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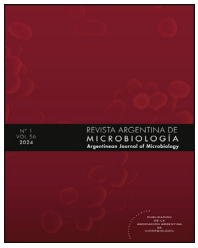

EDITORIAL

Beyond human-centered surveillance: rethinking antimicrobial resistance monitoring in a One Health framework

Más allá de la vigilancia centrada en el ser humano: repensando el monitoreo de la resistencia a los antimicrobianos en el marco de Una Salud

Antimicrobial resistance (AMR) challenges our collective capacity to respond effectively against bacterial pathogens. Regardless of the projections made for the coming years, trends consistently point upward in AMR levels worldwide and the loss of effective therapeutic options has shifted from a hypothetical threat to a tangible reality. In the context of human health, hospitals increasingly face pan-drug-resistant (PDR) microorganisms, while in the community, urinary tract infections (UTIs) are gradually more difficult to treat due to a rapid rise in antibiotic resistance. These findings raise serious concerns, as resistance to novel antibiotics that are not yet available in many countries is now being detected.

In veterinary medicine, where therapeutic options are limited to preserve the availability of critical antimicrobials for human use, AMR poses both a clinical challenge (often limiting adequate treatment options) and an epidemiological one, as animals act as reservoirs of resistant bacteria and resistance genes transmissible to humans.

Between these two domains, the environment (including water and soil) and wildlife complete and interconnect transmission cycles, reinforcing the systemic nature of AMR. It is therefore unsurprising that AMR constitutes a central pillar of the One Health paradigm and is globally addressed through the Quadripartite Alliance involving The World Health Organization (WHO), The World Organisation for Animal Health (WOAH), The Food and Agriculture Organization of the United Nations (FAO), and The United Nations Environment Programme (UNEP).

From a human health perspective, the WHO promotes AMR surveillance through the Global Antimicrobial Resistance and Use Surveillance System (GLASS), which links resistance data from selected pathogens to specific clinical syndromes and diseases reported annually (https://www.who.int/initiatives/glass/resource-centre).

In parallel, in 2024, the WHO updated the bacterial priority pathogens list (https://www.who.int/publications/i/item/9789240093461), and the list of medically important antimicrobials (https://www.who.int/news/item/08-02-2024-who-medically-important-antimicrobial-list-2024), redefining global priorities. These updates confirm Gram-negative bacilli as the main drivers of critical AMR, with carbapenem-resistant *Acinetobacter baumannii* and carbapenem- or third-generation cephalosporin-resistant Enterobacterales maintained in the highest priority, and carbapenem-resistant *Pseudomonas aeruginosa* classified within the high-priority category. Regarding the list of medically important antimicrobials, three major changes were introduced: a) the definition of non-human use antibiotics was expanded from use in food-producing animals to include all animals, including companion and laboratory animals; b) the incorporation of the WHO AWaRe (Access, Watch and Reserve) classification of antibiotics as a prioritization criterion; and c) the division of antimicrobials into three groups: those not to be used in animals, those permitted in both human and veterinary medicine, and those intended exclusively for animal use.

Under this revised classification, antimicrobials such as glycopeptides (e.g., vancomycin), carbapenems (e.g., imipenem, meropenem, ertapenem), and last-generation aminoglycosides (e.g., plazomicin) are restricted to human use. In contrast, third- and fourth-generation cephalosporins, fluoroquinolones, polymyxins, and phosphonic acid derivatives such as fosfomycin remain classified as critically important, high-priority antimicrobials, given that they continue to be used in both human and veterinary medicine.

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Focusing on Gram-negative bacilli and from a human health perspective, as outlined above, priorities for surveillance programs monitoring the emergence of AMR in animals, food and produce, and various aquatic ecosystems could focus on:

a) carbapenem resistance mediated by carbapenemases (mainly in *Klebsiella pneumoniae*, *Escherichia coli* and *Pseudomonas aeruginosa*);
b) resistance to third- and fourth-generation cephalosporins mediated by extended-spectrum β-lactamases (ESBLs), and—when *Escherichia coli* or other non−chromosomal AmpC-producing organisms are used as indicators—third-generation cephalosporin resistance produced by plasmid-mediated AmpC-type (pAmpC) enzymes;
c) aminoglycoside resistance mediated by 16S rRNA methyltransferases, reflected as high-level resistance to both gentamicin and amikacin or resistance to plazomicin (mainly in *K. pneumoniae*);
d) fluoroquinolone resistance, particularly that mediated by transferable mechanisms such as *qnr* genes (*qnrA, qnrB, qnrE, qnrS*);
e) transferable colistin resistance mediated by *mcr* gene families;
f) transferable fosfomycin resistance mediated by *fos* genes, particularly *fosA3*, given its frequency.

Although these antimicrobials are considered high priority for human use, all of these resistance mechanisms have been detected in food-producing animals or derived products[1–3].

While prioritization is essential to stay alert to the emergence of AMR, it also highlights a key limitation: surveillance priorities in human medicine do not necessarily reflect antimicrobial use patterns in veterinary medicine, according to the ninth WOAH report on antimicrobial use in animals[4]. Overall, 71% of veterinary antimicrobial use corresponds to six families: tetracyclines (28.3%), penicillins (17.8%), macrolides (10.6%), amphenicols (7.9%), aminoglycosides (6.5%), and sulfonamides, including trimethoprim−sulfamethoxazole (6.1%) [4].

In animals not intended for food production, the six most frequently used antimicrobial families are penicillins (34.8%), sulfonamides (including trimethoprim combinations) (18.8%), cephalosporins of all generations (12.19%), fluoroquinolones (11.1%), aminoglycosides (7.32%), and tetracyclines (5.1%), accounting for 89% of total use[4].

The issue becomes even more complex in companion animals, where close and continuous contact with humans facilitates the bidirectional transfer of resistant bacteria and resistance genes. Under these circumstances, resistance determinants detected in pets may originate from human sources via zooanthroponotic transmission, particularly in households with recent antimicrobial exposure or human hospitalization[5]. Importantly, microorganisms transmitted from humans to animals are often investigated in the context of human infection and accompanied by antimicrobial susceptibility reports; however, these reports typically exclude antimicrobials widely used in veterinary practice, such as tetracyclines or streptomycin. This structural disconnect between human and veterinary diagnostic frameworks is further compounded by the absence of harmonized clinical breakpoints between human and animal health laboratories and by limitations in veterinary laboratory capacity to accurately identify clinically relevant resistance mechanisms, such as ESBLs or carbapenemases, increasing the risk of inappropriate antimicrobial treatment and adverse outcomes for animal health[6]. Together, these mismatches raise a critical question: are current antimicrobial resistance surveillance systems truly aligned with the principles of One Health?

AMR surveillance is frequently framed as a need to monitor resistant microorganisms of animal origin. Yet a One Health approach requires reciprocal adaptation: not only expanding surveillance in animals but also rethinking human surveillance systems to capture resistance mechanisms relevant across sectors. Without such integration, One Health risks remain a conceptual framework rather than an operational strategy for addressing antimicrobial resistance. Finally, collaborative efforts between human and veterinary medicine could contribute to greater standardization and more effective AMR surveillance.

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