Addressing Antimicrobial Resistance Requires One Health Approach – Mind the Gap

With several recent disease outbreaks potentially having implications of multi-species involvement, and the recent growth in antimicrobial resistance making bacterial diseases more difficult to treat, it is becoming increasingly urgent that governments, inter-governmental agencies and global health organisations redouble efforts aligned to a 'One Health' approach.

One Health is the principle which recognises that greater cooperation is needed between human medicine, veterinary medicine and environmental and social sciences in the fight against today's major diseases, allied with a commitment to addressing technical, social and institution-level interventions. Many of the research programmes at the Royal Veterinary College (RVC) are aimed at improving health outcomes for both humans and animals and are conducted in partnership with fellow researchers and academics in leading institutions around the world, including the London School of Hygiene & Tropical Medicine (LSHTM), with whom the RVC runs its One Health MSc course.

So how does the One Health approach work in practice? When one considers the impact of zoonotic infectious diseases from a One Health perspective, one must include multiple and wide-ranging driving forces ranging from international travel and trade, and agricultural practices, to pressing issues such as climate changes, demographic pressure and environmental pollution. It is vital that policy-makers understand the interplay of the numerous factors involved in disease outbreaks in order to best understand and manage how to control them.

As well as understanding the science behind public and animal health problems, it is imperative for researchers to understand the social and policy context if measures are to be implemented effectively and on a global scale. This is where we need doctors working with vets, working with economists, politicians, social scientists and environmental scientists to bring about this collaborative approach. Without the synergy that such teams bring, solutions are unlikely to emerge and none of this will have any significant impact unless there is meaningful engagement, buy-in and investment at an institutional level.

Scientists have long been concerned about the threat of antimicrobial resistance and the impact it could have on the world's population. It is estimated that 700,000 people currently die as a result of antimicrobial resistance each year. A study by Harvard University concluded that if the rising trend of antimicrobial resistance continues, then up to 10 million people will die each year as a direct result by 2050 – that's in just 33 years. Couple this with the prediction that the cost of tackling antimicrobial resistance could be up to £80 trillion worldwide, and one can see that we are facing a threat of catastrophic proportions.

Antimicrobial resistance is firmly on the agenda of the World Health Organisation (WHO), the UN, and, closer to home, the UK government, and now it is time for action. The WHO states that "AMR is an increasingly serious threat to global public health that requires action across all government sectors and society."

To this end, colleagues from the Royal Veterinary College have taken part in a review of antimicrobial resistance to address these questions, which include:

- How does resistance emerge in animals?
- Does antimicrobial resistance spread through the food chain from animals to humans?
- If so, how important is this pathway compared with human sources of antimicrobial resistance?
- How important is the spread of antimicrobial resistance from livestock into the environment for spread to other animals and humans?

Some of these questions are being answered by the RVC's research, but the review, led by the Food and Agriculture Organisation of the United Nations (FAO) identifies substantial research gaps in the field of antimicrobial resistance which need to be addressed in order for us to be able to effectively tackle the threat.

The findings were published at the end of 2016 by the FAO as a technical paper entitled *Drivers, Dynamics and Epidemiology of Antimicrobial Resistance in Animal Production*, and it is intended to inform vets, farmers and other stakeholders worldwide. Some examples of the gaps identified and the respective recommendations include:

Gap	Recommendation
Better understanding of the dynamics and interactions of genes and microbes within microbiota, microbiomes and different scales of microbial ecosystems, and the transfer of resistance within those.	Use data generated by molecular techniques such as metagenomics together with epidemiological data in an integrated analysis.
Limited ability to predict the emergence and spread of resistant bacterial clones in the environment and human-agriculture interfaces will help to inform risk-assessment and management strategies.	Use molecular sequencing and epidemiological studies of resistant bacteria and resistance determinants to support risk assessment and simulation studies.
Improve the efficacy of therapy and treatment and minimise the risk of antimicrobial emergence.	Use pharmacodynamic and pharmacokinetics studies to assess how antimicrobials interact with microbial populations, particularly in the context of treatment of infection.
Quantify the association between antimicrobial usage on farms and antimicrobial resistance among food-borne bacteria, as well as the relationship between antimicrobial resistance in livestock and the incidence of resistant infections in humans.	Improve data collection through robust infrastructure and capacity.
Improve intensive livestock production methods.	Identify the most efficient systems with regard to minimising environmental contamination with antimicrobial residues and resistant pathogens, taking into account local conditions and needs, and ensuring sustainability.
Better understanding of antimicrobial residues in the environment.	These should be monitored regularly in the same way as other hazardous substances.
Reduce the pressure of environmental contamination with antimicrobial residues.	Development of highly biodegradable anti-microbials should be prioritised.

Professor Pfeiffer, Professor of Veterinary Epidemiology at the RVC and Professor of One Health at Hong Kong's City University, said:

"It has been a major success that political leaders from around the world have now recognised the enormous threat for the global community associated with AMR and the challenge that it represents for all stakeholders. We are only just beginning to recognise the immense complexity of the eco-social system within which antimicrobial resistance emerges, and rather than one sector blaming the other, a truly integrated perspective based on a One Health approach is required to have a chance to deal effectively with this threat. The findings from our review very much confirm that antimicrobial usage in food production undoubtedly needs to be reduced, while acknowledging that current knowledge suggests that the vast majority of AMR affecting humans is associated with antimicrobial usage in humans."

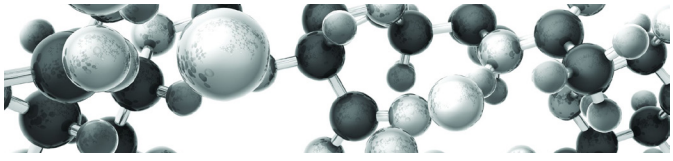
Ben Wall, the paper's first author and a researcher in the Veterinary Epidemiology, Economics and Public Health (VEEPH) Group, said: "It was really exciting to have the opportunity to work on this review paper as antimicrobial resistance is such a dynamic area of research at the moment, as well as it being a huge issue for all of us working with production animals.

"We discovered that there are still a lot of unknowns regarding the spread of antimicrobial resistance between animals and humans. Antimicrobial usage in livestock has been associated with antimicrobial resistance in food-producing animals. However, there is limited evidence at present concerning the number of infections in humans caused by resistant bacteria of food animal origin, or indirectly through the environment.

"Nevertheless, the prudent use of antimicrobials is still of utmost importance in mitigating the emergence of antimicrobial resistance in the first place, and this is true in human health, companion animal health and food production systems.

"Due to the complexity of antimicrobial resistance epidemiology, filling the knowledge gaps will require a collaborative, multidisciplinary approach."

Armed with this research and knowledge of what we need to do to get closer to tackling antimicrobial resistance, researchers at the RVC will continue to work with colleagues in academic and governmental institutions across the world to advance our collective knowledge and understanding of this global health threat and help to save lives around the world.



The RVC is the UK's largest and longest established independent veterinary school, offering programmes in veterinary medicine, veterinary nursing and biosciences. RVC produces world-class research and supports the veterinary profession through its referral hospitals, including the Queen Mother Hospital for Animals, Europe's largest small animal hospital.

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