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Letters to the Editor

Antimicrobial Stewardship in a World Racked by Conflict and Uncertainty: A Call for Global Resilience

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To the editor.

In the 21st century, the world faces an unprecedented convergence of crises, including geopolitical instability, armed conflicts, mass displacement, climate emergencies, and recurring global pandemics. These destabilizing forces have fragmented nations, strained health systems, and exposed vulnerable communities. Amid these overlapping emergencies, another silent but equally dangerous threat continues to accelerate antimicrobial resistance (AMR). At its front line stands Antimicrobial Stewardship (AMS)—an essential yet increasingly compromised pillar of global health.

Antimicrobial Stewardship refers to coordinated interventions designed to improve and measure the appropriate use of antimicrobial agents. It aims to enhance patient outcomes, reduce microbial resistance, and decrease the spread of infections caused by multidrug-resistant organisms.[1,2] However, the implementation of stewardship programs depends on systemic stability, strong multidisciplinary collaboration, and access to diagnostics and data—conditions that are often absent in the world's most affected regions.[3]

In active conflict zones—including Ukraine, Sudan, Gaza, and parts of the Sahel—health infrastructure is frequently decimated. Hospitals are deliberately or incidentally targeted, supply chains are disrupted, and healthcare workers are displaced or placed at risk.[4] These systemic breakdowns severely limit access to laboratory diagnostics and standard treatment protocols, driving the unregulated and empirical use of antibiotics. In makeshift clinics or overcrowded emergency departments, clinicians are often compelled to prescribe antibiotics "just in case," without laboratory confirmation or microbiological guidance. Such circumstances provide an ideal environment for resistant strains to emerge and disseminate, ultimately eroding decades of progress in global AMR control.[5,6] In Ukraine, the destruction of health infrastructure, disrupted supply chains, and displacement of healthcare workers have severely limited AMS implementation—resource shortages in staffing, infrastructure, and laboratory equipment force clinicians to prescribe empirically. Even outside conflict zones, weak integration of lab and health systems, poor quality control, and a fragmented sector hinder effective surveillance and coordinated Stewardship, intensifying the AMR threat. In Gaza, prolonged blockades have disrupted medical supply chains, forcing reliance on broad-spectrum antibiotics when narrower agents were unavailable. In Sudan, ongoing conflict and attacks on health infrastructure have severely limited access to essential medicines, leading to widespread empirical prescribing in the absence of diagnostics. Similarly, in Syria, widespread and unregulated use of veterinary antibiotics during the conflict has highlighted the absence of stewardship mechanisms and the heightened risk of zoonotic resistance transmission.

Exacerbating this challenge is the unprecedented rise in forced migration and displacement. According to the UNHCR, more than 110 million people are currently displaced worldwide. Refugees and internally displaced persons (IDPs) often live in overcrowded settlements characterized by poor sanitation, limited access to healthcare, and irregular drug supplies. Within such fragile environments, recurrent infections, self-medication, and dependence on informal drug markets are commonplace, further accelerating antimicrobial resistance.[7] Stewardship programs—originally designed for structured and stable health systems—struggle to function in these chaotic, resource-limited, and transient settings. Surveys in refugee camps indicate that up to 70% of antibiotics are obtained through informal markets, reflecting dangerous gaps in stewardship implementation.[6]

Even outside conflict zones, political and economic instability undermine health governance and weaken the ability of AMS to function effectively. In many low- and middle-income countries (LMICs), underfunded public

health systems leave AMS initiatives sidelined. Chronic underinvestment in microbiology laboratories, surveillance systems, and trained personnel further limits capacity. Weak regulation and corruption enable the widespread over-the-counter sale of antibiotics, transforming access into misuse. At the same time, in high-income countries, inflationary pressures, workforce burnout, and political polarization erode long-term commitments to stewardship infrastructure.[6,8]

On the other side, the COVID-19 pandemic was a critical stress test for AMS. Globally, healthcare systems—regardless of income level—struggled to maintain stewardship priorities under the pressure of emergency-driven care. Empirical antibiotic use surged during the early stages of the pandemic, despite the disease's viral etiology. WHO estimates indicate that up to 75% of hospitalized COVID-19 patients received antibiotics, though only a small minority had confirmed bacterial co-infections. This pattern not only exposed persistent gaps in Stewardship but also demonstrated how quickly crisis conditions can reverse hard-won progress.[9]

Despite these setbacks, the present moment offers a critical opportunity. Crises, by exposing systemic vulnerabilities, also sharpen collective priorities. AMS must be reframed not as a peripheral concern, but as a core pillar of health security—equally vital as vaccination programs, safe water and sanitation, and emergency trauma care.[5]

Innovative, context-specific solutions are urgently needed. Mobile diagnostic laboratories, point-of-care rapid tests, and simplified treatment algorithms can strengthen stewardship efforts in low-resource settings. Telemedicine and e-learning platforms offer scalable opportunities to train frontline clinicians in stewardship principles, even in remote or insecure environments. Stewardship protocols must remain adaptable—not all regions can rely on hospital-based pharmacy teams or infectious disease specialists; however, every health system can benefit from education, surveillance, and rational prescribing frameworks.

Furthermore, AMS should be fully integrated into humanitarian response frameworks. Non-governmental organizations, United Nations (UN) agencies, and emergency medical teams must incorporate AMS principles into their protocols for conflict and disaster relief. This engagement encompasses not only antibiotic management but also data collection, community collaboration, and the strengthening of local healthcare capacity. Donor agencies and global funders should prioritize antimicrobial Stewardship in emergency health financing, rather than limiting support to post-conflict recovery efforts.[6,10]

Finally, AMS is inherently interdisciplinary and global, residing at the intersection of medicine, public health, veterinary science, agriculture, policy, and civil society. Without political commitment, international collaboration, and sustained investment, stewardship efforts will remain fragmented and reactive. As AMR knows no borders, Stewardship must transcend them as well. Equally important, within the broader One Health framework, AMS must extend to animal health systems. In conflict zones, livestock displacement, disrupted veterinary services, and breakdowns in disease surveillance often lead to indiscriminate antibiotic use for both therapeutic and prophylactic purposes. Such practices can amplify and spread AMR across human and animal populations, particularly given the zoonotic potential of many pathogens. Effective AMS strategies should include veterinary stewardship protocols, restrictions on non-therapeutic antibiotic use in livestock, and support for animal health infrastructure even in fragile settings. Where formal veterinary oversight is limited, community education, mobile veterinary units, and collaboration with humanitarian animal health agencies are crucial in mitigating resistance at the human-animal-environment interface.[11]

The One Health framework provides a critical conceptual and operational lens for addressing AMR in fragile and conflict-affected settings. AMR emerges and circulates through interconnected reservoirs—humans, animals, and the environment—making siloed interventions inherently insufficient. Armed conflicts exacerbate this interdependence by disrupting water, sanitation, and hygiene infrastructures, facilitating uncontrolled livestock movements, and degrading ecological barriers that normally limit the transmission of pathogens. Under such conditions, the selective pressure imposed by indiscriminate antibiotic use—both therapeutic and prophylactic—can accelerate the evolution of resistance and enable horizontal gene transfer across species and ecosystems. Incorporating One Health into AMS thus requires more than rhetorical commitment; it mandates integrated surveillance systems, joint data platforms, and cross-sectoral governance that can withstand political fragility and institutional collapse. Failure to embed AMS in a One Health architecture risks perpetuating blind spots where resistant pathogens can evolve unchecked and re-emerge with transboundary consequences.[12]

Veterinary AMS constitutes a cornerstone of any global AMR containment strategy, particularly in conflict zones where conventional regulatory frameworks are dismantled. In such contexts, antibiotics in animals are often used without diagnostic confirmation, not only for disease treatment but also for growth promotion and prophylaxis, intensifying the selection pressure for resistant organisms with zoonotic potential. Effective veterinary AMS requires implementation of evidence-based prescribing guidelines, restrictions on non-therapeutic use, and context-sensitive diagnostic support that can function even in low-resource or mobile settings. Moreover, Stewardship must extend beyond clinical veterinary

practice to encompass farmer education, para-veterinary training, and integration of veterinary AMS into humanitarian response mechanisms. Innovative models—such as mobile veterinary units, remote tele-veterinary consultation, and community-based stewardship programs—have been shown to mitigate misuse and foster resilience in fragile states. Without embedding veterinary Stewardship within broader One Health strategies, the animal sector will remain a neglected driver of resistance amplification and cross-species dissemination.[13] Unfortunately, but it is true, Rojas et al. describe AMR as 'the price of war,' documenting how conflict catalyzes the spread of resistance through disrupted infrastructure and uncontrolled antibiotic use.[14]

Conclusions. We stand at a critical turning point. Treating AMS as optional or deferrable during crises will leave us increasingly powerless against the next pandemic of resistant infections. In a world defined by uncertainty and conflict, protecting the efficacy of antimicrobials is not merely a technical challenge—it is a moral and strategic imperative. Crucially, Stewardship must be reframed through a One Health perspective, acknowledging the interconnectedness of human, animal, and environmental health. The veterinary sector plays a pivotal role in this effort, as the use of antimicrobials in food-producing and companion animals contributes substantially to the global resistance burden. Strengthening surveillance, fostering responsible prescribing in veterinary practice, and integrating cross-sectoral collaboration are essential to closing critical gaps. We must act with urgency, unity, and resilience to ensure that today's antibiotics remain effective for future generations. The time to embed Stewardship at every level of crisis response is now.

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