World Journal of Health Policy and Management
2026, Vol. 1, No. 1, pp. 8–12
https://doi.org/10.11648/j.wjhpm.20260101.12

Review Article

Integrating Clinical Stewardship and Institutional Management to Control Antimicrobial Resistance in Primary Care During Wartime in Ukraine

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Abstract

Background: Antimicrobial resistance (AMR) remains a growing global health threat, and in Ukraine the burden is compounded by unregulated over-the-counter access to antibiotics, disruption of routine immunization, and reduced microbiological diagnostic capacity across primary care facilities reorganized into Territorial Medical Associations (TMOs) since the 2018 healthcare reform, all occurring against the backdrop of full-scale war. AMR stewardship at the primary-care level continues to be framed almost exclusively as a clinical rather than a managerial task, which weakens the effectiveness of local antibiotic stewardship programs. Objective: To substantiate a practical framework that integrates evidence-based clinical principles of rational antibiotic therapy with institutional management mechanisms at the primary healthcare facility level, in order to strengthen AMR containment in primary care under conflict conditions. Methods: A narrative synthesis of international evidence on AMR control was conducted, covering the One Health concept, the "Start Smart – Then Focus" antibiotic stewardship principle, the WHO AWaRe antibiotic classification, point-of-care diagnostics, and immunization policy, integrated with the authors' own prior work on managerial dysfunction in Ukraine's polyclinic-outpatient network. Sources were retrieved from Cochrane Library, PubMed/MEDLINE and Journal Citation Reports-indexed journals, prioritizing systematic reviews, meta-analyses and multicentre validation studies published through 2026. Results: Five interdependent levers were identified as decisive for stewardship effectiveness at the facility level: a locally adapted first-line antibiotic formulary; routine antimicrobial consumption monitoring; prescribing audit and feedback; point-of-care C-reactive protein and rapid antimicrobial susceptibility testing; and vaccination policy as an upstream AMR-prevention tool. Conflict-related amplifiers — including extensively drug-resistant Gram-negative pathogens associated with war wounds and their documented spread into referral networks — further elevate the managerial stakes for primary care. Conclusion: Containing AMR in primary care is a joint clinical-managerial task. Evidence robustly supports each stewardship element individually, but institutional mechanisms determine whether these elements are reproduced systematically across a facility rather than remaining dependent on individual clinician initiative. Treating antibiotic stewardship as a management function of the TMO, not solely an individual physician's discipline, is a promising direction for strengthening national AMR control programs under wartime conditions.

Keywords

Antimicrobial Resistance, Antibiotic Stewardship, Primary Health Care, One Health, Healthcare Management, Point-of-Care Testing, Vaccination, Conflict-Affected Health Systems

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Received: 13 August 2026; **Accepted:** 22 August 2026; **Published:** 22 September 2026

1. Introduction

The global burden of antimicrobial resistance (AMR) continues to rise. A large-scale Global Burden of Disease analysis attributed approximately 1.27 million deaths worldwide directly to bacterial AMR in 2019, with a further 4.95 million deaths associated with resistant infections [1]. A forecasting model produced by the same research consortium in 2024 projects continued growth in AMR-attributable annual mortality through 2050 [2], and in September 2024 the United Nations General Assembly adopted a political declaration recognizing AMR as one of the most urgent global health threats and calling for accelerated national action [3].

In Ukraine, this global trajectory is compounded by country-specific pressures. Over-the-counter purchase of antibiotics remains widespread — pooled international data indicate that self-medication with antibiotics during respiratory episodes reaches 20–45% [11] — while full-scale war has increased the caseload on primary care, interrupted routine immunization schedules, and, in a number of Territorial Medical Associations (TMOs) formed after the 2018 primary-care reform, constrained access to microbiological diagnostics. Within this setting, AMR containment continues to be approached predominantly as a matter of individual clinical judgment rather than as a structured management responsibility of the primary-care facility, which limits the traction of antibiotic stewardship programs at the local level.

The objective of this article is to substantiate a practical algorithm that integrates the clinical principles of rational antibiotic therapy with institutional management mechanisms at the level of a primary healthcare facility, so as to improve the effectiveness of AMR containment in primary care.

2. Materials and Methods

This article is a narrative synthesis of contemporary international approaches to AMR control — the One Health concept, the "Start Smart – Then Focus" antibiotic stewardship principle, the WHO AWaRe (Access, Watch, Reserve) antibiotic classification, the evidence base on point-of-care diagnostics and immunization — integrated with the authors' own prior work on managerial dysfunction in the polyclinic-outpatient segment of Ukraine's TMO system. Literature was retrieved from the Cochrane Library, PubMed/MEDLINE, and Journal Citation Reports-indexed sources, with priority given to systematic reviews, meta-analyses, and multicentre validation studies; the search was updated through the first half of 2026 to incorporate recent conflict-specific AMR surveillance data. Methods of systematic analysis, generalization, and modeling were used to construct the practical algorithm proposed below. As this is a literature synthesis and expert-opinion perspective rather than a primary study involving human participants, no ethics committee approval was required.

3. Results

3.1. Managerial Preconditions for Clinical Stewardship

The effectiveness of clinical algorithms for rational antibiotic prescribing in primary care depends critically on managerial preconditions that are frequently absent in practice: a local formulary of first-line antibiotics aligned with the regional resistance pattern; routine monitoring of antimicrobial consumption (AMC) at the facility level; and systematic feedback on prescribing patterns. The large cluster-randomized REDUCE trial, conducted across 79 primary-care practices in the United Kingdom and covering more than 580,000 patient-years, demonstrated that electronically delivered prescribing feedback combined with decision-support tools produced a statistically significant reduction in antibiotic prescribing for respiratory infections without compromising patient safety [12]. This confirms that the managerial instrument — audit and feedback — is an independent, not merely auxiliary, driver of stewardship outcomes.

3.2. Clinical Stewardship: "Start Smart – Then Focus" and the WHO AWaRe Framework

At the point of initial prescribing, the clinician should objectify the indication (clinical criteria or point-of-care diagnostics), select the narrowest-spectrum agent consistent with the WHO AWaRe classification, and document the planned treatment duration. Analyses of prescribing structure by Access/Watch/Reserve category in both primary and secondary care consistently show a growing share of Watch-category antibiotics — broader-spectrum agents with higher resistance potential — relative to Access-category agents, an indicator of irrational prescribing that warrants facility-level monitoring [8]. A mandatory clinical review at 48–72 hours — discontinuation, de-escalation to a narrower-spectrum agent, or a justified continuation — completes the cycle.

3.3. Point-of-Care Diagnostics as an Objective Basis for Decision-Making

Rapid C-reactive protein (CRP) point-of-care testing allows clinicians to differentiate probable viral from bacterial etiology of respiratory infection at the point of consultation. A Cochrane systematic review of 12 randomized trials found that CRP point-of-care testing in primary care reduced antibiotic prescribing by approximately 22% without worsening clinical outcomes [4]; subsequent international clinical guidance details the integration of CRP testing with clinical assessment and communication strategies [5]. In the inpatient setting

and for infectious-disease consultations, an analogous objectifying role is played by rapid antimicrobial susceptibility testing (EUCAST RAST) performed directly on positive blood cultures: a multicentre European validation study across 55 laboratories in 11 countries confirmed acceptable categorical agreement between RAST and the reference method after only 4–6 hours of incubation, compared with the standard 16–20 hours [10], a difference that is decisive for early de-escalation of empirical therapy in bacteremia.

3.4. Delayed Prescribing as a Communication Strategy

An updated 2023 Cochrane review of 12 trials confirms that a delayed-prescribing strategy — issuing a prescription with instructions to use it only if symptoms fail to improve within a defined period — significantly reduces actual antibiotic consumption compared with immediate prescribing, while maintaining patient satisfaction comparable to immediate prescribing [6]. This gives the physician a tool for managing patient expectations without withholding care.

3.5. Vaccination as Prevention of the Need for Antibiotics

The World Health Organization has formalized the role of vaccination as an AMR-containment tool within a dedicated action framework, positioning immunization as a means of reducing both antibiotic consumption and the selective pressure driving resistance [7]. A systematic review of the impact of 10- and 13-valent pneumococcal conjugate vaccines on resistant pneumococcal disease and carriage confirms a decline in the share of penicillin- and other first-line-drug-resistant strains following the vaccines' introduction into national immunization schedules [9]. For the family physician, this means that a conversation about AMR prevention can logically begin with a review of the patient's vaccination status.

3.6. Conflict-Specific Amplifiers of AMR Risk in Primary Care

Ukraine's full-scale war has introduced AMR pressures that extend beyond the trauma centers where war-wound infections are first treated. An observational study of conflict-associated wounds treated between February and May 2024 characterized extensively drug-resistant Gram-negative infections using extended antimicrobial susceptibility testing and a novel multiplex molecular assay for carbapenemase genes, documenting a complex and evolving resistance landscape among casualties [13]. A parallel Polish surveillance analysis of 65 carbapenemase-producing Enterobacterales isolates recovered from patients transferred from Ukraine between March 2022 and February 2023 across 36 medical centres found NDM-type carbapenemases predominant, with KPC-, VIM- and OXA-48-type enzymes also contributing substantially [14]. Because patients who survive acute trauma care are frequently referred back into regional outpatient and rehabilitation networks, these extensively resistant organisms create downstream diagnostic and infection-control demands on primary-care facilities that were not designed to manage them, reinforcing the case for treating diagnostic capacity and referral coordination as managerial, not purely clinical, priorities within the TMO system.

3.7. Placement Within the Integrated Five-Dimensional Model

The managerial, clinical, diagnostic, communicative and vaccination-related elements described above are consistent with an integrated five-dimensional model of AMR control for the Ukrainian healthcare system proposed previously by one of the authors, which treats these dimensions not as isolated interventions but as interdependent components of a single containment system at the facility and sectoral level [15]. Practical implementation of this model in primary care also requires adequate staffing of healthcare management functions, including the training of public-administration specialists capable of supporting formulary implementation, AMC monitoring, and stewardship programs at the TMO level [16].

4. Discussion

Taken individually, each element reviewed above — audit and feedback, AWaRe-guided prescribing, point-of-care diagnostics, delayed prescribing, and vaccination — has a robust evidence base from randomized trials, systematic reviews, and multicentre validation studies. What the evidence base does not resolve on its own is whether these elements are reproduced consistently across a facility's day-to-day practice or remain dependent on the initiative of individual clinicians. The REDUCE trial result is instructive precisely because it isolates a managerial lever — structured feedback — as sufficient, on its own, to shift prescribing behavior at scale across dozens of practices [12]. This suggests that in a health system such as Ukraine's, where primary care has been reorganized into TMOs with substantial variation in administrative capacity, the marginal return on investment in managerial infrastructure (formularies, AMC monitoring, feedback loops) may rival or exceed the marginal return on further clinical guideline dissemination alone.

The conflict-specific evidence reviewed in section 3.6 adds urgency to this argument. Data from both Ukrainian-linked observational cohorts [13] and receiving-country surveillance in Poland [14] indicate that extensively drug-resistant organisms associated with war trauma are not confined to frontline trauma centers; they enter referral and rehabilitation pathways that primary and secondary outpatient facilities must be prepared to recognize and manage. This is consistent with the

broader international literature on conflict as a driver of AMR, which has repeatedly identified damaged infrastructure, workforce attrition, and diagnostic gaps as structural amplifiers of resistance in war-affected settings. For Ukraine, this reinforces the case that AMR stewardship in primary care cannot be separated from the broader institutional resilience of the TMO network, including its diagnostic referral pathways and its capacity to absorb patients returning from acute war-related care.

This synthesis has limitations inherent to a narrative rather than a systematic review: source selection, while guided by database priority and study design, was not conducted according to a pre-registered protocol, and the practical algorithm proposed here has not yet been prospectively evaluated within a Ukrainian TMO setting. Future research should prioritize a pilot implementation study measuring AMC, Watch/Access prescribing ratios, and point-of-care diagnostic uptake before and after the introduction of structured audit-and-feedback and formulary tools within a defined group of Ukrainian primary-care facilities, alongside continued surveillance of conflict-associated resistant organisms entering outpatient referral networks.

5. Conclusions

Containing antimicrobial resistance in primary health care is a combined clinical-managerial task. Its resolution requires the simultaneous implementation of structured clinical algorithms for rational antibiotic therapy — objectified indications, AWaRe-guided classification, point-of-care diagnostics, delayed prescribing, and vaccination — together with institutional control mechanisms at the facility level, including a local formulary, antimicrobial consumption monitoring, and prescribing audit and feedback. The evidence base unambiguously supports the effectiveness of each of these elements individually; the managerial dimension determines whether they are reproduced systematically in daily facility practice rather than remaining the initiative of an individual physician. Conflict-associated amplifiers of resistance further strengthen this argument by extending stewardship demands beyond trauma care into the primary-care referral network. Framing antibiotic stewardship as a managerial function of the Territorial Medical Association, rather than solely as an individual clinician's discipline, is a promising direction for improving the effectiveness of national AMR control programs under wartime conditions.

Abbreviations

AMR	Antimicrobial Resistance
AMC	Antimicrobial Consumption
AWaRe	Access, Watch, Reserve (WHO antibiotic classification)
CRP	C-Reactive Protein
EUCAST	European Committee on Antimicrobial Susceptibility Testing
RAST	Rapid Antimicrobial Susceptibility Testing
TMO	Territorial Medical Association
WHO	World Health Organization

Acknowledgments

The author thanks colleagues at the Department of Infectious Diseases, Danylo Halytsky Lviv National Medical University, for helpful discussion during the preparation of this manuscript.

Author Contributions

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Conflicts of Interest

The author declares no conflicts of interest.

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