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POTENTIAL STRATEGIES AND APPROACHES TO REDUCE THE INAPPROPRIATE USE OF ANTIBIOTICS IN THE MANAGEMENT OF RESPIRATORY TRACT INFECTIONS IN PRIMARY CARE

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ABSTRACT

Introduction and Purpose: The application of antibiotics has enabled the effective treatment of bacterial infections for years. However, their inappropriate use and overprescribing remain longstanding concerns. A considerable proportion of antibiotic prescriptions originate in primary care, where respiratory tract infections constitute one of the most common indications. The aim of this study was to investigate potential strategies to reduce inappropriate antibiotic use in the management of respiratory tract infections in the primary care setting.

Materials and Methods: The methodology was based on a review of the available literature using the PubMed and Google Scholar databases. The following keywords were applied: “primary care”, “respiratory tract infection”, “limiting antibiotic overuse”, and “strategies”.

Description of the state of knowledge: The findings indicate that a range of methods and interventions may contribute to reducing antibiotic overuse in primary care. These include educational and behavioral interventions targeting both patients and healthcare professionals, as well as efforts to reduce diagnostic uncertainty, for example through the use of point-of-care biomarkers. Additional approaches such as delayed antibiotic prescribing, the implementation of non-antibiotic treatment strategies, and preventive measures aimed at reducing the incidence of respiratory tract infections may also play an important role. The analyzed methods were evaluated not only in terms of their effectiveness but also with regard to their limitations and the requirements necessary for their implementation.

Conclusions: Overall, the review underscores the need for further research to better define and optimize strategies for reducing inappropriate antibiotic use and limit the development of antimicrobial resistance.

KEYWORDS

Respiratory Tract Infections, Primary Care, Antibiotic Resistance, Antibiotic Overuse, Strategies

CITATION

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Introduction:

The development of antibiotics represents one of the greatest achievements of modern medicine. Despite their substantial and indisputable role in the treatment of infections worldwide, antibiotic therapy is not always used appropriately or in accordance with clinical indications, and these agents are overused in many countries. This, in turn, elevates the likelihood of antimicrobial resistance emerging and contributes to the spread of resistant bacterial strains. The World Health Organization (WHO) recognized antimicrobial resistance as one of the ten most critical threats to global health in its 2019 assessment. Infections caused by antibiotic-resistant bacteria exert a significant impact on individual health and public well-being, leading to prolonged hospital stays, substantially higher healthcare costs, and increased mortality. Additionally, it should be noted that antibiotics, like all other pharmacological agents, are associated with potential adverse effects. Therefore, it is essential to promote the principles of rational antibiotic therapy and to advance and implement strategies aimed at reducing the overuse of these agents. As a substantial proportion of antibiotics prescribed globally are issued in primary care, with respiratory tract infections representing a predominant indication, interventions aimed at reducing antibiotic prescribing are of particular importance in this setting and clinical context, particularly given that primary care often constitutes the first point of contact for patients presenting with infections. This review aims to evaluate various interventions for respiratory tract infections that are applicable in the primary care setting, with emphasis on their advantages, limitations, effectiveness, and any additional requirements necessary for their implementation.

Materials and Methods:

The literature review was conducted using the PubMed and Google Scholar databases. The search strategy included the following keywords: „primary care”, “respiratory tract infection”, “limiting antibiotic overuse” and “strategies”. Studies addressing respiratory tract infections were included, whereas those focusing on other types of infections were excluded. Inclusion criteria comprised studies addressing primary care directly or examining methods applicable to the primary care setting. Studies focusing specifically on hospital environments or exclusively on specialty care were excluded. This selection approach was adopted due to the distinct characteristics of primary care compared with other forms of outpatient care and, in particular, hospital settings. The organization of care, available resources, and clinical decision-making processes differ substantially across these settings, and therefore not all interventions or strategies are equally applicable in every healthcare context. Also, studies that did not provide information relevant to the subject of this work were not included. To ensure the inclusion of the most current evidence, only studies published after 2010 were considered, with a focus on those from the last 10 years. Publications from 2020 to 2025 comprised more than half of the included studies. Whenever feasible, efforts were made to include a substantial proportion of original studies.

Description of the state of knowledge:**ANTIMICROBIAL STEWARSHIP INTERVENTIONS WITH FOCUS ON EDUCATIONAL AND BEHAVIORAL INTERVENTIONS**

One of the key issues requiring analysis is the role of various antimicrobial stewardship interventions in reducing the overuse of antibiotics in primary care. Interventions may be based on a variety of approaches, including education, clinical decision aids, clinic support, ongoing audit and feedback, and compensation for antimicrobial stewardship programs activities. The study by Gulliford et al., 2019 emphasizes that although interventions may contribute to reducing the proportion of patients receiving antibiotics, the preparedness of health professionals to engage in such antimicrobial stewardship initiatives may play a substantial role in their effectiveness. Accordingly, the success of antimicrobial stewardship interventions depends not only on their design and implementation, but also on the willingness of healthcare professionals to actively participate in and adhere to these initiatives. An effective approach to enhance engagement may be financial support. Studies conducted in Japan suggest that financial incentives can significantly reduce antibiotic overuse and support efforts to mitigate antimicrobial resistance [2] [3]. Patient engagement is also an important factor. A more individualized approach that consider heterogeneity within the patient population may improve outcomes. For instance, Gulliford et al., 2019 suggest that antimicrobial stewardship strategies should incorporate targeted interventions adapted to distinct age populations. Essack and Pignatari (2013) also emphasize the importance of an individualized approach to patient and the development of personalized treatment plan.

Clinical guidelines constitute one of the fundamental elements in efforts to combat antimicrobial resistance and inappropriate antibiotic use. It is important to emphasize the significance of guidelines not only in terms of their development, but also with regard to their accessibility, physicians’ familiarity with them, and their implementation in routine clinical practice. For instance, studies conducted by Baan et al., 2018 and Tyrstrup et al., 2016 underscore the importance of adherence to guidelines in reducing antibiotic prescribing. Similarly, Saliba-Gustafsson et al., 2021 emphasize the need for access to appropriate clinical guidelines, as well as for training and educational initiatives aimed at supporting their implementation.

Educational interventions targeting both primary care providers and patients or their caregivers, as well as their combination, may be effective in reducing antibiotic use among adults and children diagnosed with ARTIs (Acute Respiratory Tract Infections) [7] [8] [9] [10] [11]. Patients’ perceptions and beliefs, particularly their expectations regarding antibiotic prescriptions and their level of health literacy, have been identified as key determinants of inappropriate antibiotic use [12]. Therefore, improving public awareness of the limited effectiveness of these medicines, as well as their potential side effects and the risks associated with their overuse, may play an important role. In this context, Godman et al., 2020 highlight the role of approaches such as targeted patient information initiatives and health education campaigns. Interestingly, the mode of educational message delivery to patients plays a significant role, and its effectiveness may vary [7]. Similarly, Elizondo-Alzola et al., 2025 indicate that the impact of educational interventions is shaped by their design, mode of delivery, and the characteristics of the target population. The research by Cabral et al., 2015 suggests that strategies aimed at reducing unwarranted prescriptions for children with RTIs should build both clinicians’ confidence in the safety of not prescribing and, to a lesser extent, parents’ confidence as well. These strategies should also encourage clinicians to place greater emphasis on conducting a risk–benefit analysis related to

antibiotic prescribing, with particular attention to the risks associated with excessive use. Understanding the natural history of acute infections may support physicians in implementing patient-centered antimicrobial stewardship strategies, including delayed prescribing and shared decision-making [16]. Efforts to reduce antibiotic overuse should also consider the role of both automatic and analytical decision-making processes, difficulties in managing patients with longer illness durations, and diversity in the interpretation of diagnostic information by physicians [17]. It is also crucial to emphasize that physician training should extend beyond the development of clinical expertise, encompassing the acquisition of effective communication skills [7] [18] [6]. Similarly, Biezen et al., 2017 highlight the importance of improved communication between primary care physicians and parents, as well as the adoption of a team-based care approach with consistent advice, recognizing that physicians' decision-making is influenced not only by clinical factors but also by emotional and psychological considerations. Furthermore, O'Connor et al., 2019 emphasize the need to optimize communication and clinical skills among healthcare professionals, as only a subset of patients presenting for consultations expect antibiotics, while the majority seek further assessment, information, and reassurance. Likewise, Mortazhejri et al., 2020 showed that patients do not necessarily expect antibiotics. Instead, they often seek clinical examination and explanations of their symptoms. Shared decision-making, understood as a collaborative process in which patients and clinicians jointly participate in treatment decisions, may serve as an effective approach for reducing the unnecessary use of antibiotics [22]. According to Brookes-Howell et al., 2014 continuity of care, open communication during consultations, a sense of comfort, and mutual trust were significant factors influencing parental acceptance of their children's treatment. The study conducted by Godman et al., 2020 also highlights the need for educational initiatives targeting pharmacists. This is particularly relevant in low- and middle-income countries, where the provision of antibiotics without a medical prescription remains a significant concern.

It may be also beneficial to combine different methods, for instance by integrating educational interventions with other types of strategies [14]. According to McIsaac et al., 2021 multi-faceted antimicrobial stewardship interventions may be linked to a lower probability of antibiotics being prescribed for respiratory infections. The study highlights the importance of local stewardship efforts that encompass not only educational initiatives, but also clinical decision-making tools, clinic support, continuous audit and feedback, and compensation for antibiotic stewardship programs activities. Moreover, distance learning programs on evidence-based communication strategies and antibiotic prescribing in combination with individualized antibiotic prescribing feedback reports may be effective in reducing unnecessary outpatient prescribing of these medications during childhood ARTI visits [24]. Interestingly, Harrigan et al., 2024 reported that the effects of educational interventions may persist beyond the intervention period, however, in the absence of ongoing provider feedback, a trend toward increased antibiotic prescribing was observed. This underscores the importance of both the development of interventions and the maintenance of their effects over time.

In addition, other methods should not be overlooked. Lane et al., 2018 suggest that applying syndromic and microbiological epidemiological data may help decrease antimicrobial prescribing in primary care. Moreover, Godman et al., 2020 point to the necessity of measures such as enhanced monitoring of prescribing and dispensing practices, especially in low- and middle-income countries.

BIOMARKERS AND OTHER DIAGNOSTIC TOOLS:

It is important to consider diagnostic uncertainty as one of the factors contributing to antibiotic overuse. The findings by Wang et al., 2021 suggest that reducing this uncertainty, together with improving how physicians and patients manage it, may contribute to a decrease in antibiotic use.

A major challenge in primary care is the limited availability of diagnostic resources. As a result, disease diagnosis often relies to a large extent on patient history and physical examination. Although signs and symptoms may not allow for precise prediction or definitive confirmation of disease, they can indicate the underlying etiology with a certain probability and assist in ruling out specific causes [28]. Therefore, the development of symptom-based predictive models may be valuable in reducing the overuse of antibiotics in primary care. Since general practitioners sometimes prescribe antibiotics defensively to minimize the perceived risk of subsequent hospital admission in children with respiratory tract infections, the development of a clinical rule that stratifies the likelihood of future hospitalization and thereby reduces diagnostic uncertainty can also support a reduction in antibiotic prescribing within primary care [29].

Attention should be also drawn to the strategy of reducing antibiotic use through the application of point-of-care biomarkers. The primary aim of point-of-care testing (POCT) is to overcome the time limitations associated with conventional microbiological tests. Point-of-care tests (POCTs) encompass a range of

diagnostic tools, including assays for C-reactive protein (CRP), procalcitonin (PCT), rapid streptococcal tests, and tests for respiratory pathogens such as influenza, COVID-19, and respiratory syncytial virus (RSV). In addition, other specialized POCTs are available, and ongoing research continues to focus on the development of new diagnostic tools in this field. Clarke et al., 2025 highlight that rapid microbiological respiratory point-of-care tests may decrease previously mentioned diagnostic uncertainty and facilitate better management of patient expectations.

Point of care testing (POCT) including CRP has been demonstrated to reduce antibiotic prescribing in the primary care setting [31][7][32]. Similarly, according to Smedemark et al., 2022 the use of C-reactive protein point-of-care tests alongside routine care likely reduces the number of participants given an antibiotic prescription in primary care patients with acute respiratory infection. Importantly, Llor, 2025 emphasizes that such approach should complement history taking and clinical examination prior to decisions on antibiotic prescribing, but should never be used as a standalone test. Gentile et al., 2023 emphasize that CRP testing should be implemented as part of a broader set of strategies, in conjunction with improved communication skills or molecular testing, rather than as a single method. The study conducted by Cooke et al., 2020 highlights not only the role of CRP testing in potentially reducing the use of antimicrobial agents but also its high acceptability among both physicians and patients. This is particularly important because, as with other interventions, the key lies not only in formulating strategies and developing new methods, but above all in implementing them in everyday practice, which requires the active involvement of both physicians and patients in carrying out these measures [34].

The evidence on the use of procalcitonin in primary care settings appears to be less consistent. O'Connor et al., 2018 suggest that the use of procalcitonin may reduce antibiotic prescribing in this setting. Similarly, Lhopitallier et al., 2021 demonstrated that point-of-care procalcitonin testing in patients with lower respiratory tract infections reduces antibiotic use without compromising clinical recovery or patient satisfaction. However, there was not shown any added benefit from the use of lung ultrasonography to manage these patients, when used for those with an elevated procalcitonin level [36]. In contrast, Gentile et al., 2023 suggest that CRP testing may be more suitable than procalcitonin testing in primary care, noting that procalcitonin is not well evaluated and not sensitive in this setting, is more expensive than CRP testing and not generally available.

Attention should also be given to other point-of-care testing (POCT) approaches. Cohen et al., 2024 highlight rapid Group A Streptococcus testing as an effective antibiotic stewardship tool in children with pharyngitis. Interestingly, they further emphasize that patient selection for testing should rely on clinical features indicative of Group A Streptococcus infection rather than viral illness, in order to prevent unnecessary antibiotic treatment. The use of less common and highly specific point-of-care diagnostics such as the FebriDx assay, which simultaneously measures markers of bacterial infection (C-reactive protein, CRP) and viral infection (myxovirus resistance protein A, MxA), may likewise contribute to reducing antibiotic utilization for respiratory tract infections in primary care settings [38].

It is important to recognize that every method has both strengths and limitations, and its application may involve specific challenges. An examination of primary care professionals' perspectives on respiratory tract infection testing reveals that clinicians recognize both potential benefits and limitations of such practices. They report that these tests can help optimize antibiotic prescribing, reduce diagnostic uncertainty, ensure the appropriate use of healthcare resources, and guide treatment according to the underlying etiology. However, they also express concerns regarding the use of these tests as stand-alone diagnostic tools, highlight the risk of over-medicalizing self-limiting conditions, and note challenges such as high costs, time demands, increased workload, and the need for improved professional training in their application [39]. Similarly, Gentile et al., 2023 identify potential barriers to the implementation of CRP point-of-care testing, including financial and logistical constraints.

NON-ANTIBIOTIC TREATMENT, PROPHYLACTIC METHODS AND DELAYED ANTIANTIBIOTIC PRESCRIBING:

Essack & Pignatari, 2013 highlight the role of non-antibiotic treatment options aimed at providing symptomatic relief in the management of respiratory tract infections. For instance, Little et al., 2024 suggest that nasal sprays can reduce antibiotic use in acute respiratory respiratory tract infections in primary care. Zawadzka - Głos, 2023 suggests that the inclusion of BNO 1016 in the management of rhinosinusitis may help to limit the unjustified use of antibiotics in viral infections. It should be emphasized that phytotherapy is included in the EPOS 2020 guidelines and is supported by evidence from randomized clinical trials. BNO 1016 has demonstrated antiviral, secretolytic, anti-inflammatory, and antibacterial effects that have been confirmed

in clinical studies. The study by Liu et al., 2025 suggests that also probiotics can be an effective adjunct therapy for pediatric respiratory diseases by reducing the incidence and severity of respiratory tract infections, shortening symptom duration, and decreasing antibiotic use in children.

Preventive measures aimed at reducing the incidence of infections also play an important role. This is a logical consequence, as a lower frequency of infections results in fewer indications for initiating antibiotic therapy. For instance, vitamin D supplementation appears to reduce the risk of acute respiratory tract infections and may therefore represent a useful strategy for decreasing excessive reliance on antibiotics [44].

The study conducted by Godman et al., 2021 highlights the role of vaccination, as well as the importance of addressing misinformation, vaccine hesitancy, and unwarranted fears about vaccines, in efforts to combat antimicrobial resistance. Marengo José Ortega Martell Susanna Esposito et al., 2020 highlight also the role of nonspecific immunomodulation with OM-85 as one of several strategies for reducing unnecessary antibiotic use by enhancing the body's natural defense mechanisms and protecting against recurrent respiratory tract infections.

Some researchers suggest that delayed prescriptions may serve as a useful adjunct for primary care providers [47], however, the evidence regarding their benefits remains inconsistent [7]. According to Gentile et al., 2023, delayed prescribing is not optimal as antibiotics are either needed at the time of the consultation or not. Nevertheless, this strategy may be useful for specific patients. Its effectiveness requires adequate patient awareness and should be supported by effective communication.

Conclusions:

Despite the fact that most respiratory tract infections are of viral origin and are typically self-limiting, antibiotics continue to be prescribed in a substantial proportion of cases. It is important to emphasize that distinguishing bacterial from viral infections solely on the basis of clinical symptoms is not always straightforward. Moreover, performing microbiological cultures and postponing treatment while awaiting antibiotic susceptibility results is not always feasible, especially in primary care. Therefore, the implementation of various approaches aimed at reducing diagnostic uncertainty, such as symptom-based predictive models or point-of-care tests, is of considerable importance. In addition, education of both patients and caregivers, as well as effective communication between them, is essential, as a sufficient level of knowledge and mutual understanding can contribute to a meaningful reduction in antibiotic overuse. It is also important to consider the implementation of treatment strategies other than antibiotics in the management of respiratory tract infections, as well as the use of prophylactic measures aimed at preventing their occurrence. Delayed antibiotic prescribing may also be a useful approach, however, it is not suitable for all patients or clinical scenarios. This study underscores the need for further research aimed at investigating strategies and methods with the potential to reduce antibiotic overuse in primary care, particularly in the management of respiratory tract infections, and at assessing their effectiveness. Such efforts are essential to mitigate the consequences and complications associated with inappropriate antibiotic use.

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