

The Problem of Pediatric Antibiotic Overuse and Strategies for Rational Medication Use

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Abstract: Antibiotic overuse in pediatric healthcare is becoming increasingly severe, posing significant challenges to children's health and public health as a whole. This paper analyzes the characteristics of pediatric antibiotic overuse, including its high frequency, diversity, arbitrariness, and blind usage, highlighting the gaps in diagnostic and treatment processes as well as insufficient enforcement of management policies. To address these issues, the paper proposes countermeasures such as strengthening the formulation and implementation of diagnostic and treatment guidelines, enhancing the knowledge levels of healthcare professionals and the public, and advancing refined management of antibiotic use. Improving the management and supervision of antibiotic use can effectively mitigate the problem of pediatric antibiotic overuse, promoting healthy growth in children.

Keywords: Pediatrics; Antibiotics; Rational Medication Use; Antibiotic Resistance

1. Introduction

The widespread use of antibiotics has played a vital role in clinical medicine, particularly in the pediatric field, where antibiotics are crucial for treating infectious diseases. However, with the increasing frequency of antibiotic use, the problem of overuse has gradually emerged. In pediatric healthcare, due to the unique characteristics of children's physiology, antibiotic overuse not only undermines therapeutic effectiveness but also may lead to a series of public health crises, such as antibiotic resistance. Although there are existing regulations and guidelines on antibiotic usage, overuse remains prevalent in practice, and management and supervision measures are inadequate. This paper aims to explore the main characteristics of pediatric antibiotic overuse, analyze the key issues involved, and

propose corresponding optimization strategies, providing a scientific basis and reference for reducing the phenomenon of pediatric antibiotic overuse [1].

2. Characteristics of Pediatric Antibiotic Overuse

2.1 High Frequency and Diversity of Antibiotic Use

The frequency of antibiotic use in pediatric healthcare is notably high. This is primarily because children are particularly susceptible to various infections during their growth, such as respiratory infections, gastrointestinal infections, and ear infections, which often require effective treatment with antibiotics. In infancy, where the immune system has not yet fully matured, children are more vulnerable to bacterial and viral invasions, making antibiotics a common choice for physicians in treating these infections. According to relevant statistics, antibiotics account for over 40% of prescriptions in pediatric outpatient clinics [2]. In addition to frequent use, the variety of antibiotics is also highly diverse. The types of antibiotics required for pediatric patients usually include broad-spectrum antibiotics, narrow-spectrum antibiotics, aminoglycosides, and cephalosporins, among others. Each type of antibiotic has a specific scope of action, allowing clinicians to choose the appropriate medication based on the source of infection, the type of pathogen, and the drug's sensitivity. Despite the wide range of available antibiotics, the lack of bacterial culture and sensitivity testing often leads clinicians to select antibiotics based on empirical knowledge rather than precise detection. The frequent and wide-ranging use of antibiotics increases the risk of overuse to a certain extent [3].

2.2 Arbitrariness and Blindness in Medication Selection

Arbitrariness and blind use are common

phenomena in pediatric antibiotic administration. Many parents, eager for their child's quick recovery, often request or purchase antibiotics without professional diagnosis or testing. On the other hand, some doctors in primary healthcare institutions, lacking adequate diagnostic tools and precise treatment guidelines, rely on experience and common approaches to treating frequent illnesses. In many cases, antibiotics are prescribed without a confirmed diagnosis or sensitivity test.

As a result, many children receive antibiotic treatment for conditions such as colds and fevers, even in the absence of clear bacterial infections, leading to antibiotic use far exceeding clinical needs. Broad-spectrum antibiotics, which can target a wide range of pathogens, are often prescribed when the infection type is unclear. This indiscriminate approach to prescribing antibiotics frequently results in medication waste and increases the risk of resistant bacteria emerging. Blind use of antibiotics may fail to effectively control diseases and can even lead to secondary infections or the proliferation of resistant bacteria, posing greater health risks to children. The lack of rational assessments of antibiotic usage contributes to the proliferation of overuse [4].

2.3 Specificity and Individual Differences in Pediatric Medication

The physiological characteristics of children necessitate more cautious and individualized medication regimens. Compared to adults, children exhibit significant differences in drug metabolism, absorption, distribution, and excretion. These differences mean that the effects of medications in children may vary greatly from those in adults. For example, children's gastrointestinal acidity differs from that of adults, and their liver and kidney functions are not yet fully developed, affecting the absorption rate and clearance capacity of drugs. The dosage and type of medication for children must be adjusted based on factors such as age, weight, and liver and kidney function.

Drug responses also vary across different pediatric age groups. In newborns and infants, underdeveloped organs lead to longer drug half-lives, increasing the risk of drug accumulation and side effects. School-age

children and adolescents metabolize drugs more similarly to adults, but their medication needs still differ from those of adults. However, many antibiotics currently lack pharmacological studies specifically tailored to children, leading to adult medication regimens being directly applied to pediatric patients. This practice can result in adverse effects or suboptimal outcomes.

Additionally, individual differences among children, including variations in age, weight, genetic background, and pre-existing conditions, can influence drug efficacy. Although clinicians adjust treatment plans based on these differences, the lack of pediatric-specific medications and corresponding research data still poses risks of improper drug use. The unique characteristics of pediatric medication demand greater attention to detail and caution from healthcare providers when selecting treatments.

3. Problems in Pediatric Antibiotic Overuse

3.1 Widespread Phenomenon of Overuse

Antibiotic overuse is particularly evident in pediatric clinical care and home medication. Parents, overly concerned about their children's health, often administer antibiotics to their children without a doctor's guidance, especially during viral diseases like colds and coughs, mistakenly believing that antibiotics can shorten the illness duration or prevent complications. In primary healthcare institutions, doctors also tend to over-rely on antibiotics, often prescribing them prematurely without confirming the nature of the pathogen. This phenomenon leads to the incorrect application of antibiotics in viral diseases, where they are ineffective. Not only do antibiotics fail to control the illness, but they may also delay proper treatment.

The widespread overuse has contributed to the growing problem of antibiotic resistance. The World Health Organization (WHO) has identified antibiotic resistance as a major global public health challenge. The increase in resistant strains reduces the effectiveness of antibiotics, raising healthcare costs and complicating treatment. For children, the side effects of antibiotic overuse include gut microbiota imbalance, decreased immune function, and long-term health risks, which may cause irreversible harm to their physical

development. The overuse also reflects specific issues in the pediatric drug market. Due to the insufficient development of pediatric antibiotic formulations and varieties, many medications are forced to use adult formulations, with dosages adjusted for children. This practice often leads to inaccurate dosages and suboptimal therapeutic outcomes. Antibiotic overuse is not only a problem of improper medical practice but also a result of the medical supply side failing to adequately meet pediatric needs.

3.2 Gaps in the Diagnostic and Treatment Process

The gaps in the diagnostic and treatment processes severely hinder the implementation of rational medication use. Many medical institutions lack routine bacterial culture and sensitivity testing, relying more on doctors' experience than scientific evidence for diagnosing infectious diseases. Especially in primary healthcare institutions, due to inadequate equipment and technical conditions, doctors often choose broad-spectrum antibiotics for empirical treatment, overlooking the need for precise diagnosis.

The regulatory and evaluation mechanisms for antibiotic use during the diagnostic process are still underdeveloped. While antibiotic usage guidelines exist in clinical practice, their implementation is inconsistent. Some doctors have not received adequate medication training and are unaware of new antibiotics and their indications. They often rely on traditional practices and overlook the need for individualized treatment. The strained doctor-patient relationship also leads doctors to favor "accommodating prescribing" to avoid disputes due to delayed treatment outcomes.

The gaps in the diagnostic process also manifest in patients' non-compliance. Many parents have misconceptions about antibiotics, such as stopping treatment prematurely, adjusting dosages, or frequently changing doctors. These improper treatment behaviors not only reduce the effectiveness of antibiotics but also exacerbate the issue of resistance. Optimizing the diagnostic and treatment process and improving standardization are crucial steps in addressing antibiotic overuse.

3.3 Insufficient Management and Policy Enforcement

There is a clear lack of effective management and policy enforcement regarding antibiotic use. At the institutional level, there is no detailed management mechanism for antibiotic use. Although health departments have established a graded management system for antibiotics, the review process for prescriptions is often superficial in practice. Especially in pediatric emergency care, the phenomenon of antibiotic overuse remains frequent. Meanwhile, weak regulation of the pharmaceutical retail market allows parents to easily obtain antibiotics through over-the-counter channels, further exacerbating the overuse issue.

The lack of policy enforcement also reflects the weak public education efforts. Many parents have limited understanding of the role and side effects of antibiotics and even view them as a "universal remedy" for all infections, lacking awareness of their potential risks and the issue of resistance. Policies have failed to promote the development of antibiotics specifically for pediatric use, resulting in a longstanding reliance on "adult drugs for children" in pediatric clinical practice.

International experience shows that effective antibiotic management requires a comprehensive use of legal, administrative, and market tools. In contrast, China still needs to improve its relevant laws and regulations, particularly in controlling antibiotic sales channels, ensuring medication transparency, and penalizing violations. Strengthening policy enforcement and improving regulatory mechanisms can effectively enhance the management of antibiotics, providing stronger protection for children's health.

4. Optimizing Strategies to Address Pediatric Antibiotic Overuse

4.1 Strengthening the Formulation and Implementation of Diagnostic and Treatment Guidelines

To effectively curb antibiotic overuse, priority should be given to improving diagnostic and treatment guidelines, particularly those tailored to pediatric patients. Current clinical antibiotic guidelines are primarily focused on adults and are less applicable to children. Health authorities and professional societies should collaboratively develop antibiotic usage standards for children of different age groups,

clearly defining diagnostic criteria for bacterial and viral infections. These guidelines should be regularly updated based on the latest domestic and international research findings.

The implementation of diagnostic and treatment guidelines depends on enforcement at healthcare institutions. Hospitals at all levels should strengthen internal oversight of antibiotic usage by establishing evaluation teams to regularly review prescriptions and usage. Bacterial culture and sensitivity testing should be incorporated into the standard diagnostic procedures for infectious diseases to scientifically guide antibiotic selection and reduce improper use at its root.

Promoting diagnostic and treatment guidelines also requires comprehensive coverage in primary healthcare. Improving equipment and training systems for primary healthcare providers can enhance their diagnostic capabilities, reducing antibiotic overuse caused by insufficient diagnosis. Utilizing information technology to establish a nationwide antibiotic usage database can enable real-time monitoring and evaluation of usage trends, providing data support for policymaking and clinical practice.

4.2 Enhancing Knowledge Levels of Medical Professionals and the Public

Optimizing antibiotic use requires joint efforts from healthcare professionals and the public. For medical professionals, continuous professional training is essential to enhance their understanding of rational antibiotic use and practical skills. Hospitals can organize regular workshops, case analysis meetings, or training sessions to help doctors understand the latest guidelines on antibiotic use and strategies for combating antibiotic resistance. Simulated case discussions can further strengthen their ability to diagnose and prescribe antibiotics for complex infections. Governments and healthcare institutions should establish continuous education systems, integrating antibiotic usage guidelines into physician evaluation criteria to encourage ongoing knowledge updates. Hospitals can also promote experience-sharing among doctors, such as regional case-sharing sessions on antibiotic use, to disseminate successful treatment plans and improve overall antibiotic management.

Enhancing public awareness of antibiotics is

equally critical. Parents often harbor misconceptions about antibiotic use in children, such as viewing antibiotics as a "cure-all" and misusing them for viral infections like colds and fevers. Therefore, educational initiatives targeting parents should cover the basic functions, indications, and resistance risks of antibiotics, guiding them toward rational medication practices by dispelling misunderstandings. Schools, communities, and media platforms can collaborate to launch diverse outreach programs, such as creating educational animations, short videos, or hosting health lectures to illustrate the potential harms of antibiotic overuse. These efforts can help parents understand proper antibiotic use. Community healthcare services can also serve as a bridge, organizing interactive training sessions for parents and fostering a scientific outlook on medication, reducing the arbitrariness and misuse in home treatment practices.

Strengthening doctor-patient communication is another crucial aspect of promoting rational antibiotic use. When prescribing antibiotics, doctors should clearly explain their intended use, necessity, duration, and potential side effects to parents. Addressing their concerns with patience helps parents better understand the principles of rational antibiotic use, improving compliance and cooperation. Doctors should also actively listen to parents' worries, enhancing mutual trust to gain greater support for the proposed treatment plans. Active parental involvement is vital for achieving standardized antibiotic use in children. Through positive interaction and collaboration between doctors and parents, both the effectiveness of pediatric treatments and the management of antibiotic use can be significantly improved.

4.3 Advancing the Fine-Grained Management of Antibiotic Use

Fine-grained management is essential for the rational use of antibiotics and is a key step in addressing the issue of antibiotic overuse. Medical institutions should establish comprehensive antibiotic usage tracking systems to record every antibiotic prescription in real time, ensuring that medication complies with diagnostic and treatment standards. This process can be implemented through the adoption of electronic medical record systems

and artificial intelligence technologies. By utilizing big data analytics and machine learning, the system can automatically review prescriptions for rationality and issue alerts, thereby helping doctors optimize medication plans and reducing the blind reliance on empirical treatments. Additionally, medical institutions can appoint antibiotic management specialists or establish management teams to conduct regular reviews of antibiotic usage, analyze the causes of inappropriate prescriptions, and propose targeted improvement measures.

At the policy level, governments should strengthen the regulation of antibiotic sales channels, strictly limiting access to over-the-counter antibiotics and preventing parents from purchasing antibiotics without professional guidance. Furthermore, harsher penalties should be imposed on illegal sales of antibiotics to address the problem at its root. To further promote rational antibiotic use, governments can encourage pharmaceutical companies to develop child-specific antibiotic formulations, addressing the limitations of "adult drugs adapted for children" in the current market. Financial incentives and policy support can also be provided to foster innovation in antibiotic treatments by medical institutions and pharmaceutical companies, enhancing the specificity and effectiveness of drug development.

Fine-grained management must also emphasize real-time monitoring and in-depth research on the development of antibiotic resistance trends. Establishing a nationwide antibiotic resistance surveillance network can provide dynamic insights into the distribution of resistant strains across different regions and offer scientific evidence for the formulation and adjustment of antibiotic usage strategies. Additionally, research institutions and pharmaceutical companies should be actively encouraged to increase investment in the development of alternative therapies to antibiotics, such as new vaccines, probiotic formulations, or other anti-infective treatments. By integrating strengthened management with scientific research, a more solid foundation can be laid for the long-term development of antibiotic management, contributing to the goals of rational medication use and the healthy growth of children.

5. Conclusion

The issue of pediatric antibiotic overuse is one of the increasingly severe public health challenges worldwide. Its widespread and arbitrary usage not only heightens the risk of antibiotic resistance but also poses significant threats to children's immediate and long-term health. Antibiotic overuse often results in the emergence of resistant bacterial strains, rendering common treatments ineffective and increasing the burden on healthcare systems. For children, the improper use of antibiotics can lead to disruptions in gut microbiota, weakened immune responses, and a higher likelihood of developing chronic health conditions later in life. This problem is exacerbated by limited access to diagnostic tools, the overprescription of broad-spectrum antibiotics, and misconceptions among parents regarding the role of antibiotics in treating viral infections. Addressing these issues requires urgent and coordinated action to promote safer and more effective antibiotic use.

By analyzing the characteristics and underlying causes of pediatric antibiotic overuse, this paper proposes a series of optimization strategies. These include strengthening the formulation and implementation of age-specific diagnostic and treatment guidelines, improving healthcare professionals' understanding of rational antibiotic use through regular training, and fostering public awareness of the risks associated with antibiotic misuse. Fine-grained management, supported by modern technologies like electronic medical records and artificial intelligence, can also play a critical role in tracking prescriptions and ensuring adherence to best practices. Rational antibiotic use relies not only on robust policies and the professional judgment of doctors but also on the informed cooperation of parents and the broader public. Through joint efforts across healthcare systems, communities, and policymakers, it is possible to effectively reduce antibiotic overuse, protect children's health, and safeguard the effectiveness of antibiotics for future generations.

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