One Health: a multifaceted concept combining diverse approaches to prevent and control antimicrobial resistance

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Editorial

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The term 'One Health' refers to a collaborative, multisectoral and transdisciplinary approach—working at the local, regional, national and global levels—with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants and their shared environment. Such a holistic approach is required for effective control and prevention of many infectious diseases, including emerging infections and antimicrobial resistance (AMR) [1]. In the case of AMR, this approach is needed because many of the antimicrobial drugs used in human medicine are also used in veterinary medicine, and livestock production and their use leads to selection of AMR, regardless of the specific context in which they are used. Moreover, there is increasing evidence that at least some clinically relevant resistant bacteria and/or their resistance genes are able to transfer between animals and humans by overcoming ecological and geographical barriers [2]. In line with this concept, the World Health Organization (WHO), the Food and Agriculture Organization (FAO) and the World Organization for Animal Health (OIE) have joined forces to promote cross-sectoral collaboration to assess, control and prevent the spread of AMR in human and animal populations and in the environment. In 2019, the three organizations established a joint monitoring and evaluation framework for implementation of the Global Action Plan (GAP) on AMR that was launched by the World Health Assembly in May 2015 [3]. This framework generates data to assess the delivery of GAP objectives, and will inform operational and strategic decision making relating to AMR in the years ahead.

The European Society for Clinical Microbiology and Infectious Diseases (ESCMID) and the ESCMID Study Group for Veterinary Microbiology (ESGVM) have been key stakeholders in promoting the importance of One Health in the fight against AMR. They have provided a forum to bring together multidisciplinary scientists in the 2nd International Conference on One Health Antimicrobial Resistance (ICOHAR), held 16–18 April 2019 in Utrecht, the Netherlands (http://www.icohar2019.org). The conference highlighted key themes in One Health and AMR where multidisciplinary research is addressing key concerns, like zoonotic transmission of AMR, surveillance and transfer of AMR, precision antimicrobial therapy, antimicrobial susceptibility testing, animal models for studying the effects of antimicrobial therapy on dysbiosis and AMR development, the quality of university education on AMR and antimicrobial therapy, the impact of vaccination on antimicrobial use and management of critically ill patients.

This special issue contains three reviews selected by the Scientific Committee of the 2nd ICOHAR to best represent the scientific perspective of the meeting. Each paper focuses on a specific feature of AMR prevention and control: surveillance [4], risk assessment [5] and alternative anti-infective strategies [6]. Nielsen et al. [4] reviewed the strengths and weaknesses of three diverse tools for evaluating integrated AMR surveillance systems, providing guidance on how to choose a fit-for-purpose tool. Wee et al. [5] highlighted the function of well-designed, high-resolution genome sequencing approaches to quantify transmission of AMR at the human–animal interface. Finally, Pollock et al. [6] outlined the value of microbial and host genomics for developing alternative strategies for prevention and control of infectious diseases in livestock, namely microbiota modulation via faecal transplantation and probiotics, genetic manipulation of the host via selective breeding and gene editing, vaccines, antivirulence strategies and phage therapy. Broadly speaking, the three reviews provide a timely perspective on some of the challenges posed by the occurrence of AMR at the human–animal interface: evaluation of the efficiency of integrated surveillance systems, quantification of the risk of AMR transmission between reservoirs and development of alternatives ensuring production of healthy animals with reduced antimicrobial use. Addressing any of these challenges requires an interdisciplinary and multisectoral approach involving key stakeholders. In other words, it requires implementation of the One Health concept.

The benefits of the One Health are relevant to a large variety of professionals, including researchers, diagnostic microbiologists, pharmacologists and clinicians. In addition to the areas highlighted in the reviews of this special issue, several other important areas require multisectoral and transdisciplinary collaboration in the fight against AMR. Pharmacokinetics/pharmacodynamics-driven therapy has been shown to be a promising approach with which to optimize antimicrobial therapy on the basis of the characteristics of the individual patient or herd under treatment. It has become apparent that revision of dosage regimens and development of drugs with improved pharmacokinetic/pharmacodynamic properties are research goals shared by human and veterinary pharmacologists in order to maximize clinical efficacy, improve patient care and minimize the negative effects of antimicrobial therapy on the commensal microbiota.

The use of dogs as animal models to study the effects of antimicrobial therapy on the commensal microbiota has been presented and discussed in light of the anatomical and physiologic similarities to the human body. Research has highlighted that the challenges faced by clinical microbiologists working in human and veterinary diagnostic laboratories are fundamentally the same, including optimization of identical technologies for rapid microbial identification (e.g. MALDI-TOF MS and point-of-care tests) and the interpretation

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of antimicrobial susceptibility testing (e.g. lack of disease-specific breakpoints). Clinicians working in human and veterinary companion animal hospitals also face similar problems, including outbreaks caused by the same multidrug-resistant bacteria (e.g. methicillin-resistant *Staphylococcus aureus* and extended-spectrum β-lactamase (ESBL), or carbapenemase-producing *Escherichia coli*) and implementation of the same key measures (i.e. hospital infection control and antimicrobial stewardship) for preventing and controlling their spread within the clinic. Epidemiologic studies emphasize the important role of companion animals as reservoirs in transmission of AMR. Importantly, similar challenges are also faced in education as indicated by two large independent surveys of final-year students at medicine and veterinary medicine universities in Europe, which unequivocally indicated a strong need for a greater focus in the curriculum on One Health and AMR.

Strikingly, recent articles have not indicated a major contribution of the veterinary sector to the occurrence of AMR in humans, even for AMR determinants that are usually located on mobile genetic elements and are relatively common in food products of animal origin. For example, an unprecedented large-scale, population-based modeling study in the Netherlands revealed that human-to-human transmission (mean, 67%) is by far the main source of ESBL-producing *E. coli* carriage in the open community, with relatively low contributions by food consumption and preparation (18.9%), contact with companion animals (7.9%), nonoccupational contact with farm animals (3.6%) and environmental sources (2.6%) [7]. Other studies have shown that the animal-to-human movement of plasmid-mediated colistin resistance in *E. coli* [8,9] and vancomycin resistance in *Enterococcus faecium* [10] is less frequent than previously hypothesized, suggesting that resistance to these high-priority, critically important antimicrobials is largely driven by hospital use and human-to-human transmission.

It has been argued that these data should be interpreted as a failure of the One Health approach to tackle AMR, meaning that AMR should be handled separately in human and animal populations because of the weak epidemiologic linkage between human and nonhuman sources. Although we tend to agree that the contribution by veterinary use of antimicrobials to AMR problems in human medicine might have been overestimated in the past, at least for developed countries in the western hemisphere, we utterly reject the conclusion that control of AMR does not require a One Health approach. The value of One Health is independent of the risk of zoonotic transmission of AMR. It is intrinsically linked to the need for shared information and joint training amongst the professionals that are at the forefront of the fight against AMR in human and veterinary settings, namely general practitioners, infectious disease specialists and clinical microbiologists.

Transparency declaration

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