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Antimicrobial Resistance and Precision Pharmacotherapy: Why 2026 Needs Faster Diagnostics and Smarter Antibiotic Use

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Perspective

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Abstract

Antimicrobial resistance (AMR) is increasingly a pharmaceutical development problem as well as an infectious-disease problem. Resistance reduces the useful lifetime of existing medicines while the pipeline of innovative antibacterial agents remains limited. In 2026, the response is moving toward a combination of new antibiotics, rapid diagnostics, genomic surveillance, antimicrobial stewardship and precision pharmacotherapy. This perspective argues that the future of antibacterial treatment should be defined by matching the narrowest effective medicine to the pathogen and patient as quickly as possible. Artificial intelligence, genomic data, rapid susceptibility testing and novel delivery systems can contribute, but their value depends on integration into clinical workflows. Pharmaceutical scientists have an important role in developing agents with appropriate pharmacokinetics, safety, accessibility and resistance-suppressing characteristics.

Keywords: Antimicrobial Resistance; Antibiotics; Precision Medicine; Antimicrobial Stewardship; Rapid Diagnostics; Pharmacotherapy; Pharmaceutical Development

Introduction

Antimicrobial resistance is one of the clearest examples of a pharmaceutical problem that cannot be solved by developing medicines alone. When bacteria, viruses, fungi or parasites become less susceptible to available treatments, the clinical value of existing drugs declines. WHO reports that approximately one in six laboratory-confirmed bacterial infections worldwide in 2023 were resistant to antibiotic treatment, while resistance increased in more than 40% of monitored pathogen-antibiotic combinations between 2018 and 2023 [1].

The pharmaceutical response must therefore address two linked objectives: create effective new therapies and preserve the effectiveness of existing ones. In 2026, precision pharmacotherapy provides a promising framework for doing both.

From Empirical Treatment to Precision Treatment

Traditional treatment of serious infection often begins empirically because clinicians cannot wait several days for definitive susceptibility results. The difficulty is that broad-spectrum therapy may expose patients and microbial communities to unnecessary antibiotic pressure. When diagnostic information becomes available, treatment can be narrowed.

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Rapid molecular tests, biosensors and accelerated susceptibility testing can reduce this delay. WHO's 2026 AMR materials highlight rapid point-of-care technologies and research on biosensors capable of producing susceptibility information in a few hours [2]. The pharmaceutical implication is that a drug's value increasingly depends on the diagnostic ecosystem surrounding it. A highly effective narrow-spectrum antibiotic may be clinically difficult to use if the pathogen cannot be identified rapidly.

New Antibiotics Must Match Unmet Needs

The global pipeline contains antibacterial candidates, but many do not sufficiently address the highest-priority resistant pathogens. WHO released new Target Product Profiles in March 2026 for severe multidrug-resistant Gram-negative infections, resistant Gram-positive infections in vulnerable patients, and bacterial meningitis. These profiles specify desired characteristics including efficacy, pharmacokinetics, safety, route, stability, access and affordability [3].

This approach is important because pharmaceutical innovation should begin with the clinical problem rather than with a molecule searching for an indication. A new antibiotic should ideally be designed around a clearly defined resistant pathogen, patient population, treatment setting and access requirement.

Precision Dosing and Pharmacokinetics

Even when the correct antibiotic is selected, the dose must be adequate at the site of infection without producing avoidable toxicity. Pharmacokinetic and pharmacodynamic modelling can help determine exposure targets, particularly in critically ill patients whose physiology may change rapidly.

Therapeutic drug monitoring, population pharmaco kinetic models and patient-specific variables can support dose optimisation. AI may assist in identifying patterns in large clinical datasets, but clinical pharmacology remains essential for translating predictions into dosing recommendations. Precision antimicrobial therapy therefore means precision in both drug choice and drug exposure.

Genomics and AI for Resistance Prediction

Whole-genome sequencing can reveal resistance-associated mutations and transmission patterns. AI and machine-learning approaches can use genomic and clinical data to predict resistance and potentially identify pathogen vulnerabilities. WHO's 2026 AMR surveillance materials describe research in which machine-learning models were used to predict bedaquiline resistance in Mycobacterium tuberculosis, with explainable AI identifying genomic features associated with resistance [4].

Such tools should not be viewed as replacements for laboratory susceptibility testing. Their strongest role may be to accelerate decisions, identify high-risk patterns and support surveillance.

Pharmaceutical Innovation Beyond Conventional Antibiotics

The future AMR portfolio may include antimicrobial peptides, bacteriophages, targeted delivery systems, microbiome-sparing strategies and combinations that restore antibiotic activity. Natural products and AI-assisted discovery are also being investigated [5].

Drug delivery can contribute by concentrating an antimicrobial at the infection site or improving exposure while reducing systemic toxicity. Controlled-release hydrogels and other delivery platforms are examples of how pharmaceutics can contribute to antimicrobial innovation [6]. However, every new approach must be evaluated for resistance selection, manufacturing feasibility and real-world accessibility.

Stewardship as a Pharmaceutical Principle

Antimicrobial stewardship is sometimes treated as a clinical policy issue separate from pharmaceutical science. That separation is artificial. A medicine's effectiveness over time is influenced by how it is used. Narrow-spectrum therapy, appropriate dosing, correct duration and rapid de-escalation can reduce unnecessary selective pressure.

The updated Global Action Plan on AMR 2026–2036 adopted by the World Health Assembly emphasises a One Health framework spanning human, animal, plant, food and environmental dimensions [7]. Pharmaceutical science should therefore consider the entire lifecycle of antimicrobial use, including environmental release and antibiotic residues.

Perspective: The Winning Model Is Integration

The most promising AMR strategy is not a single breakthrough antibiotic. It is an integrated system: rapid diagnosis identifies the pathogen, resistance prediction estimates likely susceptibility, pharmacokinetic tools select an appropriate exposure, a targeted medicine treats the infection, and stewardship limits unnecessary use. Surveillance then feeds resistance data back into research and policy.

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This model changes how pharmaceutical innovation should be evaluated. A new medicine that fits into a precision diagnostic and stewardship pathway may have greater long-term value than a broader agent that is easy to prescribe but rapidly drives resistance.

Conclusion

AMR requires pharmaceutical science to move from a product-centred mindset toward a system-centred one. New antibiotics remain urgently needed, especially for multidrug-resistant pathogens, but their impact will be limited without rapid diagnostics, precision dosing, surveillance and stewardship. The 2026 policy and research landscape increasingly supports this integrated direction. Pharmaceutical scientists can contribute through antibiotic discovery, formulation, pharmacokinetic modelling, diagnostic integration and development of alternatives to conventional antibiotics. The goal should be durable therapeutic effectiveness: treating today's patient while preserving tomorrow's treatment options.

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