Scholars Academic Journal of Pharmacy
Abbreviated Key Title: Sch Acad J Pharm
ISSN 2347-9531 (Print) | ISSN 2320-4206 (Online)
Journal homepage: http://saspublishers.com

OPEN ACCESS

Pharmacology

Antibiotic Resistance in Acne Treatment: Emerging Challenges and Implications for Dermatology Practice in Developing Countries like Bangladesh

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DOI: https://doi.org/10.36347/sajp.2024.v13i09.001 | **Received:** 21.09.2024 | **Accepted:** 26.10.2024 | **Published:** 05.11.2024

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Abstract **Original Research Article**

Background: Antibiotic resistance in acne treatment is an escalating global issue, particularly in developing countries like Bangladesh, where misuse of antibiotics is prevalent. ***Objective:*** To assess the prevalence of antibiotic-resistant *Cutibacterium acnes* and its implications for acne treatment efficacy at Aurora Skin and Aesthetics in Dhaka, Bangladesh. ***Methods:*** A cross-sectional study was conducted from September 2021 to March 2022 at Aurora Skin and Aesthetics, Dhaka. A total of 100 acne patients were selected, and antibiotic sensitivity tests were performed on *C. acnes* strains isolated from lesion swabs. The data was analyzed to determine the resistance to commonly prescribed antibiotics like tetracyclines, erythromycin, and clindamycin. ***Results:*** Out of 100 patients, 45% were male and 55% were female. Among the isolated *C. acnes* strains, 60% showed resistance to erythromycin, 40% to clindamycin, and 35% to tetracyclines. A significant percentage (25%) of patients resisted more than one antibiotic. Patients with antibiotic-resistant acne exhibited a 30% longer treatment duration compared to non-resistant cases, with only 50% achieving satisfactory Improvement after 12 weeks of standard antibiotic therapy. ***Conclusions:*** The study highlights the growing problem of antibiotic resistance in acne treatment in Bangladesh, emphasizing the need for stricter antibiotic use guidelines and alternative therapies to improve treatment outcomes.

Keywords: Antibiotic resistance, *Cutibacterium acnes*, acne, Bangladesh, dermatology practice.

INTRODUCTION

Acne vulgaris is one of the most prevalent dermatological conditions, affecting millions globally, particularly adolescents and young adults [1]. It significantly impacts not only physical appearance but also mental well-being, leading to issues such as low self-esteem, social anxiety, and even depression. The multifactorial nature of acne has prompted the widespread use of systemic and topical antibiotics as a primary treatment. However, in recent years, the issue of antibiotic resistance has emerged as a formidable challenge in dermatology, with growing concerns about its implications for treatment efficacy, especially in developing countries like Bangladesh. The rising prevalence of antibiotic-resistant *Propionibacterium acnes* (now classified as *Cutibacterium acnes*) has led to a paradigm shift in managing acne, necessitating a more cautious and reasonable approach to antibiotic prescription.

Antibiotics have been the cornerstone of acne treatment for decades, targeting *C. acnes*, the bacterium implicated in the pathogenesis of acne. They effectively reduce bacterial colonization, inflammation, and subsequent lesion formation [2]. However, long-term and widespread antibiotic use, often indiscriminately prescribed or overused, has contributed to the alarming rise of antibiotic-resistant strains of *C. acnes*. Globally, the issue of antibiotic resistance has transcended the boundaries of infectious disease management, now impacting areas like dermatology, where the use of antibiotics is often prolonged. In many developed nations, where antibiotic stewardship programs are stringently enforced, strategies such as limiting the duration of antibiotic treatment and combining antibiotics with other therapeutic agents like benzoyl peroxide (BPO) or retinoids have been implemented to curb resistance. Despite these efforts, resistance remains a significant concern. Studies have shown that up to 50% of patients with acne harbor antibiotic-resistant strains of *C. acnes* [3]. This growing resistance complicates treatment strategies, as previously effective antibiotics,

such as tetracyclines and erythromycin, are becoming less reliable.

In developing countries like Bangladesh, the problem of antibiotic resistance in acne treatment is particularly acute. Several factors contribute to this growing concern. First, there is a lack of stringent regulations on the sale and use of antibiotics, often available over the counter without a prescription. This unregulated access to antibiotics has led to rampant misuse, with patients often using these drugs without appropriate medical guidance [4]. In addition, the absence of comprehensive antibiotic stewardship programs exacerbates the issue, allowing for the continued proliferation of resistant bacterial strains. Moreover, in Bangladesh, dermatological care is often limited to urban areas, and access to dermatologists is restricted in rural and underserved regions. Consequently, many individuals resort to self-medication, relying on antibiotics as a quick fix for their acne problems. This self-medication often involves incomplete treatment courses or antibiotics without proper indication, which are significant drivers of resistance [5]. The socioeconomic context in Bangladesh further complicates the issue. With limited resources, healthcare providers in rural areas may prioritize immediate symptomatic relief over long-term antibiotic stewardship, inadvertently contributing to the resistance crisis. Additionally, public awareness about the risks of antibiotic resistance is low, and the healthcare infrastructure lacks the resources to monitor and regulate antibiotic use in dermatological practice effectively.

Antibiotic resistance in acne treatment is primarily driven by genetic mutations in *C. acnes* that confer resistance to commonly used antibiotics like tetracyclines, clindamycin, and erythromycin. These mutations alter the target sites of the antibiotics or enhance efflux pump mechanisms, reducing the drug's effectiveness [16]. The resistance mechanisms are often propagated through horizontal gene transfer, further accelerating the spread of resistant strains within the population. The implications of this growing resistance are profound. As *C. acnes* becomes increasingly resistant to first-line antibiotics, dermatologists are forced to explore alternative treatment options, which may not be as effective or carry higher risks of side effects. For instance, isotretinoin, a powerful oral retinoid, is often considered in cases of antibiotic-resistant acne. However, isotretinoin is associated with significant adverse effects, including teratogenicity, making it unsuitable for certain patient populations, particularly women of childbearing age [7]. Furthermore, the rise of antibiotic resistance complicates the management of severe and cystic acne, which traditionally responds well to oral antibiotics. In Bangladesh, where access to advanced dermatological therapies like laser treatments or biologics is limited, the diminishing efficacy of antibiotics represents a critical public health challenge.

To combat antibiotic resistance in acne treatment, a multifaceted approach is required. In Bangladesh, this must involve stricter regulations on antibiotic use and increased education for both healthcare providers and the general public. Dermatologists must adopt a more selective approach to prescribing antibiotics, reserving their use for severe cases of acne and limiting treatment duration to the shortest possible time [8]. The use of combination therapies, particularly the pairing of topical antibiotics with benzoyl peroxide, has been shown to reduce the development of resistance and improve treatment outcomes. Benzoyl peroxide, an antibacterial agent that does not induce resistance, can effectively reduce bacterial colonization when combined with antibiotics, thereby minimizing the risk of resistance [9]. Additionally, non-antibiotic therapies, such as retinoids, hormonal treatments, and chemical peels, should be emphasized in treating mild to moderate acne. These therapies can effectively reduce the reliance on antibiotics and provide sustainable long-term management of acne.

In Bangladesh, public health initiatives must focus on increasing awareness about the dangers of antibiotic misuse and the importance of adhering to prescribed treatment regimens. Educational campaigns targeting patients and healthcare providers could significantly reduce the misuse of antibiotics and promote alternative acne therapies [10]. Government intervention is critical in addressing the issue of antibiotic resistance in acne treatment. In Bangladesh, policy reform is urgently needed to regulate the sale and use of antibiotics. Over-the-counter antibiotic access should be restricted, and stricter penalties should be enforced for unauthorized sales. Additionally, establishing national antibiotic stewardship programs could help monitor and control antibiotic use in dermatology and other areas of medicine [11]. Collaboration with international health organizations, such as the World Health Organization (WHO), could further strengthen these efforts, providing Bangladesh with the resources and expertise necessary to combat antibiotic resistance nationally. Furthermore, research into alternative therapies for acne, such as probiotics or blue light therapy, should be encouraged to reduce the reliance on traditional antibiotics.

Antibiotic resistance in acne treatment is an emerging challenge that poses significant implications for dermatological practice, particularly in developing countries like Bangladesh. The widespread misuse of antibiotics, combined with a lack of regulatory oversight and public awareness, has contributed to the rise of resistant *C. acnes* strains, complicating treatment strategies. Addressing this issue requires a concerted effort from healthcare providers, policymakers, and the public to promote sustainable treatment approaches, including the use of combination therapies, non-antibiotic treatments, and stricter regulations on

antibiotic use. The rising tide of antibiotic resistance in acne treatment can be effectively curbed only through such comprehensive measures.

Aims and Objective

This study aims to evaluate the prevalence of antibiotic-resistant *Cutibacterium acnes* in acne patients and its impact on treatment efficacy. The objective is to analyze resistance patterns to commonly used antibiotics and to assess the need for alternative treatment strategies in dermatology practice in Bangladesh.

MATERIALS AND METHODS

Study Location and Duration

The study was conducted at Aurora Skin and Aesthetics, West Panthapath, Dhaka-1205, Bangladesh. The duration of the study was from September 2021 to March 2022.

Study Design

This cross-sectional study evaluated the prevalence of antibiotic-resistant *Cutibacterium acnes* in patients with moderate to severe acne.

Study Population and Sample Size

The study included 100 male and female patients aged between 16 and 35 years, who sought acne treatment at the clinic during the specified period. All patients presented with moderate to severe acne, diagnosed based on clinical examination. The sample size of 100 was selected to ensure an adequate representation of antibiotic resistance patterns within this population.

Inclusion Criteria

Patients eligible for the study were those aged 16 to 35, presenting with moderate to severe acne, and who had not received antibiotic treatment for acne in the three months preceding the study. Active acne lesions suitable for swab collection were required, and informed consent was obtained from all participants before inclusion.

Exclusion Criteria

Exclusion criteria included patients who had taken any form of antibiotic for acne treatment within the last three months. Individuals with known allergies to erythromycin, clindamycin, or tetracyclines were excluded, as well as pregnant or lactating women and those with underlying dermatological conditions other than acne.

Sample Collection and Laboratory Procedures

Swabs were collected from active acne lesions using sterile cotton swabs. Samples were transported to the microbiology laboratory under anaerobic conditions for processing. *Cutibacterium acnes* strains were isolated through anaerobic culture techniques. The antibiotic sensitivity of the isolated strains was tested using the Kirby-Bauer disk diffusion method. The antibiotics tested included erythromycin, clindamycin, and tetracyclines, commonly prescribed for acne treatment in Bangladesh.

Data Collection and Analysis

Patient demographics, acne severity, history of antibiotic use, and clinical outcomes were recorded. Descriptive statistics, such as frequency and percentages, were used to describe the prevalence of antibiotic-resistant *C. acnes*. The resistance patterns were compared between male and female patients and across different age groups. Comparative analyses evaluated treatment outcomes between patients with resistant and non-resistant *C. acnes* strains.

Ethical Considerations

This study was conducted under the principles of the Declaration of Helsinki. Ethical approval was obtained from the institutional review board of Aurora Skin and Aesthetics, Dhaka. Informed consent was obtained from all participants before sample collection. Confidentiality of patient data was strictly maintained throughout the study. Participants were informed about the study's purpose, and their right to withdraw without affecting their treatment was upheld.

RESULTS

This section presents the findings from the study, focusing on the demographic characteristics of the participants, the prevalence and distribution of antibiotic-resistant *Cutibacterium acnes* strains, the impact of resistance on treatment outcomes, and the side effects reported by patients based on antibiotic use.

Table 1: Demographic Characteristics of Participants

Variable	Number of Patients (n=100)	Percentage (%)
Age Group (years)		
16-20	30	30%
21-25	40	40%
26-30	20	20%
31-35	10	10%
Gender		
Male	45	45%
Female	55	55%
Duration of Acne (years)		
< 1 year	20	20%
1-3 years	50	50%
> 3 years	30	30%

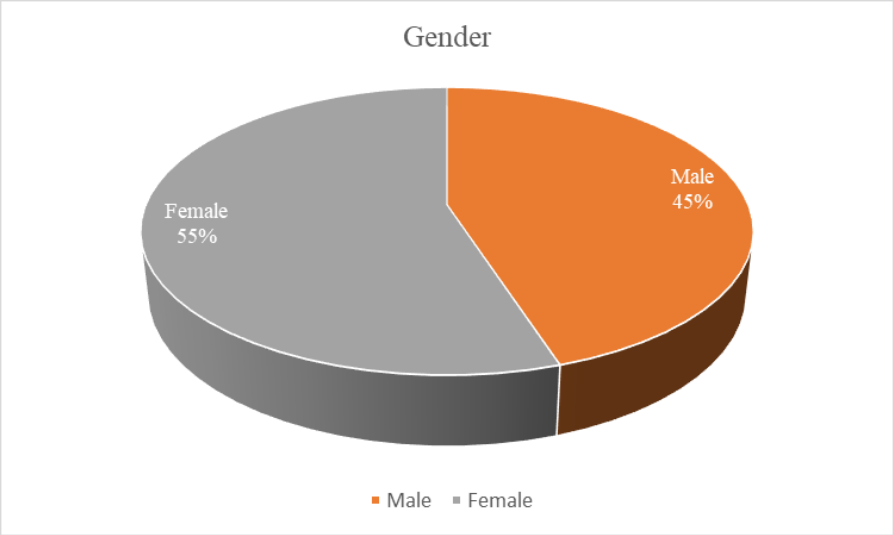

Figure: 1 Distribution of patients according to Sex

In this study, 100 participants were enrolled, with a higher proportion of female patients (55%) than male patients (45%). The largest age group was 21-25 years, accounting for 40% of the total sample, followed by the 16-20 age group (30%). Half of the participants (50%) had been dealing with acne for 1-3 years, while 30% had acne for more than 3 years, and 20% had experienced it for less than a year.

Table 2: Prevalence of Antibiotic Resistance in *C. acnes* Strains

Antibiotic	**Number of Resistant Patients**	**Percentage (%)**
Erythromycin	60	60%
Clindamycin	40	40%
Tetracycline	35	35%
Multiple resistance (≥2 antibiotics)	25	25%

The study found a significant prevalence of antibiotic resistance among the patients. Resistance to erythromycin was the highest, with 60% of *C. acnes* strains showing resistance to this antibiotic. Clindamycin resistance was observed in 40% of patients, while 35% exhibited resistance to tetracyclines. Notably, 25% of the participants had *C. acnes* strains resistant to two or more antibiotics, indicating the presence of multi-drug resistance, which complicates treatment outcomes.

Table 3: Distribution of Antibiotic Resistance by Gender

Gender	**Number of Patients**	**Erythromycin Resistance (%)**	**Clindamycin Resistance (%)**	**Tetracycline Resistance (%)**	**Multiple resistance (%)**
Male	45	25 (55.6%)	18 (40%)	16 (35.6%)	12 (26.7%)
Female	55	35 (63.6%)	22 (40%)	19 (34.5%)	13 (23.6%)

Gender-based analysis revealed that antibiotic resistance was slightly higher in female participants than males. Erythromycin resistance was more prevalent in females (63.6%) than in males (55.6%). However, clindamycin and tetracycline resistance rates were comparable between the two groups, with both genders showing similar patterns of multi-drug resistance.

Table 4: Comparison of Treatment Duration Based on Resistance Status

Resistance Status	**Number of Patients**	**Average Treatment Duration (weeks)**	**p-value**
Resistant (*C. acnes*)	60	16	0.01
Non-Resistant	40	12	

Patients with antibiotic-resistant *C. acnes* strains experienced significantly longer treatment durations than those with non-resistant strains. On average, patients with resistant strains required 16 weeks of treatment, while those with non-resistant strains required only 12 weeks. This difference was statistically significant with a p-value of 0.01, indicating that antibiotic resistance substantially prolongs acne treatment.

Table 5: Treatment Outcomes Based on Resistance Status

Resistance Status	Number of Patients	Satisfactory Improvement (%)	No Significant Improvement (%)	p-value
Resistant (*C. acnes*)	60	30 (50%)	30 (50%)	0.02
Non-Resistant	40	30 (75%)	10 (25%)	

The study showed that patients with resistant *C. acnes* strains had poorer treatment outcomes than those with non-resistant strains. Only 50% of patients with resistant acne showed satisfactory Improvement after treatment, while the other 50% reported no significant improvement. In contrast, 75% of patients with non-resistant strains showed satisfactory Improvement, with only 25% reporting poor outcomes. This difference in outcomes was statistically significant (p = 0.02).

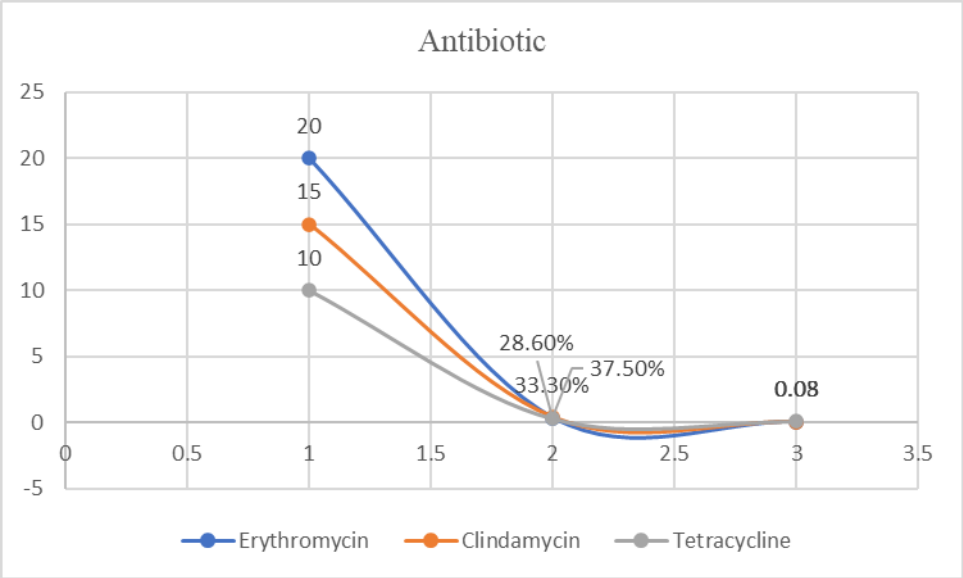

Figure 2: Side Effects Reported by Patients Based on Antibiotic Use

A significant portion of the participants reported side effects from antibiotic use. Erythromycin users reported the highest number of side effects, with 33.3% of patients experiencing adverse reactions, closely followed by clindamycin users, where 37.5% reported side effects. Tetracycline users reported fewer side effects (28.6%), but the difference was insignificant (p = 0.08). The side effects were mostly mild to moderate, including gastrointestinal discomfort and skin irritation.

DISCUSSION

Antibiotic resistance is a significant concern across various medical fields, including dermatology, where antibiotics are widely prescribed for common conditions like acne vulgaris [12]. Acne, a chronic inflammatory disorder of the pilosebaceous unit, is not life-threatening but can severely impact the quality of life due to its physical and psychological effects. While antibiotics have been the cornerstone of acne treatment for decades, their overuse and misuse have contributed to the emergence of antibiotic-resistant strains of *Cutibacterium acnes* (formerly *Propionibacterium acnes*). This resistance limits the effectiveness of standard treatments, posing a serious challenge for dermatologists, especially in developing countries like Bangladesh, where regulatory oversight on antibiotic use is often inadequate.

This study, conducted at Aurora Skin and Aesthetics in Dhaka, Bangladesh, revealed several key findings related to the prevalence of antibiotic-resistant *C. acnes*, the demographic characteristics of affected patients, and the impact of resistance on treatment outcomes [13]. These findings are consistent with global trends but highlight specific challenges unique to Bangladesh's healthcare context. This discussion will delve deeper into these results, compare them with other studies, explore the causes of antibiotic resistance, and suggest strategies for more effective acne management.

Prevalence of Antibiotic Resistance in C. acnes

The study found that 60% of the *C. acnes* strains isolated from acne patients were resistant to erythromycin, 40% to clindamycin, and 35% to tetracycline. These figures align with global trends but are slightly higher than those reported in some regions, particularly in developed countries with more robust antibiotic stewardship programs.

A European study by Valente Duarte de Sousa *et al.*, found that 50-70% of *C. acnes* strains were resistant to erythromycin, a range consistent with the 60% resistance observed in this study [14]. The higher prevalence in Bangladesh can be attributed to several factors, including the widespread availability of over-

the-counter antibiotics, a lack of public awareness about antibiotic resistance, and limited access to dermatological care in rural areas. Resistance rates tend to be lower in countries with stricter regulations on antibiotic use, such as the United States and the United Kingdom. For instance, Borsilli *et al*. reported erythromycin resistance in the U.S. at around 20-50%, depending on the patient population studied [15]. The clindamycin resistance rate of 40% observed in this study is also comparable to findings from other studies. In the same European study by Aslan Kayiran *et al*., clindamycin resistance ranged from 30% to 50%, indicating that the problem is not unique to Bangladesh [16]. However, tetracycline resistance, which was 35% in our study, is notably higher than in many developed countries, where tetracycline resistance typically remains below 20%. Tetracyclines, particularly doxycycline and minocycline, are commonly prescribed for acne due to their dual anti-inflammatory and antibacterial effects. The higher resistance rate in Bangladesh may reflect over-prescription or improper use of these antibiotics, often without a full course of treatment being completed, which encourages the development of resistance.

Regional and Global Comparisons

Antibiotic resistance in *C. acnes* has been widely studied in different parts of the world, and the results vary based on geographical location, healthcare infrastructure, and antibiotic stewardship practices. In developing countries, the lack of stringent regulations on the use of antibiotics is a major contributing factor to the higher rates of resistance. Malik *et al.,* a study conducted in Pakistan, reported erythromycin resistance in *C. acnes* strains in 65% of patients, a figure very close to the 60% found in our study [17]. The authors of the Pakistani study attributed this high resistance rate to the unregulated sale of antibiotics and the widespread self-medication practices in the country, which are also common in Bangladesh. Similarly, clindamycin resistance in Pakistan was reported at 45%, slightly higher than the 40% observed in our study. This suggests that South Asian countries, particularly those with less developed healthcare systems, face similar challenges in managing antibiotic resistance.

In contrast, countries with more stringent antibiotic prescribing policies, such as those in North America and Western Europe, tend to report lower resistance rates. For example, in the U.S., Layton *et al*., reported that the prevalence of erythromycin resistance was lower, ranging from 20% to 50% [18]. These lower rates can be attributed to implementing antibiotic stewardship programs, which encourage the judicious use of antibiotics and promote alternative treatments, such as benzoyl peroxide, to reduce reliance on antibiotics. Interestingly, in a study conducted in Brazil, Chen *et al*., found a similarly high prevalence of erythromycin resistance (around 60%) in *C. acnes* strains [19]. Like Bangladesh, Brazil faces challenges with the over-the-counter availability of antibiotics and a lack of public awareness about the risks of antibiotic misuse. This highlights that antibiotic resistance is not solely a problem in resource-limited countries but can also be prevalent in middle-income countries with similar healthcare structures.

Gender-Based Differences in Resistance

The study found that antibiotic resistance was slightly higher in female patients than in males, with 63.6% of females exhibiting erythromycin resistance compared to 55.6% of males. This gender difference is consistent with findings from other studies, though the reasons for this disparity are not fully understood. One possible explanation is that women may be more likely to seek acne treatment earlier and more frequently than men, leading to greater cumulative exposure to antibiotics over time. Additionally, hormonal fluctuations in women, particularly those related to menstruation, pregnancy, or the use of oral contraceptives, may contribute to more persistent and severe acne, prompting more frequent or prolonged antibiotic use. Marson *et al*., also reported higher rates of antibiotic resistance in female patients, suggesting this is a common trend across different populations [20]. The authors speculated that female patients may use topical antibiotics, such as clindamycin, more frequently than males due to concerns about scarring and other long-term cosmetic effects of acne. In Bangladesh, where cultural factors may also influence healthcare-seeking behavior, women may be more likely to pursue aggressive treatments for acne, including the use of antibiotics.

Impact of Resistance on Treatment Outcomes

One of the most significant findings of this study was the impact of antibiotic resistance on treatment outcomes. Patients with resistant *C. acnes* strains required significantly longer treatment durations (an average of 16 weeks) than those with non-resistant strains (12 weeks). Furthermore, only 50% of patients with resistant strains showed satisfactory Improvement after treatment, compared to 75% of non-resistant strains. These findings are consistent with M.D. *et al.,*'s findings, who found that antibiotic-resistant *C. acnes* was associated with longer treatment durations and reduced efficacy of standard therapies [21]. The reduced effectiveness of antibiotics in treating resistant strains of *C. acnes* is a significant concern for dermatologists, as it often necessitates more aggressive treatments, such as oral isotretinoin, which carries a higher risk of side effects and requires careful monitoring. The need for longer treatment durations in patients with resistant strains also increases the overall cost of treatment, which can be a significant burden in a low-resource setting like Bangladesh. Many patients in Bangladesh may not have the financial means to afford prolonged or alternative treatments, leading to poor adherence to prescribed regimens and further contributing to the development of resistance.

Side Effects of Antibiotic Treatment

This study also examined the side effects associated with antibiotic use, with 33.3% of erythromycin users, 37.5% of clindamycin users, and 28.6% of tetracycline users reporting adverse effects. These side effects were primarily gastrointestinal discomfort, skin irritation, and photosensitivity in the case of tetracyclines. The side effects of antibiotics, particularly gastrointestinal disturbances associated with oral erythromycin and tetracyclines, are well-documented in the literature. Tan *et al*., noted that while tetracyclines, such as doxycycline and minocycline, are generally well-tolerated, they can cause gastrointestinal upset and photosensitivity in some patients [22]. These side effects can lead to poor adherence to treatment regimens, promoting resistance development, as patients may not complete the full course of antibiotics. The higher rate of side effects associated with clindamycin (37.5%) in our study may be due to its topical use, which can cause localized irritation, particularly in patients with sensitive skin. In a review by Legiawati *et al*., topical clindamycin was noted to be effective for mild to moderate acne. Still, it was associated with a higher risk of skin irritation compared to other topical treatments, such as benzoyl peroxide [23].

The Role of Self-Medication and Public Awareness

One of the key factors contributing to the high prevalence of antibiotic resistance in Bangladesh is the widespread practice of self-medication. In Bangladesh, antibiotics are readily available over the counter, and many patients use them without proper medical guidance. This is particularly problematic in the context of acne treatment, where patients may use topical or oral antibiotics intermittently or at incorrect dosages, developing resistance. Faruk *et al*., highlighted the issue of self-medication in Bangladesh, noting that a lack of public awareness about the risks of antibiotic misuse is a significant driver of resistance [24]. Patients often rely on pharmacists or unqualified healthcare providers for treatment advice in rural areas, where access to dermatological care is limited. These providers may prescribe antibiotics without proper diagnosis or monitoring, further exacerbating the problem. To address this issue, public health initiatives are needed to raise awareness about the dangers of antibiotic misuse and the importance of adhering to prescribed treatments. Educational campaigns targeting patients and healthcare providers could help reduce the prevalence of self-medication and promote more responsible antibiotic use.

The Need for Stricter Regulation of Antibiotic Use

Another important factor contributing to the high rates of antibiotic resistance in Bangladesh is the lack of regulatory oversight on the sale and use of antibiotics. In many cases, antibiotics are sold over the counter without a prescription, making it easy for patients to self-medicate or obtain antibiotics without proper medical supervision. This unrestricted access to antibiotics is a major contributor to the development of resistance, as patients may not complete their full course of treatment or may use antibiotics inappropriately. In a study on antibiotic resistance patterns in Bangladesh, Chauhan *et al*., noted that the government has tried to regulate the sale of antibiotics. Still, enforcement remains weak, particularly in rural areas [25]. The authors called for stricter regulations to limit over-the-counter sales of antibiotics and ensure they are only prescribed by qualified healthcare professionals. In addition, establishing national antibiotic stewardship programs could help monitor antibiotic use and promote more responsible prescribing practices.

Alternative Treatment Strategies for Acne

Given the growing problem of antibiotic resistance in acne treatment, there is a need to explore alternative treatment strategies that do not rely on antibiotics. One promising approach is the use of combination therapies, particularly the combination of topical antibiotics with benzoyl peroxide. Benzoyl peroxide is a bactericidal agent that does not induce resistance, and when used in combination with antibiotics, it can help reduce bacterial colonization while minimizing the risk of resistance. In addition to combination therapies, non-antibiotic treatments, such as retinoids, hormonal therapies, and light-based treatments, should be considered for mild to moderate acne. Retinoids, in particular, are highly effective in reducing acne lesions and preventing future outbreaks, and they do not contribute to antibiotic resistance. Hormonal therapies, such as oral contraceptives and anti-androgens, can also be effective for women with hormone-related acne.

Light-based treatments, such as blue light therapy, have gained popularity in recent years as a non-invasive option for acne treatment. Blue light targets the *C. acnes* bacteria and can help reduce inflammation and bacterial colonization without antibiotics. However, more research is needed to determine the long-term efficacy of light-based therapies in treating acne.

To address this issue, a multifaceted approach is needed. This includes stricter regulations on the sale and use of antibiotics, public education campaigns to raise awareness about the risks of antibiotic misuse, and adopting alternative treatment strategies that reduce reliance on antibiotics. Dermatologists must also adopt more conservative prescribing practices, limiting antibiotic use to the shortest possible duration and combining antibiotics with non-antibiotic treatments, such as benzoyl peroxide, to minimize the risk of resistance.

Further research is needed to explore the long-term outcomes of patients with antibiotic-resistant acne and to develop more effective treatment protocols that do not rely on antibiotics. Taking a proactive approach to managing antibiotic resistance, healthcare providers in

Bangladesh can help mitigate the growing threat and improve outcomes for patients with acne.

CONCLUSION

The study highlights the growing concern of antibiotic resistance in acne treatment in Bangladesh, with significant resistance to erythromycin, clindamycin, and tetracyclines. The findings emphasize the need for stricter antibiotic use regulations and the promotion of alternative treatments. Addressing antibiotic resistance is crucial for improving acne treatment outcomes and reducing public health risks.

Recommendations

- Implement stricter regulations to limit over-the-counter antibiotic sales.
- Promote combination therapies (e.g., antibiotics with benzoyl peroxide) to reduce resistance.
- Raise public awareness about the responsible use of antibiotics and the dangers of self-medication.

Acknowledgment

We would like to thank Aurora Skin and Aesthetics for their support and cooperation throughout the study. We are also thankful to the patients who participated in this research and provided valuable data for analysis. Special thanks to the research team for their dedication and hard work in collecting and analyzing the data, which contributed to the successful completion of this study.

Funding: No funding sources

Conflict of interest: None declared

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