RESISTANCE

The first drug-resistant bacterium in a clinical setting was identified in the late 1940s; only 4 years after mass treatment with penicillin had been introduced. Since then the emergence and spread of drug-resistant microbes has continued to grow. Highly resistant bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci, account for a high percentage of hospital-acquired infections, which cost the NHS an estimated £1 billion per year.

WHY IS ANTIMICROBIAL RESISTANCE INCREASING SO RAPIDLY?

Treating a patient with antimicrobials causes micro-organisms to adapt or die: this is known as 'selective pressure'. Incorrect use of antimicrobials increases the likelihood that bacteria and other microbes will adapt and replicate. Many factors have contributed to the rise in antimicrobial resistance, including:

- pressure on GPs to prescribe antimicrobials (even when they are not needed)
- patient failure to complete their full course of treatment
- heavy use of antimicrobials in hospitals
- over-the-counter access to antimicrobials in many countries



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CONSEQUENCES OF ANTIMICROBIAL RESISTANCE

Infections caused by antimicrobial-resistant microbes often fail to respond to standard drug therapy. This leads to prolonged illness and longer periods of infectivity. When infections are resistant to 'front-line' antimicrobials, second- or third-line drugs are administered, which are usually more expensive and sometimes more toxic. For example, the combination of drugs needed to treat multidrug-resistant forms of tuberculosis (MDR-TB) are more than 100 times more expensive than the combination of front-line drugs used to treat non-resistant forms of TB. Longer hospitalization periods for patients also increase the financial burden to healthcare authorities. Drug-resistant infections also compromise the success of treatments such as organ transplantation, cancer chemotherapy and major surgery.

MONITORING ANTIMICROBIAL RESISTANCE IN THE UK

The Health Protection Agency (HPA) has a resistance alert system to inform microbiologists in the NHS about new and emerging antimicrobial resistance issues. The recent emergence of Gram-negative bacteria that are resistant to cephalosporin and carbapenem antibiotics is a particular concern.

Cephalosporins are the most common group of antibiotics prescribed in hospitals. Bacteria that produce extended-spectrum beta-lactamases (ESBLs) are resistant to cephalosporins. Multidrug-resistant infections such as hospital pneumonias and urinary infections, caused by *Escherichia coli* and *Klebsiella* that produce ESBLs, have become more frequent in the last decade.

Carbapenems are powerful broad-spectrum antibiotics that are often the last line of effective treatment for patients with multidrug-resistant infections, including those caused by ESBL-producing bacteria. In recent years bacteria have been isolated that produce carbapenemase enzymes. These bacteria are resistant to carbapenems and also many

other drugs, which creates significant treatment problems. Carbapenemase-producing bacteria are already circulating widely in some countries such as Greece and Israel. Cases of carbapenem resistance in *E. coli* and *Klebsiella* in the UK started to increase during 2008 and 2009. The most common carbapenemase enzyme identified in the UK in 2009 was NDM (New Delhi Metallo-1), which is widespread in India and Pakistan. More than half of the UK patients carrying NDM had travelled to these countries and a third had been hospitalized there. In January 2011, advice on the recognition, control and treatment of carbapenemase-producers was issued by the HPA and sent to all UK consultant medical microbiologists and infection control specialists.

ANTIVIRAL AND ANTIFUNGAL RESISTANCE

Antiviral resistance is less common than antibiotic resistance but does occur, especially in viruses such as HIV or influenza that can mutate very easily. Resistance to antiretroviral drugs used to treat HIV is a growing concern.

Resistance to antifungals is a problem particularly for immunocompromised people who are more susceptible to fungal infections. Infections caused by species of *Candida* that are resistant to treatment by azole compounds have already been isolated.

A GLOBAL STRATEGY TO REDUCE ANTIMICROBIAL RESISTANCE

Antimicrobial resistance is a global problem that must be addressed in all countries, due to the importation of drug-resistant micro-organisms through international travel and trade. The World Health Organization (WHO) has chosen combating antimicrobial resistance as the theme for World Health Day 2011, which takes place on 7 April. On this day WHO issues an international call for concerted action to halt the spread of antimicrobial resistance and recommends a six-point policy package for governments. For further information, see www.who.int/world-health-day/2011

SGM BRIEFINGS

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