The role of pharmacists in ensuring rational antibiotic therapy within the interdisciplinary team

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DOI: 10.15386/mpr-2740

Manuscript received: 20.04.2024
Received in revised form: 21.08.2024
Accepted: 16.09.2024

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Abstract

The irrational use of antibiotics is one of the biggest threats to public health, as recently highlighted in the documents from the World Health Organization. It includes both the choice of an inappropriate drug, dose, form, or length of therapy for the patient, and a lack of attention to the global cost of treatment. One of the effects of excessive and irrational use of antibiotics worldwide is the increasing number of antibiotic-resistant microorganisms. The growing number of bacterial illnesses and deaths caused by this type of pathogens is of great significance, making the consequences of incorrect antibiotic use both medical and economic.

In the rationalization of pharmacotherapy, the significant role of medical staff, including pharmacists, who have extensive knowledge in the field of antibiotic therapy, is emphasized. The main goal of the rational management of antimicrobial drugs should be to improve patient treatment outcomes and minimize the medical and economic consequences of antibiotic use. Antibiotic therapy rationalization programs are needed in all healthcare facilities, both in open care and in hospital settings. Educational interventions that target primary care physicians and physicians prescribing antibiotics in hospitals are necessary. Additionally, pharmacists, being the most accessible healthcare workers, can build awareness of rational antibiotic therapy among patients.

Keywords: antibiotics, community pharmacy, pharmacist, hospital pharmacy

Introduction

The irrational use of drugs, including antibiotics, is currently one of the biggest health challenges in the world. The root causes of this problem is highlighted by the World Health Organization (WHO), among others. The rational use of medicines requires that patients receive medicines that meet their clinical needs, in doses that meet their individual needs, for the appropriate duration and at the lowest cost to them and their communities [1,2]. WHO estimates that more than half of all medicines are prescribed, dispensed or sold inappropriately, and half of all patients do not take them correctly. Overuse, underuse or misuse of medicines wastes limited resources and causes widespread health risks. Among some of the greatest threats is the inappropriate use of antimicrobial drugs, often in inappropriate doses, often also in the case of non-bacterial infections, as indicated by WHO [2].

Bacterial infections are one of the leading causes of morbidity and mortality worldwide [3]. In 2019, 33 pathogens were responsible for 7.7 million deaths (13.6% of global deaths). Although antibiotics help restore health, the reality is that they are often overused. The result of excessive and irrational use of antibiotics around the world is, among others, the increasing number of multi-drug resistant microorganisms (MDR).

Antibiotic-resistant bacteria account for a large percentage of morbidity and mortality due to bacterial diseases. The link between antibiotic use and the development and spread of antimicrobial resistance is well documented [4]. This situation, apart from its medical consequences, entails increasingly higher treatment costs that is in turn becoming a challenge for global healthcare systems [5,6].

The described problem is important because antibiotics are one of the most frequently prescribed drugs [7]. Between 2000 and 2018, global antibiotic use increased by 46% [4], with almost 60% of prescriptions containing at least one antibiotic [8]. As a result, antimicrobial resistance (AMR) poses a serious threat to global public health [4].

The response to the challenges related to inappropriate pharmacotherapy, including inappropriate antibiotic therapy, are the interventions recommended by WHO, which include: application of clinical guidelines, creation of drug and therapeutic committees, inclusion of problem-solving pharmacotherapy training in study programs and medical training in this area, use of independent information about drugs, and public education about drugs.

Many WHO documents, as well as other scientific publications, emphasize the significant role of medical staff, including pharmacists, in building awareness of rational antibiotic therapy. The main goal of rational management of antimicrobial drugs should be to improve patient treatment outcomes and minimize the medical and economic consequences of antibiotic use [9,10]. Antibiotic stewardship programs are needed in all healthcare settings, regardless of size or location. It is necessary to take appropriate actions both at the level of stationary healthcare and in open care [11]. Antimicrobial stewardship should not only limit their inappropriate use, but also optimize the selection, dosage, route and duration of therapy in order to maximize the clinical effect while limiting unintended consequences, such as the emergence of resistance, side effects and treatment costs [12].

Taking the aforementioned into account, the aim of this article is to gather knowledge about the role of pharmacists in rationalizing antibiotic therapy. The article will separately discuss the actions of pharmacists that can be undertaken at the level of open healthcare and at the hospital level. Based on the review of literature, we also identified the key challenges that we believe may contribute to the best possible implementation of the solutions.

Given the purpose of the article, which is interdisciplinary in nature, it was decided to use an unsystematic literature review. This approach is widely used in scientific works, and our review was conducted in accordance with the principles adopted for this type of work. The review consisted of several stages:

1. Defining the objectives of the literature review

The aim of this stage was to collect and discuss available studies and publications on the role of pharmacists in rationalizing antibiotic therapy, both at the level of open healthcare and in hospital settings. The emphasis was placed on identifying the actions that pharmacists can take in these two different environments and on indicating the key challenges related to the implementation of effective solutions.

2. Selection of sources and inclusion criteria

The literature review included a variety of sources, such as scientific articles, literature reviews, research reports, clinical guidelines and conference materials. A rigorous process of article selection was not applied, which would allow for the inclusion of a wide range of publications. However, the following inclusion criteria were adopted:

– Publications in English and Polish. Articles published in the last 10-15 years to ensure the validity of the data.

– Studies and publications on pharmacists' activities in the context of antibiotic therapy in various healthcare settings.

– Keywords included: antibiotics; community pharmacy; pharmacist; hospital pharmacy

3. Literature collection and analysis

Literature collection was conducted using search engines and databases such as PubMed, Scopus, Google Scholar and the Cochrane database. Additionally, websites of organizations involved in pharmaceutical care and rational use of antibiotics, such as the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), have been searched.

4. Structuring the literature review

The literature was divided into categories according to the objectives of the article, which are reflected in the subsections of the article.

5. Summary of the literature review

The literature review was concluded with a summary that includes key findings regarding the role of pharmacists in rationalizing antibiotic therapy and the challenges identified.

Out-of-hospital care and the role of pharmacists in community pharmacies

The rationalization of antibiotic therapy is very important at the out-of-hospital pharmacy level. Analyses of antibiotic use indicate that up to three-quarters of antibiotic prescriptions are issued at this level, including a large percent for respiratory tract infections (RTIs) and urinary tract infections (UTI) [13-15]. In addition, research shows that doctors admit that they do not always know whether antibiotics are necessary for a patient's treatment [16]. Overall, in outpatient care, about half of patients are prescribed the wrong antibiotic, 20% the wrong dose, while 20% of patients are indicated the wrong duration of therapy [14]. Analysis of pneumonia patients using

antibiotics, indicated that only 31% of patients received antibiotic therapy in accordance with guidelines. In terms of irregularities, it was indicated that 76.7% of prescriptions included the wrong drug due to the patient's comorbidities, and 39.4% included the wrong duration of therapy, which most often resulted from extending therapy beyond 7 days [17]. Overuse of antibiotics remains common in the treatment of outpatient respiratory tract infections, commonly including patients with laboratory-confirmed influenza [18]. The frequent use at the out-of-hospital level of broad-spectrum antibiotics is also highlighted, most of which are prescribed and dispensed inappropriately [19].

Pharmacists working in community pharmacies are well prepared to manage antibiotics [20,21], as they have both the knowledge of these products and the ability to interact with prescribers and have direct contact with patients who have been prescribed the antibiotic. The role of pharmacists in particular in reducing the use of broad-spectrum antibiotics under antimicrobial stewardship (AMS) initiatives is significant [22]. Such initiatives include reviews of antibiotic prescriptions, but also the optimization of therapy based on scientific evidence, and conducting audits and providing feedback to people prescribing and dispensing drugs.

Education of patients, society and doctors may play a special role in this context [22]. Education has a very large impact on the possibility of changing behavior. When it comes to patients, education can lead to reduction in the expectation of unnecessary antibiotic prescriptions, which is becoming very common, and in the context of doctors, awareness that many infections are viral, so antibiotic therapy becomes inappropriate [23].

A community pharmacy is one of the most common places where patients come into contact with healthcare. As pharmacies are visited by a large number of patients (not only sick people, as in the case of clinics and hospitals), they are places with great potential for large-scale patient education in the field of rational antibiotic therapy as well as providing advice to patients receiving medications. Research shows that patients often require doctors to prescribe antibiotics and if they receive such a prescription, they are more satisfied with their visit [24]. As a result, antibiotics are also prescribed for coughs and colds that do not require this type of therapy. Understanding patients' and the general public's views on antibiotics can be crucial to planning and delivering the appropriate educational intervention.

Research also highlights the significant role of a pharmacist-physician collaboration. For example, a meta-analysis assessing the antibiotic prescribing rate (APR) and the antibiotic prescribing adherence rate (APAR) highlighted the effectiveness of an intervention involving pharmacist-physician collaboration through physician education and feedback on how to act. The effects of this type of intervention are a decrease in APR and an increase in APAR. In turn, physicians' education alone, detailed academic information and workshop training, without the role and feedback from pharmacists, were only effective for APAR results [15]. Pharmaceutical interventions therefore influence physicians in two ways: they effectively reduce the prescription of antibiotics overall, but at the same time increase the prescription of antibiotics in accordance with guidelines.

Hospital care and the role of clinical pharmacists

The implementation of the rationalization of antibiotic therapy is also necessary in-hospital care. Such actions can improve patient outcomes, reduce the spread of bacterial resistance, and optimize the costs of antibiotic therapy. Initiatives undertaken at the hospital level may include reviews of antibiotic prescriptions to improve the accuracy of their prescription and use, audits, feedback to physicians to promote the safe and appropriate use of antibiotics, as well as the development, monitoring of implementation and development/improvement of hospital antibiotic policies [5,22]. The involvement of pharmacists in the implementation of hospital antibiotic policies through audits and providing feedback on applied practices also plays an important role [25]. Scientific research on the methods of rationalizing antibiotic therapy indicates the great importance of interdisciplinary work, which consequently leads to improved quality of patient care and reduced treatment costs [26].

Pharmacists therefore play a key role in taking actions and implementing activities aimed at rationalizing pharmacotherapy in healthcare facilities, including hospitals, long-term care facilities, as well as outpatient and primary healthcare institutions. By regularly reviewing antibiotic therapy regimens, pharmacists have the opportunity to optimize the selection of the composition, dose, form and duration of antibiotic therapy. When correctly completed, medication reviews can greatly help physicians improve their antibiotic prescribing skills. Moreover, pharmacists have the necessary skills to monitor health indicators of a patient taking antibiotic therapy, which is particularly important for patients in a more serious clinical condition who are under 24-hour hospital care. The role of pharmacists in multidisciplinary teams for nosocomial infections management is also significant [5,22].

Monitoring the appropriateness of antibiotic therapy is particularly important in the pediatric population. A prospective interventional study, the aim of which was to analyze the correct use of antibiotics among 180 pediatric patients, indicated that most cases of inappropriate antibiotic use in this group of patients involved the inappropriate drug choice (23.3%). Importantly, the reason for these errors was mainly ignorance [27]. Long-term use of antibiotics causes side effects in critically ill newborns. A systematic review

and meta-analysis that evaluated the role of pharmacists in antibiotic stewardship programs (ASPs) for critically ill neonates and the impact of ASP implementation on antibiotic use concluded that pharmacists play multiple roles in rationalizing pharmacotherapy. Pharmacists are involved in developing guidelines for antibiotic use, monitoring antibiotic prescriptions, taking part in interdisciplinary ward rounds, educating other groups of healthcare staff on proper antibiotic therapy, checking patients' blood cultures or laboratory data, and monitoring antibiotic use. The cited meta-analysis showed that the implementation of antibiotic management programs in critically ill newborns resulted in a 23% reduction in the overall rate of antibiotic use, as well as a 15% reduction in the duration of antibiotic use, which confirms the key role of pharmacists in the rationalization of hospital antibiotic therapy [28].

Information systems supporting the rationalization of pharmacotherapy, streamlining the prescription of antibiotics, supervising the accuracy of antibiotic therapy from the moment of ordering drugs, allowing for quick intervention if necessary, and thus having an impact on patient treatment outcomes are all of great importance. These types of systems, integrated with the hospital information system, are becoming more and more popular at the hospital level of care. In addition to supporting the effects of therapy, they help reduce patients' treatment costs. Research indicated that the most frequently implemented interventions using information systems are alerts, most of which significantly influence the behavior or therapeutic decisions of medical staff [29].

It should be emphasized here that regardless of the size of the hospital, the support of the hospital management, both at the lower and the highest level, is of key importance for the development and durability of the hospital antibiotic policy and activities in the field of rationalization of antibiotic therapy. It is important for managers to understand the need to rationalize antibiotic therapy and introduce actions aimed at improving patient treatment outcomes and reducing antibiotic resistance. Management is usually the initiator of hospital antibiotic policies. If initiatives of this type come from the bottom up, it is necessary to regularly inform the management about the plans and actions taken, as well as the goals that will be achieved after the implementation of these types of initiatives. Understanding the actions taken and mutual support are of great importance. Antibiotic policies are usually implemented by a hospital infection team headed by an appropriately trained doctor or pharmacist. The most frequently implemented initiatives are a prospective audit with intervention and feedback and restrictions on prescribing antibiotics (e.g. issuing a prescription only with the consent of the head/clinical manager), the pillars of rational hospital antibiotic therapy regardless of the size or location of the hospital. Implemented actions should be monitored using specific indicators to measure their real impact (effectiveness). Key indicators include analysis of antibiotic use (per ward, per patient, by clinical status, etc.) as well as patient clinical outcomes [11].

Challenges and directions of change

Rational antibiotic therapy includes many activities at the level of primary, specialized and hospital healthcare, focusing on different groups of recipients. Often, a number of multi-faceted approaches need to be developed, tested and evaluated [22]. The most important activities include: prevention and control of bacterial infections, especially those caused by drug-resistant bacteria; rational prescription and use of antibiotics; education and training of medical professionals and the general public; careful monitoring of the results of patients undergoing antibiotic therapy; strengthening interdisciplinary cooperation, especially doctor-patient cooperation; dissemination of research and good practices aimed at rationalizing antibiotic therapy.

Antibiotic stewardship programs aim to promote evidence-based medicine (EBM) prescribing and typically include several of the initiatives outlined above, which include education, implementation of antibiotic prescribing and guidelines use, prescription auditing, feedback to medicines prescribers [30]. Such a wide range of action requires not only coordination, but also the involvement of various staff groups, with particular emphasis on pharmacists [22]. The effectiveness of antibiotic management programs both in primary and secondary care, as well as at the level of hospitals and long-term care facilities, may be influenced by various factors, such as the method of management (including the introduction, implementation and monitoring of the effects of programs), appropriate financial support and patterns of individual antibiotic use practices.

One of the most important areas influencing the rationalization of antibiotic therapy, regardless of the level of healthcare, is the cooperation of doctors with pharmacists. The importance of this cooperation is emphasized by the World Health Organization. Research on a physician-pharmacist collaboration conducted in 44 countries indicates that while the role and responsibilities of pharmacists may vary between countries, pharmacists are best placed to help combat antibiotic resistance because of their position (professional interface between the doctor and patient), and accessibility for patients. At the same time, it was indicated that the role of the physician in the use of antibiotics could be strengthened, in cooperation with pharmacists [31].

The studies cited in this article also clearly indicate that education is the basis of any antibiotic stewardship program. To ensure the maximum effect of the undertaken activities, this education should start at an early stage of education, regardless of the type of studies (medicine, pharmacy, and more broadly - nursing, public health, etc.) [12,20,21].

Research conducted among pharmacy students showed that they have average knowledge of antibiotic resistance, appropriate antibiotic therapy and antibiotic management. In turn, awareness of the consequences of antibiotic resistance and cases in which an antibiotic was unnecessary was low in this group. Importantly, significant differences in students' knowledge are observed between schools. Knowledge about antibiotic resistance was greater among male respondents and people who participated in antibiotic therapy courses [32].

Research shows that pharmacists are aware of their role in educating the public and medical staff about the proper use of antibiotics. Almost 90% of pharmacists indicate that if they had the opportunity to conduct this type of education, they would take part in it. The biggest challenges in this regard included lack of time, staff, own training, lack of appropriate technological support, but also lack of willingness on the part of prescribers and patients, lack of organized activities, financial incentives or legal requirements supporting such activities [33].

A systematic review on the effectiveness of pharmaceutical interventions in the field of antibiotic therapy indicates that the expertise of pharmacists can be used in the education of physicians on the rationalization of antibiotic therapy, which may include workshops, meetings of consensus groups, and the preparation of educational materials. It has been proven that the education of doctors by a trained pharmacist in the field of antibiotic therapy, but also the pharmacokinetics and pharmacodynamics of antibiotics, together with analysis of patient case studies and data on resistance as well as antibiotic recommendations based on scientific evidence, can have a significant impact on doctors' prescription of antibiotics [15].

Conversely, research on the knowledge of proper antibiotic therapy conducted among medical students and practicing doctors indicates that students (doctors during their studies) were more hesitant in deciding to start antibiotic therapy. After graduation, antibiotics were prescribed with greater certainty. Additionally, doctors quickly forget theoretical knowledge regarding proper antibiotic therapy and are unable to keep up with current guidelines due to the large amount of work, which may be one of the main reasons for errors made in this area. The most important concern of students when prescribing antibiotics was the selection of products from the wrong group, while for doctors it was the fear of the presence of a hidden infection. The group of doctors quickly forgot their theoretical knowledge, being prone to making mistakes [10]. Such results indicate the need to conduct postgraduate education programs, which may be of key importance in reducing the excessive use of antibiotics. The situation may also be improved by clear guidelines created at the level of open healthcare and hospitals, based on scientific research, which should be followed by doctors [5].

Importantly, the study by Salsgiver et al., conducted among doctors working in hospitals and prescribing antibiotics, indicates that the doctors themselves emphasize that a lack of education is one of the main issues that hinder the appropriate selection of antibiotics. Doctors prescribing antibiotics indicated the need for more education regarding antibiotic therapy, mainly including the revision of prescriptions and feedback on the accuracy of their decisions. It is also important to examine the needs of doctors in specific environments in order to best adapt educational methods [34].

Similar results are indicated by an Australian study where physicians indicated the following reasons for inappropriate antibiotic therapy: inappropriate level of knowledge about prescribing antibiotics, lack of knowledge about which antibiotics are subject to restrictions, and following the advice of other physicians regarding the prescription of antibiotics. The needs reported by physicians in this study included assistance in properly prescribing antibiotics, education regarding antibiotic protocols, including the use of specific clinical guidelines [35].

Importantly, research also indicates the importance of multi-aspect, different methods of education on antibiotic therapy, conducted simultaneously, and therefore as part of entire antibiotic management programs. The literature indicates that interventions in the field of rationalization of antibiotic therapy are most often addressed to doctors who prescribe this group of drugs, and their recipients are less often pharmacists, nurses or members of the management team. Educational methods include seminars, webinars, but also unique methods such as social media platforms, educational video games or education based on case studies. Educational interventions often occur in conjunction with prospective audit and feedback. Many studies show positive results from this approach. Education addressed to patients or the general public aims to increase patients' awareness of appropriate antibiotic therapy and the use of these products only in justified cases, which is particularly important considering patients' expectations towards doctors regarding the prescription of antibiotics [10]. Patient education most often includes educational leaflets and focuses on information about the proper treatment of upper respiratory tract infections [36].

When emphasizing the direction of change aimed at promoting steps to rationalize antibiotic therapy, it is impossible to forget information systems that support doctors' decisions, along with educational modules that are part of general information systems (at the level of open or hospital care). Users of such systems especially appreciate suggestions regarding the selection of a specific drug for the patient and indications, alerts regarding incorrectly prescribed antibiotic therapy, suggestions regarding antibiotics taking into account the patient's characteristics (including adjusting the dose to weight), alerts checking interactions, alerts regarding too long a course of treatment [37].

Conclusions

Irrational use of antibiotics is a common problem at various levels of healthcare, leading to, among others: unnecessary spending on medicines, increased risk of side effects and the development of microbial resistance. The use of antimicrobial drugs is closely related to the knowledge and attitudes of people prescribing the drugs, therefore educational activities carried out both during studies and during practice will play an important role in the rationalization of antibiotic therapy. In this context, cooperation between doctors and pharmacists who have extensive knowledge about medicines is of key importance. Pharmacists can create antibiotic stewardship programs not only in hospitals, but also in medical facilities at the open care level. As the most easily available medical workers, pharmacists can also educate patients.

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