



LEARNING LOUNGE EXCLUSIVE

Data Science Meets Antimicrobial Stewardship: Real-Time Analytics Help Combat Antimicrobial Resistance



Editorial by:

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Antimicrobial resistance (AMR) poses an unprecedented threat to global health, demanding innovative solutions that transcend traditional stewardship approaches. At the intersection of data science and infectious disease management, a new paradigm is emerging, one where advanced analytics and software solutions are helping healthcare professionals optimize patient care and strengthen antimicrobial stewardship (AMS) programs. The scale of this challenge cannot be overstated: AMR was directly responsible for 1.14 million global deaths in 2021 and contributed to 4.71 million deaths.¹ Without intervention, by 2050, AMR deaths could rise by nearly 70% compared to 2022.¹ Computerized approaches now offer promising strategies to combat this growing public health crisis.

The AMR Crisis Demands Data-Driven Solutions

The global rise in AMR is primarily driven by the overuse and misuse of antibiotics, both in human medicine and agriculture.² Inappropriate prescribing, such as unnecessary use for viral infections or incorrect dosing, accelerates the development of resistant strains, creating a cycle that threatens the foundation of modern medicine. Surveillance data from 76 countries reveals some alarming resistance rates: 42% for third-generation cephalosporin-resistant *E. coli* and 35% for methicillin-resistant *Staphylococcus aureus*.³

The financial stakes are equally dire, with the World Bank estimating that AMR could result in US\$1 trillion in additional healthcare costs by 2050 and US\$1-3.4 trillion in gross domestic product losses annually by 2030.⁴ This underscores the urgent need for innovative technology that delivers both medical and economic advantages.



The integration of data science and real-time analytics enables proactive AMR management supporting measurable reductions in antimicrobial use, hospital stays, and costs – all of which are essential for global adoption. Significant technological advancements have also been made in connecting laboratory, clinical, and pharmacy data to facilitate transparency across healthcare organizations and better AMS practices.

Driving Stewardship with Real-Time Analytics

Studies confirm that clinical decision support systems (CDSS) serve as essential informatics tools, helping clinicians make evidence-based treatment decisions by incorporating clinical guidelines and patient data into their algorithms. When properly integrated within hospital information systems and connected to electronic health records, these tools facilitate more precise prescribing practices, which in turn addresses the financial burden of antimicrobial misuse.⁵

My dual background in computer science and clinical collaborations informs the design of systems that are both technically robust and clinically practical, like the Antimicrobial Prescription Surveillance System (APSS), which exemplifies this synergy. Systems like APSS enable real-time feedback to prescribers, ensuring adherence to guidelines and reducing inappropriate prescriptions. As an example, a Canadian APSS implementation was associated with a 2-day reduction in length-of-stay and a 24% decrease in antimicrobial use, which equated to a 28% reduction in antimicrobial spending over three years.⁶

The integration of data science and real-time analytics is poised to transform the future management of AMR, enabling proactive, rather than reactive, interventions. True success will depend on global collaboration among governments, academia, and healthcare providers to balance innovation with equitable access.

For healthcare professionals looking to integrate these evolving data-driven approaches into daily workflows, systems that prioritize user-friendly interfaces aligned with existing workflows should be selected. It is also important to ensure that training and on-going education are available to strengthen competencies, build confidence, and support collaboration across healthcare teams.

Future Frontiers: Where Computation Meets Microbiology

Today, emerging technologies are reshaping AMR management. As identification and antimicrobial susceptibility testing (ID/AST) continue to accelerate each year, hospitals must adapt by integrating solutions, such as real-time CDSS, that can keep pace with the speed of treatment decisions and highlight timely actions required for optimal patient care.

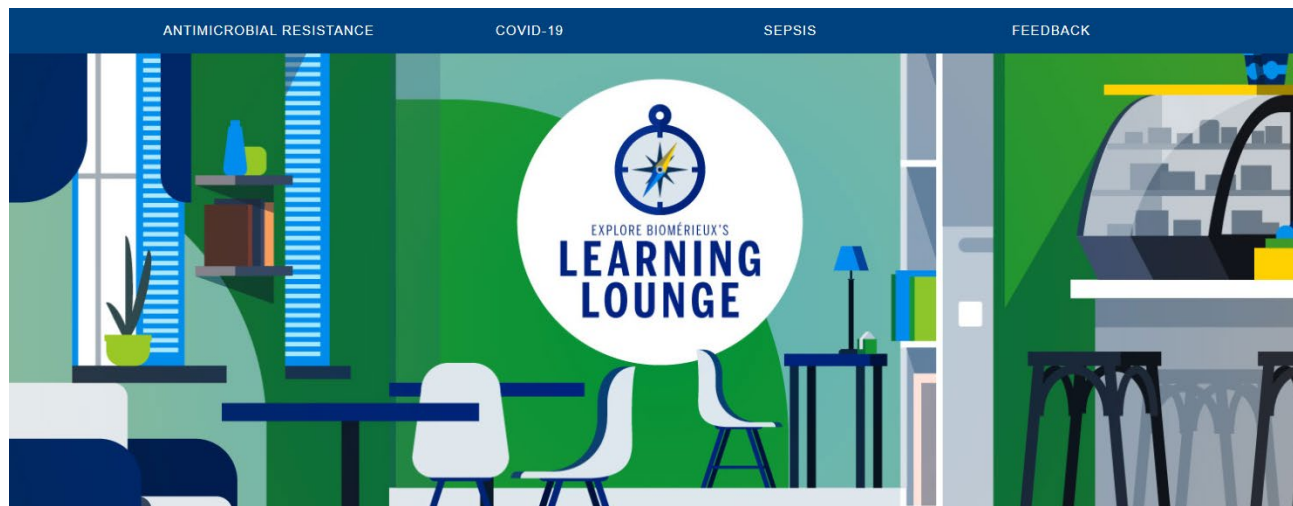
There is also another profound transformation on the horizon. Within the decade, generative Artificial Intelligence (AI) capabilities border on science fiction, and healthcare innovation in this space is advancing at an unprecedented pace. AI is already being harnessed to improve the speed and accuracy of infectious disease diagnostics, optimize antibiotic selection, and enhance real-time surveillance of resistance patterns. For example, leading AI research institutes are driving the development of models that analyze genomic and clinical data, enabling earlier detection of resistant pathogens and more personalized treatment recommendations.⁷ Dynamic, data-driven tools, such as automated, real-time antibiograms, now empower clinicians to make informed therapy decisions based on current local resistance trends rather than outdated data.⁸ As these technologies continue to evolve, AI is expected to play an increasingly central role in patient diagnosis, treatment optimization, and the development of novel antimicrobial strategies.



As we face projections of increasing AMR-related mortality, the convergence and continued advancements in AI, CDSS, and real-time surveillance systems gives reason for optimism in our ability to preserve the efficacy of antimicrobial treatments, both now and for future generations.

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