

Measuring Antimicrobial Prescribing Quality and Driving Behavioral Change: A Call to Action Against Antimicrobial Resistance

Medir a Qualidade de Prescrição Antimicrobiana e Promover a Mudança Comportamental: Um Apelo à Ação contra a Resistência Antimicrobiana

Carlos PALOS ^{1,2}, Paulo SOUSA ¹, José-Artur PAIVA ^{3,4}
Acta Med Port 2026 Jun-Jul;39(6-7):379-382 • <https://doi.org/10.20344/amp.24396>

Keywords: Anti-Bacterial Agents; Antimicrobial Stewardship; Drug Prescriptions; Drug Resistance, Bacterial
Palavras-chave: Antibacterianos; Farmacorresistência Bacteriana; Gestão de Antimicrobianos; Prescrições de Medicamentos

THE PROBLEM

Portugal faces a significant challenge with infections caused by antimicrobial-resistant bacteria (AMR). According to the Organisation for Economic Co-operation and Development (OECD), in Portugal, AMR is responsible each year for approximately 1167 deaths, 127 500 additional hospital days, 26 560 disability-adjusted life years (DALYs), and around 50 million USD in extra costs.¹

Despite legislative measures, reduction targets, and awareness campaigns, antibiotic consumption – the main driver of AMR – has increased over the past five years. In 2024, total antibiotic consumption in Portugal reached 20.8 defined daily doses (DDD) per 1000 inhabitants per day, up from 19.3 in 2019, and slightly above the European Union/European Economic Area (EU/EEA) average (20.5). Over the last five years, outpatient consumption increased from 17.9 to 18.9 DDD (EU/EEA: 18.8), while hospital consumption rose from 1.4 to 1.8 DDD (EU/EEA: 1.8), reversing the declining trend observed between 2016 and 2019.²

Secondary indicators of antimicrobial consumption defined by the European Centre for Disease Prevention and Control/European Food Safety Authority/European Medicines Agency show that, in Portugal, the use of broad-spectrum antibiotics exceeds the EU/EEA average. Outpatient use of broad-spectrum penicillins (including amoxicillin-clavulanate), third-generation cephalosporins, macrolides (excluding erythromycin), and fluoroquinolones compared to narrow-spectrum penicillins, first- and second-generation cephalosporins, and erythromycin increased from 5.0 to 5.4, remaining above the EU/EEA value (4.7). Amoxicillin-clavulanate use increased from 6.7 to 7.1 DDD (EU/EEA: 4.5) and macrolides from 3.1 to 3.3 DDD (EU/EEA: 3.3).²

In hospitals, the proportion of broad-spectrum agents (glycopeptides, third- and fourth-generation cephalospo-

rins, monobactams, carbapenems, fluoroquinolones, polymyxins, piperacillin-tazobactam, linezolid, tedizolid, and daptomycin) increased from 42.57% to 43.44% of total consumption, remaining above the EU/EEA average (39.74%). The proportion of antibiotics in the 'Access' category, according to the World Health Organization's AWaRe (Access, Watch, Reserve) classification, was 61.4%, remaining below the 65% target.²

MULTIFACTORIAL DETERMINANTS

From a behavioral perspective, Hofstede's cultural dimension theory helps explain some prescribing trends: in Portugal, high 'uncertainty avoidance' (feeling uncomfortable with ambiguity and uncertainty), high 'power distance' (acceptance of unequal distribution of power) and low 'long-term orientation' (focus on short-term outcomes) promote broad-spectrum and prolonged antibiotic use as a 'precaution', favoring immediate efficacy over long-term efficiency, with decisions strongly influenced by senior physicians.³

Contributing factors include gaps in under- and post-graduate education on rational antibiotic use and low public literacy on antimicrobial behavior.

Excessive physician workload, a primary care system with insufficient coverage, high reliance on emergency services, and below-average healthcare investment compared to the OECD are also relevant determinants.⁴


Although Antimicrobial Stewardship Programs (ASPs) are mandatory across all levels of care in the Portuguese National Health Service, with post-prescription review and feedback within 72 hours for certain inpatient antibiotics, implementation seems accomplished in hospitals but remains insufficient in primary care, emergency departments, and long-term care.

1. NOVA National School of Public Health. Public Health Research Centre. Comprehensive Health Research Center. Universidade NOVA de Lisboa. Lisbon. Portugal.

2. Infection Control and Antimicrobial Resistance Prevention Unit. Unidade Local de Saúde Santa Maria. Lisbon. Portugal.

3. Intensive Care Department. Unidade Local de Saúde São João. Porto. Portugal.

4. Faculty of Medicine. Universidade do Porto. Porto. Portugal.

 **Autor correspondente:** Carlos Palos. cpalos1inovhealth@gmail.com

Recebido/Received: 06/01/2026 - **Aceite/Accepted:** 18/02/2026 - **Publicado Online/Published Online:** 22/04/2026 - **Publicado/Published:** 01/06/2026
Copyright © Ordem dos Médicos 2026



The private sector, which represents a growing share of healthcare delivery, remains outside the ASP regulatory framework and may contribute to the increase in antibiotic use, as reported in the United Kingdom.⁵

THE CHALLENGE OF MEASURING QUALITY AND DRIVING BEHAVIORAL CHANGE

Evaluating the appropriateness of antibiotic prescribing is central to ASPs, requiring consensus-based, validated definitions to reduce observer subjectivity.⁶

Using qualitative indicators (how well we prescribe) alongside quantitative indicators (how much we prescribe) is essential to identify areas for improvement and measure the impact of interventions. Indicators thus serve both as a bridge from data to knowledge and as a lever for actionable change.

The rapid ASP post-prescription intervention cycle must be aligned and supported by a slower cycle, in which quality improvement interventions are planned based on diagnostic analysis of prescribers and their context, promoting standards, education, and behavioral change.

Two national quality improvement initiatives have been implemented, with broader adoption, potentially transforming the current landscape.

NATIONAL ANTIMICROBIAL PRESCRIBING SURVEY (NAPS)

The National Antimicrobial Prescribing Survey (NAPS) is a structured program that provides consensus-based, validated definitions for assessing antimicrobial prescribing appropriateness, together with a standardized methodology and an online platform to support systematic evaluation of antimicrobial prescriptions.⁷

Developed by the Royal Melbourne Hospital Guidance Group and the Australian National Centre for Antimicrobial Stewardship, the Hospital NAPS has been successfully implemented in Australia since 2013, as a core component of the national strategy to combat antimicrobial resistance. Further adaptation to specific contexts (surgical prophylaxis, long-term care, antifungal prescribing, outpatient, and home hospitalization) was performed. In addition, hospital NAPS has been conducted in 12 countries with different incomes, showing feasibility and scalability beyond Australia.

Experts involved in translating, culturally adapting, and validating the Australian appropriateness assessment definitions for the Portuguese context, as well as evaluating clinical vignettes, described these definitions as “very important,” “fundamental,” and “filling a gap”. They also highlighted their contribution to standardizing evaluation criteria, improving communication with prescribers, and enhancing interinstitutional comparability. Interrater reliability testing with clinical vignettes showed that the Portuguese version

achieved agreement levels comparable to the original studies.⁸

The First Portugal Hospital NAPS, conducted in eight mainland hospitals representing different sizes, organizational models, and academic affiliations, provided the first multicenter, nationwide assessment of antibiotic prescribing in Portuguese hospitals using standardized, translated and validated definitions. The study found a 42% baseline inappropriateness, mainly from unnecessary or overly broad-spectrum use and limited prescribing guidance. It identified multiple opportunities for improvement in the most used antibiotics (piperacillin-tazobactam, amoxicillin-clavulanate, and ceftriaxone) and the most frequent indications (surgical prophylaxis, community-acquired pneumonia, and pyelonephritis), demonstrating national feasibility and scalability.⁹ Data on the factors determining inappropriateness will be published shortly.

DRIVE-AMS PROGRAM

Drive-AMS is a quality improvement initiative implementing a staged behavioral change approach and expert consultancy for more appropriate antimicrobial use, resulting from a collaboration between Radboud University Medical Center and the University of Antwerp.¹⁰

After identifying key quality gaps, a context-specific behavior-change intervention is designed based on a systematic analysis of prescribers and their context.

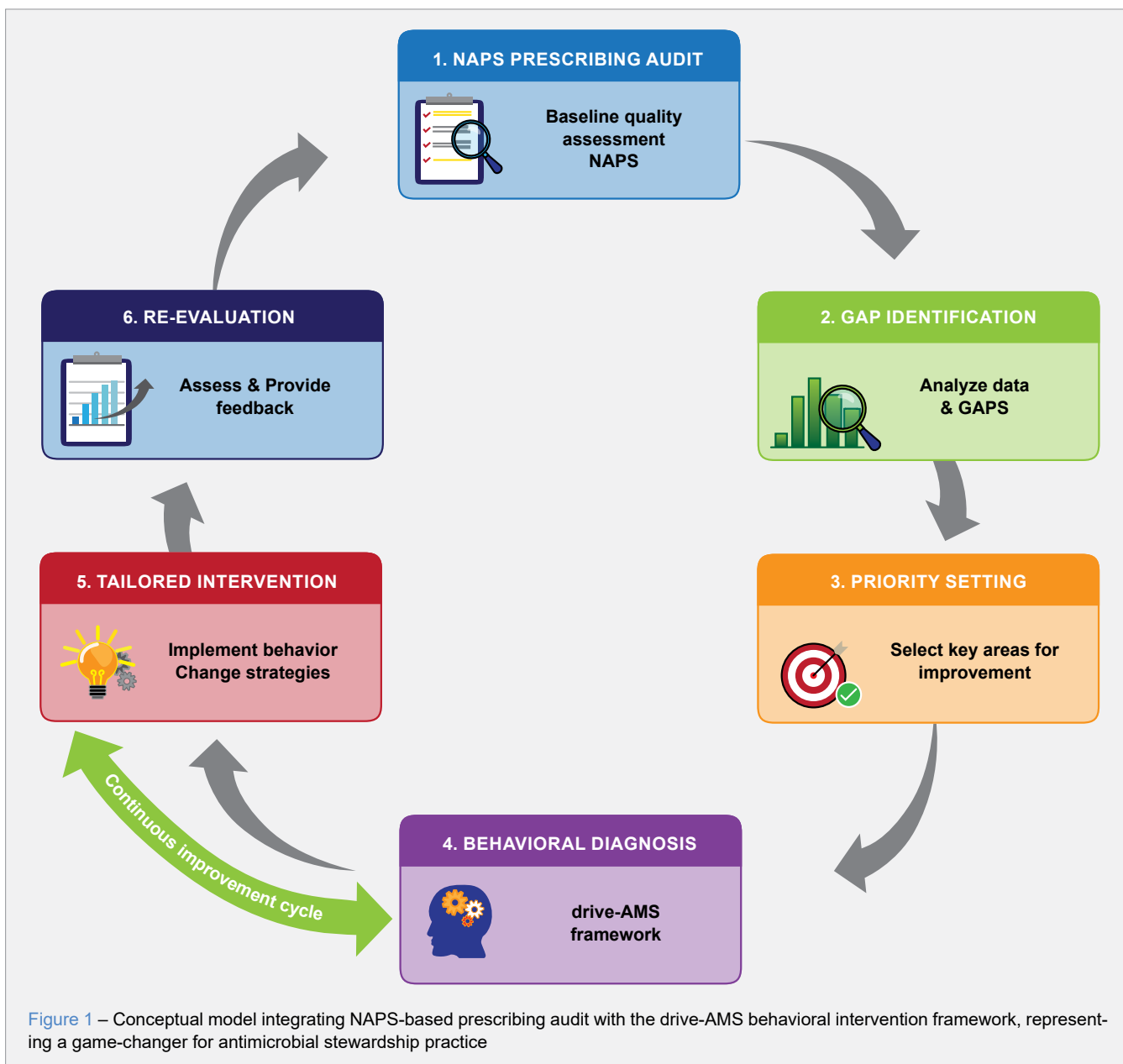
The program runs in multiple European countries. In Portugal, the program started in 2023. Since then, 88 healthcare professionals from 16 different healthcare institutions, representing 58% of all Portuguese acute care beds, have been trained in this methodology. The program is now implemented in all 16 institutions with highly positive results (unpublished data).

CHANGING THE GAME: THE WAY FORWARD

Improving appropriate antimicrobial prescribing should be addressed as an implementation issue. Understanding antibiotic prescribing quality is essential to identify priority intervention areas and engage clinicians.

Although these examples are hospital-focused and some data are still unpublished, integrating NAPS appropriateness definitions and methodology with locally tailored behaviour-change programmes such as drive-AMS could be transformative. This approach has the potential to establish a national ASP paradigm that is both scalable and adaptable across all care settings (Fig. 1).

In order to tackle antimicrobial resistance in Portugal, it is necessary to mobilize action by strengthening the assessment of antimicrobial prescribing quality and promoting targeted behavioral change.



ACKNOWLEDGMENTS

The authors declare that no AI tools were used during the preparation of this work.

The authors gratefully acknowledge Royal Melbourne Hospital Guidance Group and the Australian National Centre for Antimicrobial Stewardship (NAPS) and Radboud University Medical Center and University of Antwerp (drive-AMS), as well as all participating institutions and professionals whose engagement made the Portuguese initiatives possible.

AUTHOR CONTRIBUTIONS

All authors contributed equally to this manuscript and approved the final version to be published.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

FUNDING SOURCES

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Organisation for Economic Co-operation and Development. Stemming the superbug tide: just a few dollars more. 2018. [cited 2025 Apr 05]. Available from: https://www.oecd.org/content/dam/oecd/en/publications/reports/2018/11/stemming-the-superbug-tide_g1g98de5/9789264307599-en.pdf.
2. European Centre for Disease Prevention and Control. AMC Dashboard (ESAC-Net) — EU/EEA antimicrobial consumption data. [cited 2025 Dec 05]. Available at: https://qap.ecdc.europa.eu/public/extensions/AMC2_Dashboard/AMC2_Dashboard.html#eu-consumption-tab.
3. Borg MA, Camilleri L. Broad-spectrum antibiotic use in Europe: more evidence of cultural influences on prescribing behaviour. *J Antimicrob Chemother.* 2019;74:3379-83.
4. Silva AC, Nogueira PJ, Paiva JA. Determinants of antimicrobial resistance among the different European countries: more than human and animal antimicrobial consumption. *Antibiotics.* 2021;10:834.
5. Mahase E. Antimicrobial resistance: private providers are reversing progress by dispensing more drugs, top adviser warns. *BMJ.* 2025;391:r2451.
6. DePestel DD, Eiland EH 3rd, Lusardi K, Destache CJ, Mercier RC, McDaniel PM, et al. Assessing appropriateness of antimicrobial therapy: in the eye of the interpreter. *Clin Infect Dis.* 2014;59:S154-61.
7. James R, Nakamachi Y, Morris A, So M, Ponnampalavanar SS, Chuki P, et al. The feasibility and generalizability of assessing the appropriateness of antimicrobial prescribing in hospitals: a review of the Australian National Antimicrobial Prescribing Survey. *JAC Antimicrob Resist.* 2022;4:dla012.
8. Palos C, Ierano C, Santos MJ, Leitão I, Nogueira P, James R, et al. Cultivating global antimicrobial stewardship: linguistic and cultural validation of the Australian National Antimicrobial Prescribing Survey appropriateness assessment definitions for Portugal. *J Antimicrob Chemother.* 2024;79:2281-91.
9. Palos C, Ierano C, James R, Paiva JA, Thursky K, Sousa P, et al. Cultivating global antimicrobial stewardship: prescribing quality and implementability insights from Portugal's First Hospital National Antimicrobial Prescribing Survey. *Antimicrob Resist Infect Control.* 2026;15:11.
10. Global-PPS. About drive-AMS. Global-PPS. [cited 2025 Dec 05]. Available from: <https://www.global-pps.com/about-ams/>.