RESISTANCE FIGHTERS

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In the natural struggle to survive, species evolve alongside each other and their environment as part of an evolutionary arms race. Predators evolve ways to catch their prey, and prey species evolve ways to escape capture. Hosts evolve ways to detect and destroy parasites, and parasites evolve ways to evade them. An inevitable consequence of this natural process of competition is antibiotic resistance, and an arms race between organisms and the scientific community.

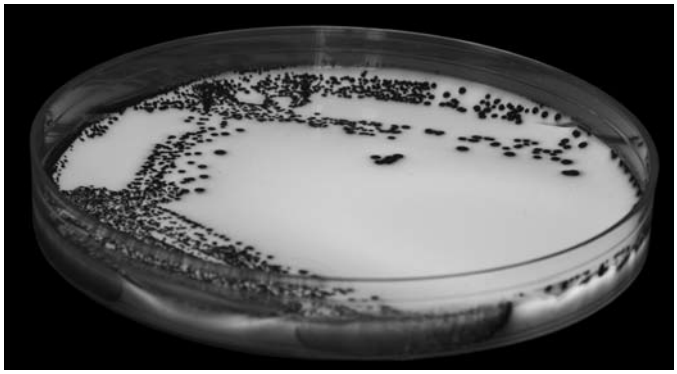
The appearance of new 'super bugs' resistant to much of the available armoury of antibiotics, such as MRSA, is a major threat to human health, and prescribing practices past and present have played a part in causing them to emerge. Resistance, however, is a much wider problem than this and the exact mechanisms often remain unclear.

ANTIBIOTICS IN THE ENVIRONMENT

In the 1950s farmers began to add low levels of antibiotics to animal feed as growth promoters. Antibiotics given to pigs were estimated to save as much as 20% of feed per pound of weight gain. However, there have been reports of antibiotic resistance emerging in animals as a result of antibiotics in feeds, although the story is extremely complex and not fully understood. In 2006 the EU banned antibiotic use at sub-therapeutic levels in animal feed to reduce the non-essential use of antibiotics.

The mechanisms of antibiotic resistance are likewise complex, and research is needed to understand them better. One cause is the transfer of the genes across bacterial groups, with non-pathogenic bacteria acting as reservoirs of antibiotic resistance. Even if very low doses of antibiotic do not kill susceptible bacteria but reduce their growth rates, resistant bacteria can outgrow them.

Bacteria move between animals and humans through air, water, physical contact and via the food chain. Although the use of antibiotics as growth promoters in livestock has been banned, therapeutic doses of antibiotics can still be prescribed by the vet. Antibiotic residues are not always fully metabolised by the animal so there is concern that they can end up in the food chain. Increasing human exposure to these antibiotics might contribute to an increase in antibiotic-resistance.



As well as solutions to antibiotic resistance in human pathogens, we need alternatives to the current battery of antibiotics for use in livestock. There is no single solution, but alternatives could include vaccines and bacteriophages (viruses which infect bacteria).

RESISTANCE IN OTHER SPECIES

Antibiotic resistance is by no means the only type of resistance affecting healthcare and agriculture.

Fungi, like bacteria, are intrinsically capable of developing resistance to antifungal agents, and this may be an under-recognised problem. Fungal infections are especially common in immunosuppressed patients, such as those suffering from AIDS, cancer or cystic fibrosis, and organ transplant patients. Fungi also cause extensive losses to agriculture and forestry; the most recent fungal concern is ash dieback.

. . . Bacteria move between animals and humans . . .

In principle, antibiotic resistance is a subset of a wider problem of drug resistance such as the evolving drug resistance of parasites such as malaria. Likewise, insect vectors of disease are evolving resistance to insecticides, and certain plants are developing herbicide resistance to become so-called 'super weeds.' Short of making a species effectively extinct, as has happened with smallpox, we will only ever have temporary victories in combatting diseases and pests.

CONCLUSION

For all antibiotics, the question of resistance is 'when' rather than 'if' we will ever need new ones. To minimise the impact on human health and our food supply, research is urgently needed to determine the mechanisms of resistance and to create new antibiotics and alternatives. The development of new patient-ready treatments is a long process, beginning with understanding of fundamental biology and progressing to the search for potential treatments. Drug Discovery skills are in danger of being lost in the UK as the pharmaceutical industry restructures at a time when they are most needed. Many of the learned societies are working together to help identify mechanisms to address this.