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Features of Regional Antibiotic Resistance in Pharyngeal Infections

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Abstract: *Antibiotic resistance (ABR) is a global public health issue. The World Health Organization (WHO) predicts that by 2050, ABR could lead to 10 million deaths annually if no countermeasures are taken (WHO, 2019). The rise in multidrug-resistant (MDR) bacteria and fungi complicates treatment strategies, particularly in healthcare facilities where nosocomial infections are prevalent, according to various studies. To analyze the results of bacteriological examination of throat swabs with antibiograms in pharyngeal diseases and, based on the data analysis, develop recommendations for empirical antibiotic therapy. From 2024 to 2025, 255 throat swabs were collected and cultured at the Brovary Multidisciplinary Clinical Hospital to determine the bacteriological composition of the pharyngeal mucosa and antibiotic resistance. Isolates were identified using standard microbiological methods, such as culturing on nutrient media and biochemical tests. Antibiotic susceptibility was assessed using the minimum inhibitory concentration (MIC) method or the Kirby-Bauer disk diffusion method. Testing was conducted on a panel of antibiotics. Results were interpreted according to standards such as those of the Clinical and Laboratory Standards Institute (CLSI) to classify strains as susceptible, intermediate, or resistant. A multilevel statistical methodology was employed for comprehensive analysis of microbiological data and antibiotic resistance profiles. Data analysis was performed using Python 3.9 and specialized libraries for scientific data processing (NumPy, SciPy, Pandas, and scikit-learn; data visualization was conducted using Matplotlib and Seaborn). Antifungal drugs—clotrimazole (100%) and ketoconazole (90.0%)—demonstrated the highest efficacy in treating fungal infections. Ceftazidime, vancomycin, benzylpenicillin, and clindamycin showed low efficacy (less than 50%), which may indicate high microbial resistance to these drugs. Amikacin, ceftriaxone, and cefepime were the most effective antibiotics for β-hemolytic streptococcus in terms of susceptibility. Staphylococcus aureus exhibited complete susceptibility to levofloxacin, ofloxacin, and meropenem. The study highlights the severity of the antibiotic resistance problem and the need for rational use of antimicrobial agents in clinical practice.*

Keywords: Antibiotic Resistance, Antibiotics, Bacteria, Pharynx, Fungi, Pharyngeal Diseases, Tonsillitis, Oral Cavity, Pharyngitis.

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Introduction

Antibiotic resistance (ABR) is a global public health challenge. The World Health Organization (WHO) projects that by 2050, ABR could cause 10 million deaths annually if no countermeasures are implemented (WHO, 2019). The rise in multidrug-resistant (MDR) bacteria and fungi complicates treatment strategies, particularly in healthcare settings where nosocomial infections are more prevalent.

The clinical consequences of ABR are significant, as high resistance to commonly used antibiotics, such as amoxicillin-clavulanate and clarithromycin, limits treatment options, especially for bacterial infections caused by gram-positive bacteria. Regarding the distribution of bacteria by epidemiology, the most common gram-positive bacterium is *Staphylococcus aureus*. For instance, Jones et al. (2018) found that 30–50% of *S. aureus* isolates in European healthcare facilities were methicillin-resistant (MRSA), with high resistance to clarithromycin (60%) and clindamycin (40%) [6]. Meanwhile, the most frequent gram-negative pathogens include *Enterobacter* spp. Additionally, gram-negative bacteria such as *Pseudomonas aeruginosa* and *Enterobacter* spp. pose further challenges due to their acquired resistance mechanisms. *P. aeruginosa* is known for resistance to carbapenems and aminoglycosides [5]. *Citrobacter* spp. exhibit multidrug resistance to cephalosporins and amoxicillin-clavulanate [3]. Fungal pathogens, particularly *Candida albicans*, also show increasing resistance to azoles [5]. A global study by Pfaller et al. (2020) revealed that 10–15% of *C. albicans* isolates had acquired resistance to fluconazole, with higher resistance observed in immunocompromised patients [5].

Limiting the use of broad-spectrum antibiotics and regularly monitoring susceptibility are critical measures to combat antibiotic resistance. The WHO Global Action Plan on ABR emphasizes infection monitoring and control [1].

Materials and Methods

The study was approved by the Bioethics Committee of the Bogomolets National Medical University (protocol №187 23.09.2024) and complies with the requirements of the Helsinki Declaration. Since the study is retrospective, obtaining informed consent from patients was not required.

From 2024 to 2025, a study was conducted at the Brovary Multidisciplinary Clinical Hospital, where 255 throat swabs were collected and cultured to assess antibiotic resistance. The study investigated regional antibiotic resistance patterns in patients with pharyngeal infections from otolaryngology and infectious disease departments.

Isolates were identified using standard microbiological methods, including cultivation on nutrient media and biochemical tests. Antibiotic susceptibility was evaluated using the minimum inhibitory concentration (MIC) method or the Kirby-Bauer disk diffusion method. Testing was performed on a panel of antibiotics, and results were interpreted according to standards such as those of the Clinical and Laboratory Standards Institute (CLSI) to classify strains as susceptible, intermediate, or resistant.

A multilevel statistical methodology was employed for comprehensive analysis of microbiological data and antibiotic resistance profiles. Data analysis was conducted using Python 3.9 with specialized libraries for scientific data processing (NumPy, SciPy, Pandas, scikit-learn), and data visualization was performed using Matplotlib and Seaborn.

Microbiological data were analyzed using standard measures of central tendency (mean, median) and variability (standard deviation, range of minimum and maximum values). Categorical variables were evaluated using absolute frequencies and relative proportions (percentages). The distribution of microorganisms and colony-forming unit (CFU) levels were presented as absolute counts and percentages of the total sample.

Antibiotic resistance was assessed based on standard classifications (susceptible (S), intermediate (I), and resistant (R) strains). Percentages of susceptibility and resistance were calculated for each antibiotic. The multiple antibiotic resistance (MAR) index was calculated as the ratio of the number of antibiotics to which resistance was detected to the total number of antibiotics tested. Cross-

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resistance was evaluated using Spearman's rank correlation coefficient (ρ) with statistical significance determined by p-values. Antibiotic pairs with a correlation coefficient $\rho \geq 0.7$ and $p < 0.05$ were considered to have significant cross-resistance.

For comparing resistance profiles between different microorganisms, the chi-square (χ^2) test was used for categorical variables with large sample sizes, and Fisher's exact test was applied for small samples. Differences were considered statistically significant at $p < 0.05$. The relationship between CFU levels and antibiotic resistance was analyzed using Spearman's rank correlation coefficient.

The dynamics of antibiotic resistance were analyzed using time-series analysis methods. Trends were assessed via linear regression, calculating the slope, coefficient of determination (R^2), and statistical significance (p-value). Future resistance levels were predicted using linear extrapolation with the construction of 95% confidence intervals.

To identify subgroups of strains with similar resistance profiles, k-means clustering was applied with prior data standardization. The optimal number of clusters was determined using the "elbow method" by analyzing the within-cluster sum of squares. For bacterial isolates with sufficient data ($n \geq 20$), dendrograms of antibiogram similarity were constructed using hierarchical agglomerative clustering with Euclidean distance metrics.

The effectiveness of antibiotics for empirical therapy was evaluated based on the percentage of susceptible strains with 95% confidence intervals. Antibiotic combinations were analyzed using a methodology that calculated combined effectiveness, considering the probability of susceptibility to at least one of the paired antibiotics.

Various visualization methods were employed to present results: bar charts (for frequency comparisons), heatmaps (for resistance matrices), line graphs (for trend analysis), boxplot diagrams (for distribution comparisons), correlation matrices, and dendrograms (for cluster analysis).

Artificial intelligence was not used.

Results and Discussion

A total of 255 individuals were examined, comprising 156 males (61.1%) and 99 females (38.9%), with a mean age of 37 years.

Among all isolated strains, *Streptococcus* (gram-positive) was the most frequently encountered (72.1%), while *Pseudomonas aeruginosa* was the least common (0.4%). *Candida albicans* (12.1%) and *Staphylococcus aureus* (7.3%) were also relatively frequent. The complete distribution is presented in Figure 1.

The highest number of multidrug-resistant strains was observed in Citrobacter, which may be explained by its frequent presence in healthcare facilities and its association with nosocomial infections. Additionally, hemolytic *Staphylococcus* (30%) and *Escherichia coli* (16.7%) exhibited high levels of multidrug-resistant strains, necessitating attention in the treatment of these infections. The frequency of multidrug-resistant strains among the isolated isolates is presented in Figure 2.

Regarding the trends in the temporal distribution of microorganisms, hemolytic streptococcus exhibits significant fluctuations with two peaks (September 2024 and March 2025), followed by a sharp decline to a minimum value (2%) by the end of the period. *Candida albicans* shows one pronounced peak in September 2024 (15%), after which its share remains low (1–4%) with minor fluctuations. *Staphylococcus aureus* displays a relatively stable distribution (1–2%) with one notable peak in November 2024 (9%). The data are presented in Figure 3.

The highest level of multiple antibiotic resistance (MAR) is observed in *Citrobacter* (0.70), indicating a serious resistance issue. Moderately high resistance levels are seen in *Pseudomonas aeruginosa* (0.38) and *Staphylococcus haemolyticus* (0.27). An average resistance level is demonstrated by *Enterobacter* (0.23) and Streptococcus (gram-positive) (0.20). Low resistance levels are observed in Klebsiella spp. (0.12) and *Staphylococcus* aureus (0.10). *Citrobacter* and *Pseudomonas aeruginosa* are the most problematic due to their high levels of multiple resistance. The data can be reviewed in Figure 4.

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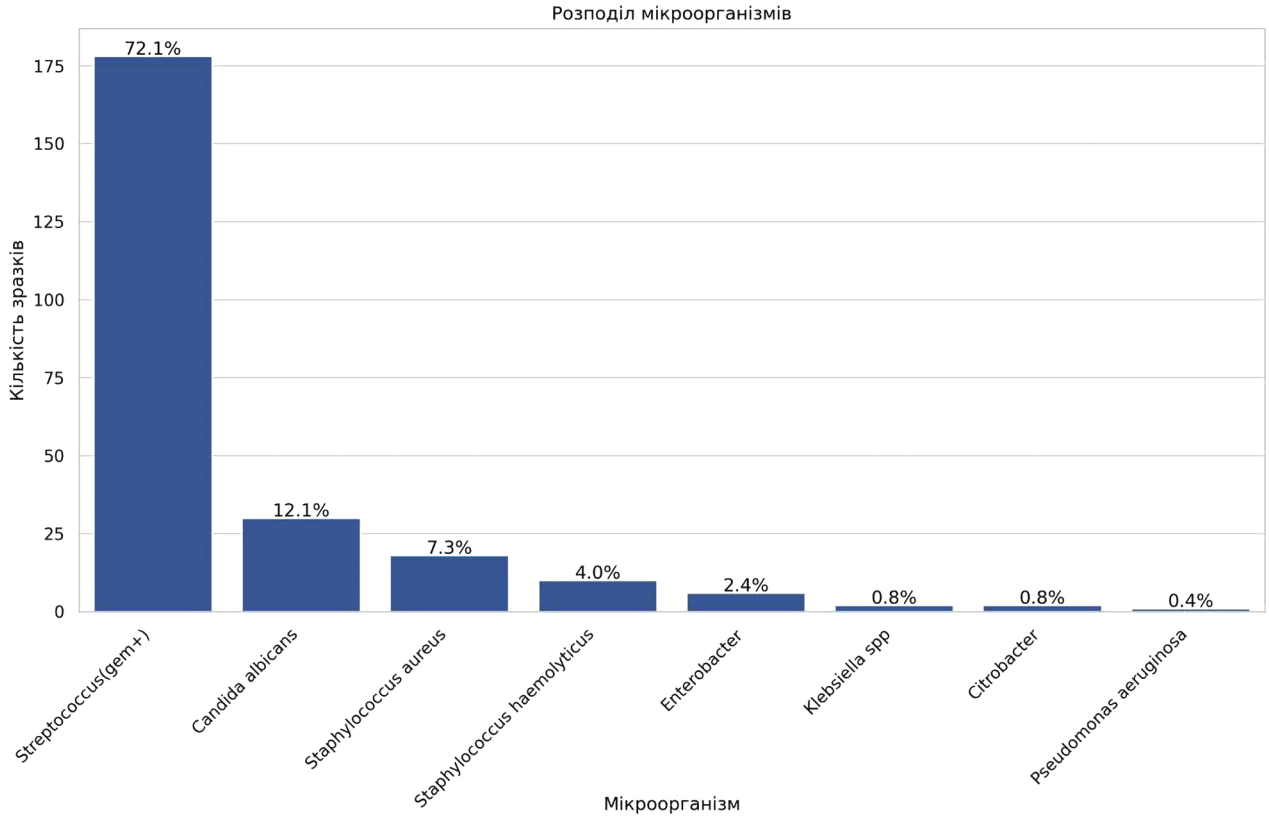

Figure 1. Distribution of Microorganisms

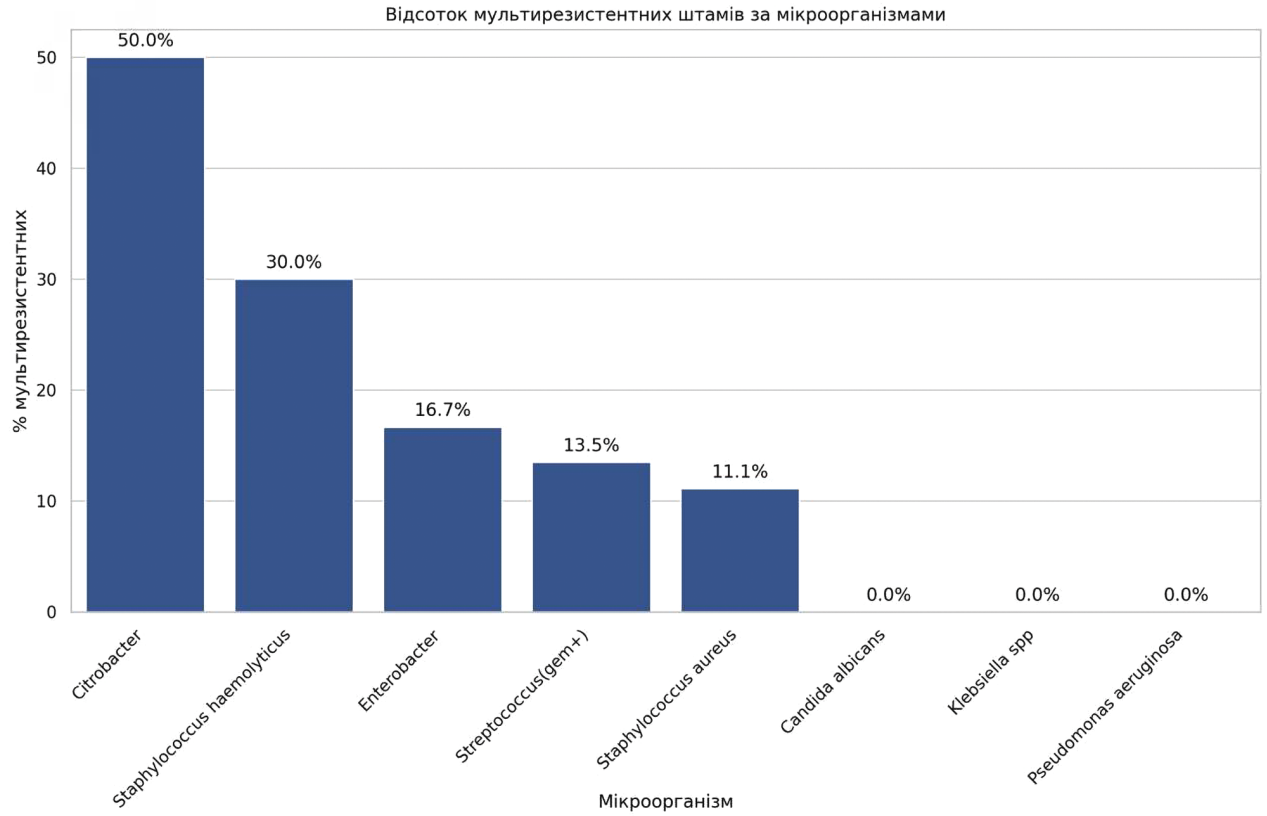

Figure 2. Percentage of Multidrug-Resistant Strains by Microorganism

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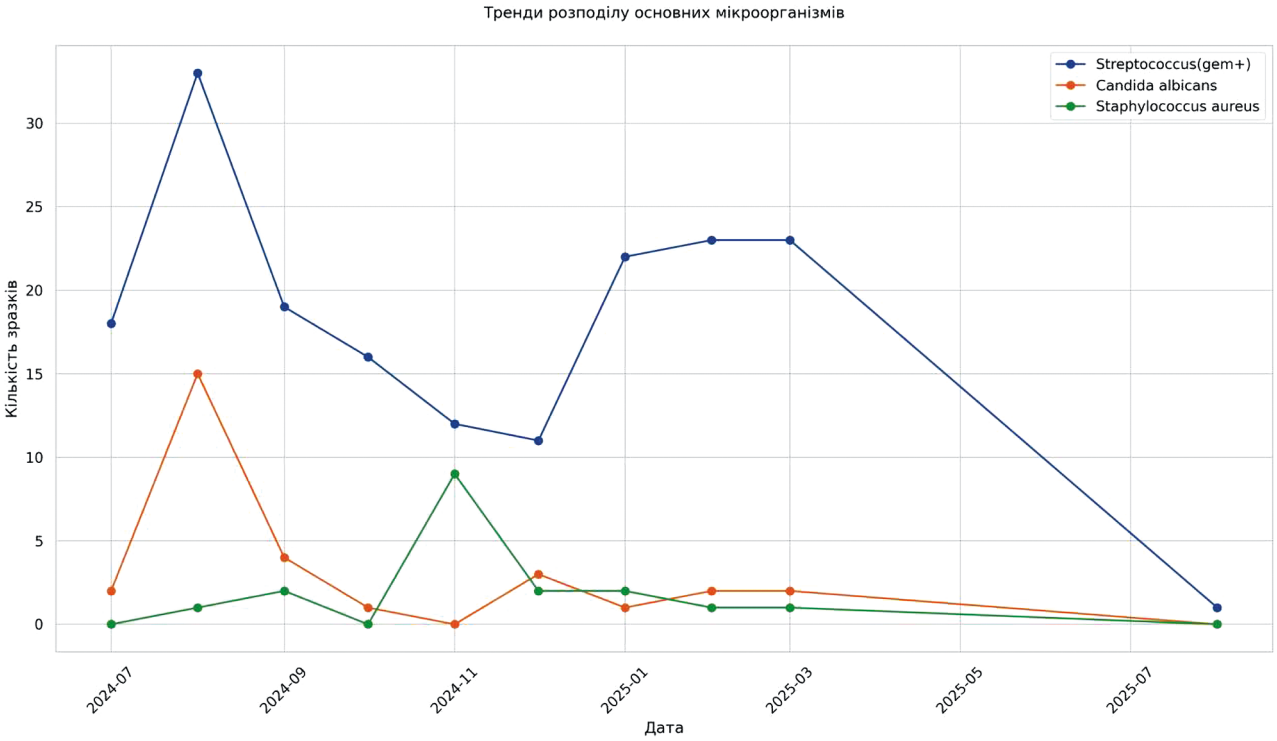

Figure 3. Trends in the Distribution of Major Microorganisms

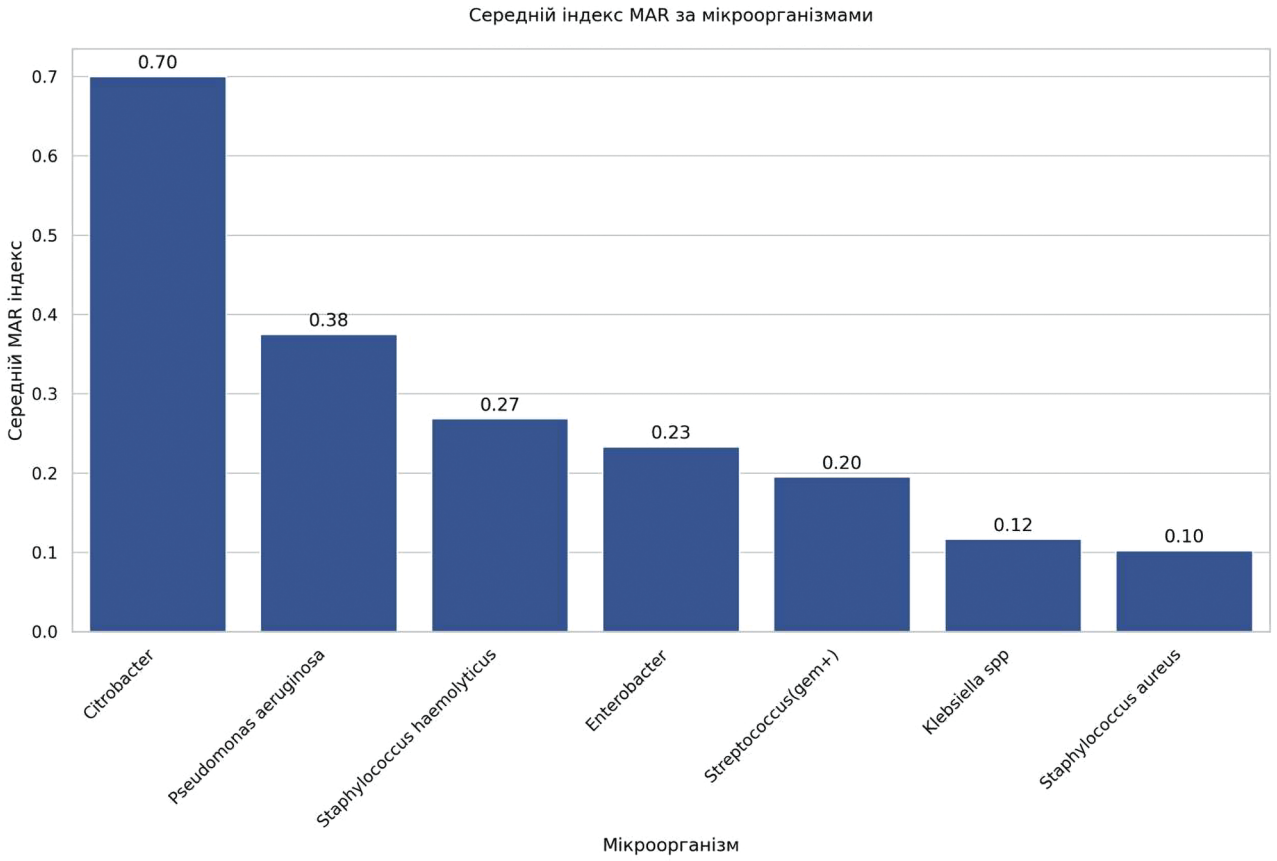

Figure 4. Average MAR Index by Microorganism

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Overall, only a small proportion of bacteria (less than 10%) have an MAR index ≥ 0.5. This means that approximately 90% of microorganisms predominantly exhibit monoresistance to a specific antibiotic. The final distribution of the MAR index can be reviewed in Figure 5.

Regarding fungi, the average MAR index is 0.32, which is higher than the average MAR index for bacteria (0.20), as shown in Figure 5. This suggests that fungi are more resistant than bacteria and require mandatory susceptibility testing for antifungal drugs for each fungal isolate. It is also important to implement resistance control measures and restrict the use of antifungal agents unless necessary. The data on the MAR index for fungi are illustrated in Figure 6.

In addition to evaluating the aforementioned parameters, a correlation heatmap of antibiotic

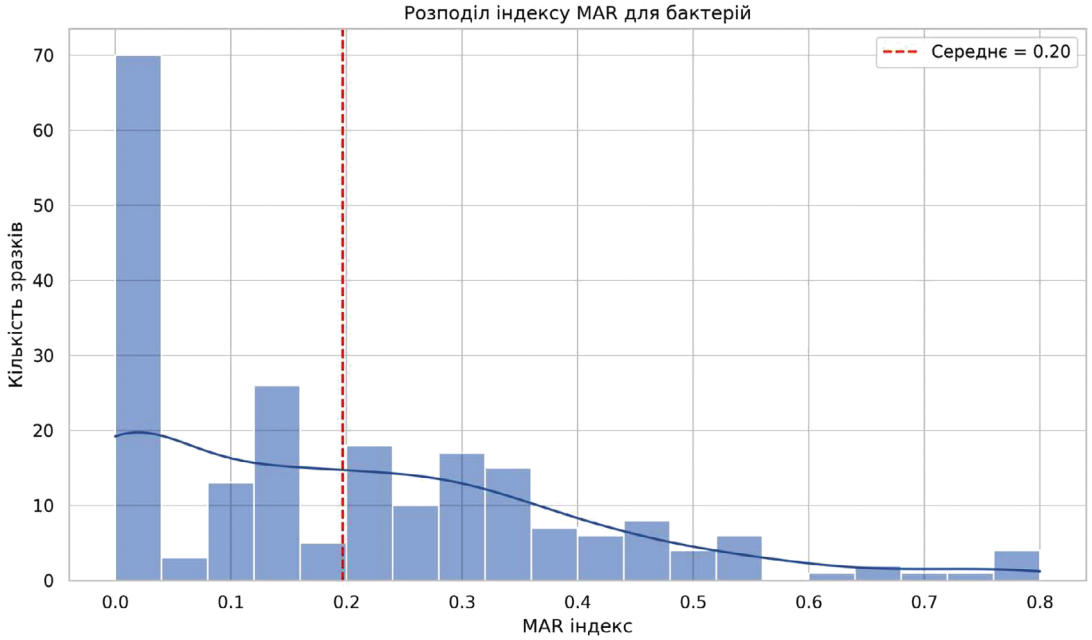

Figure 5. Distribution of MAR Index for Bacteria

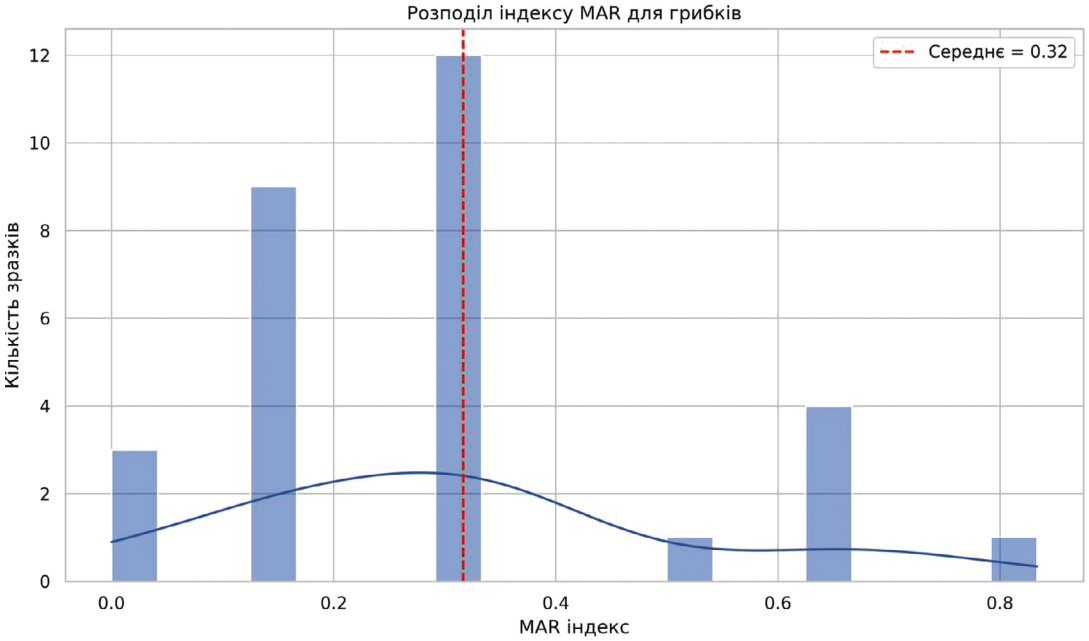

Figure 6. Distribution of MAR Index for Fungi

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resistance was constructed. The highest positive correlation is observed between fluconazole and ketoconazole (1.00), indicating that resistance to one of these antifungal agents is accompanied by resistance to the other. Surprisingly, strong correlational links were found between antibiotics within the same groups, such as levofloxacin and ofloxacin (0.77). Strong correlations were also observed between ofloxacin and linezolid (1.00), imipenem and clarithromycin (1.00), and imipenem and ceftriaxone (1.00).

The highest negative correlation was found between azithromycin and vancomycin (-0.35), meaning that microorganisms resistant to azithromycin were sensitive to vancomycin, and vice versa. A similar trend was noted with imipenem and vancomycin (-0.69), and imipenem and ampicillin (-0.43).

This correlation heatmap helps to understand which antibiotics share similar resistance profiles, which can be useful for selecting alternative drugs in the treatment of bacterial and fungal infections.

Based on the collected data, clotrimazole (100%) *and ketoconazole* (90.0%) demonstrated high effectiveness for the empirical treatment of fungal pharyngeal infections (Figure 8). Similarly, broad-spectrum antibiotics such as amikacin, ceftriaxone, and cefepime also showed high

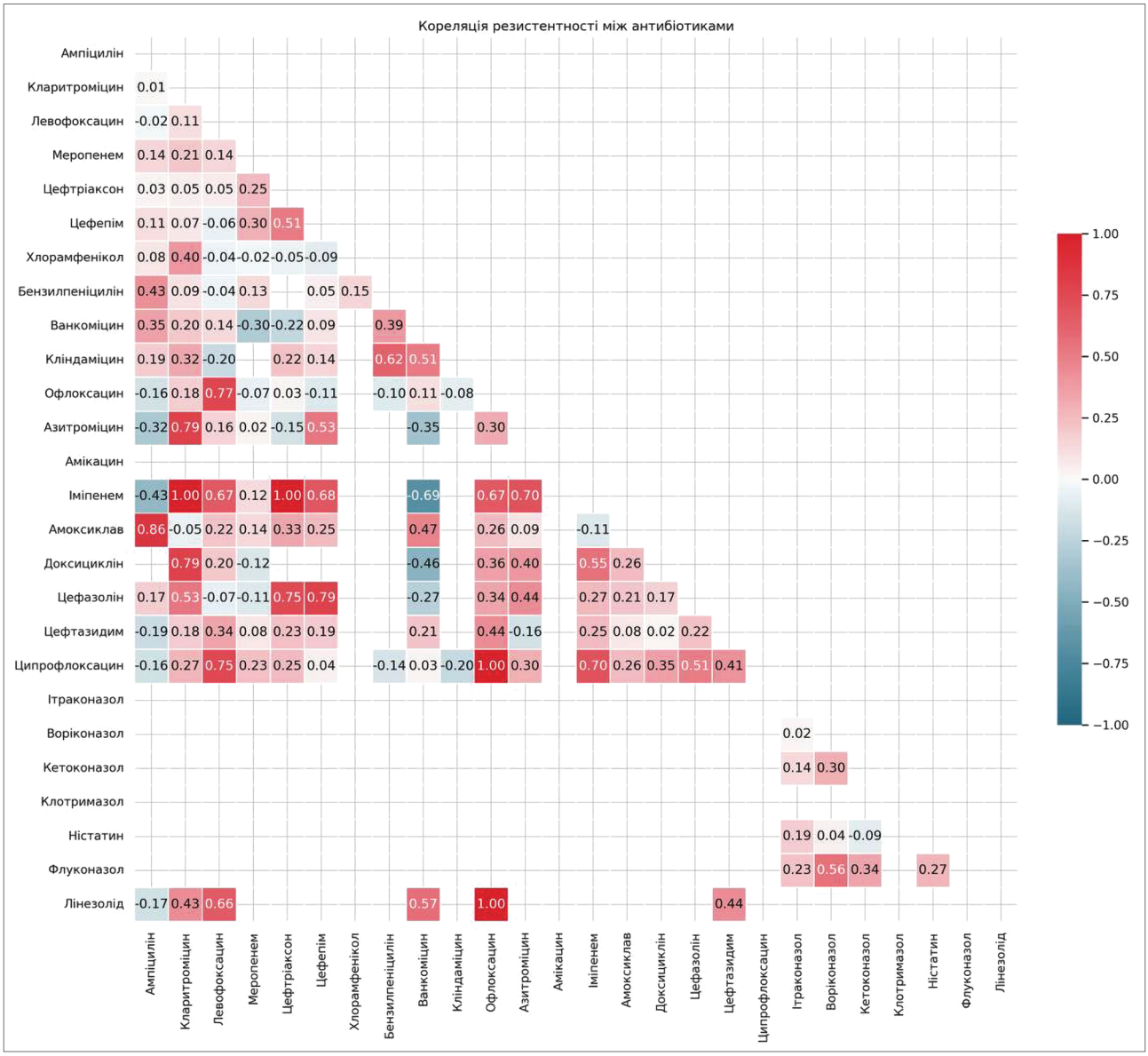

Figure 7. Correlation of Resistance Between Antibiotics

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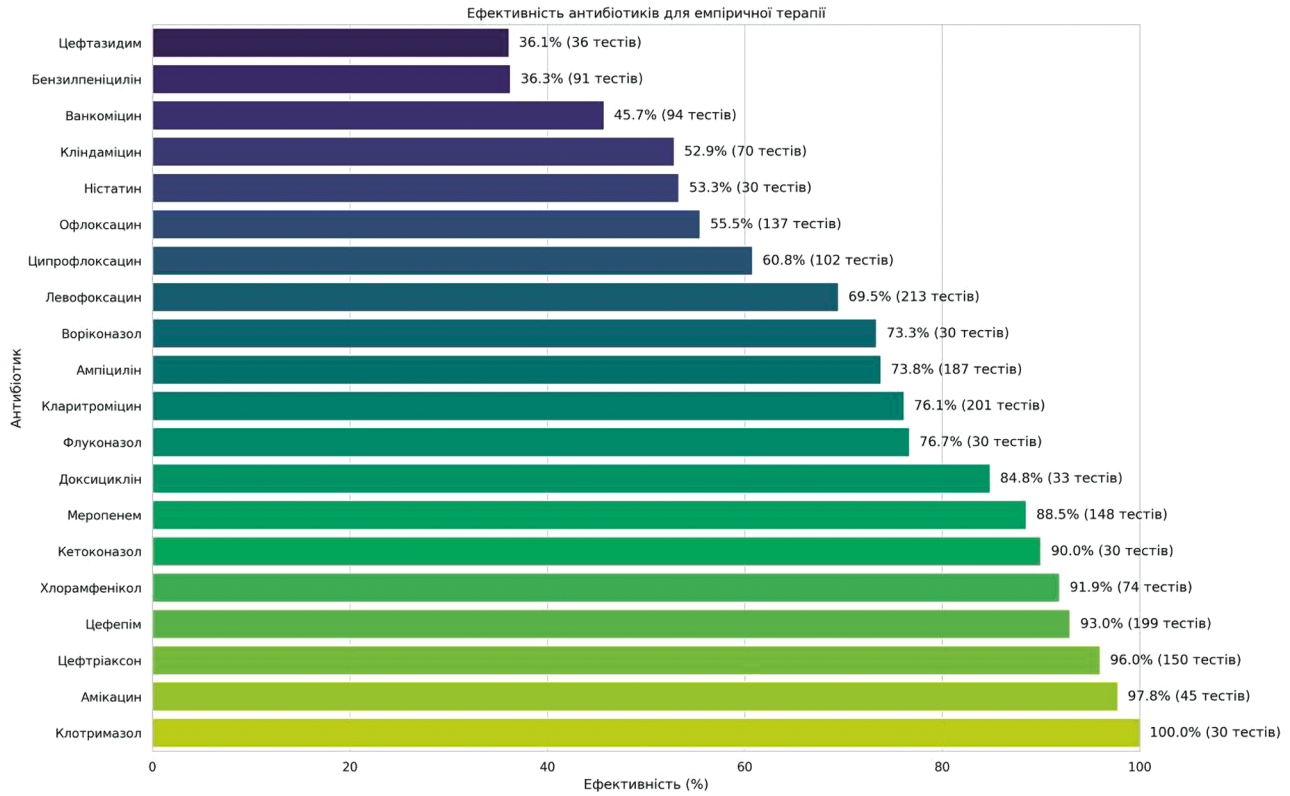

Figure 8. Effectiveness of Antibiotics for Empirical Therapy

effectiveness (over 90%). In contrast, ceftazidime, vancomycin, and clindamycin exhibited low effectiveness (less than 50%), which may indicate high resistance of microorganisms to these drugs.

It should be noted that for certain antibiotics, the number of tests was relatively low—fewer than 20 tests—which may affect the reported level of antibiotic resistance.

A detailed analysis of antibiotic resistance revealed that amikacin is the most effective antibiotic for *Streptococcus* (gram-positive) in terms of susceptibility (100%), though the small number of tests (8) suggests the need for further studies to confirm this finding. Meanwhile, ceftriaxone (98.5%, 131 tests) and cefepime (94.7%, 171 tests) also exhibit high effectiveness in treating pharyngeal bacterial infections caused by β-hemolytic streptococcus, with their results being more reliable due to the larger number of tests. The data are presented in Figure 9.

Figure 9. Most Effective Antibiotics for β-Hemolytic Streptococcus

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Three antibiotics (levofloxacin, meropenem, and ofloxacin) were found to have complete susceptibility for *Staphylococcus aureus*, with two belonging to the fluoroquinolone group. This is likely due to the similarity in the structural properties of these antibiotics. The data are presented in Figure 10.

Based on the statistical calculations conducted, clotrimazole was found to be the most effective antifungal agent with an effectiveness of 100% (30 tests), making it the best choice for empirical therapy. Ketoconazole (90.0%) is also highly effective and can serve as an alternative to clotrimazole. Fluconazole (76.7%) and voriconazole (73.3%) exhibit moderate effectiveness. Nystatin (53.3%) is the least effective, and its use may be limited in our context.

It is noted that an equal number of tests were conducted for all antifungal agents.

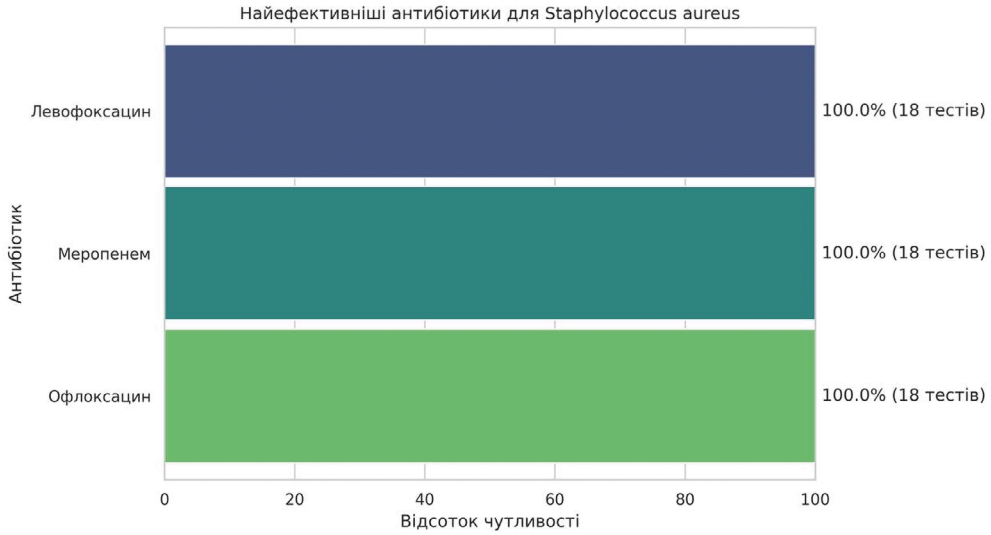

Figure 10. Most Effective Antibiotics for Staphylococcus aureus

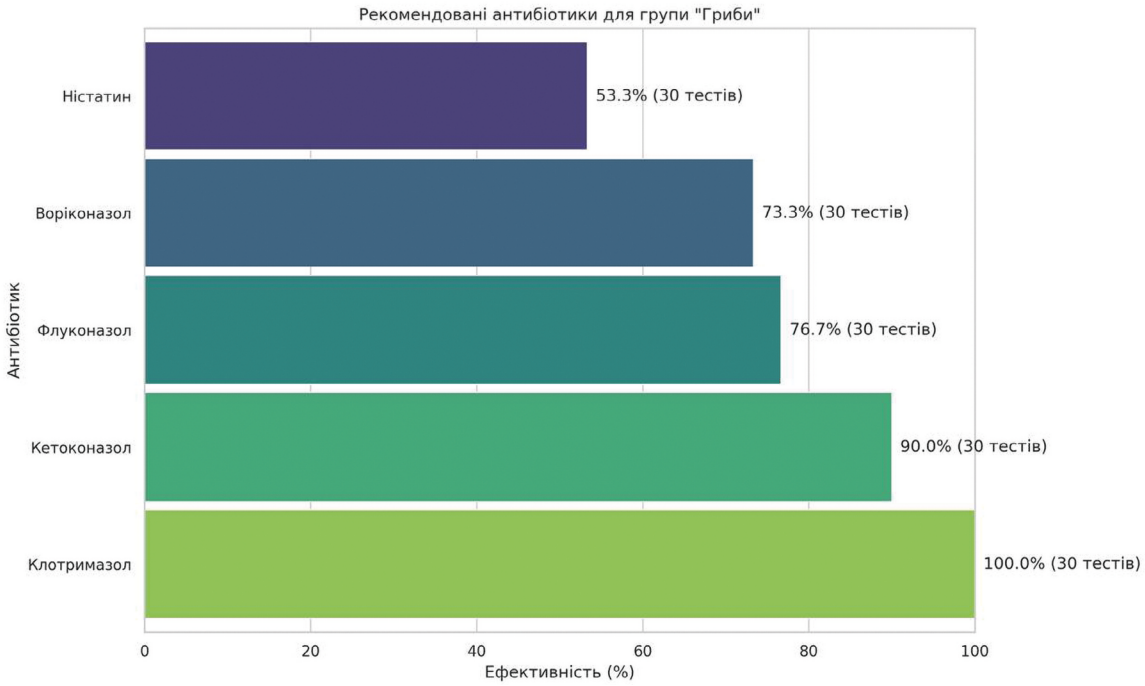

Figure 11. Recommended Antibiotics for the Fungi Group

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Upon group analysis, it was found that ampicillin exhibits the highest susceptibility (73.8%) and the lowest resistance (20%), whereas amoxicillin shows the lowest susceptibility (16.7%) and the highest resistance (78%) within the penicillin group. The data are presented in Figure 12.

Analysis of the macrolide group revealed that clarithromycin has higher susceptibility (76.1%) and lower resistance (14%), while azithromycin shows slightly lower susceptibility (69.6%) and higher resistance (25%). The data are presented in Figure 13.

An interesting finding is that levofloxacin exhibits the highest susceptibility among the studied drugs, whereas ofloxacin is the least effective in terms of the percentage of susceptible strains across various bacteria. The data are illustrated in Figure 14.

Among the cephalosporin group, ceftriaxone is the most effective. Ceftazidime, however, has the lowest effectiveness due to a high level of

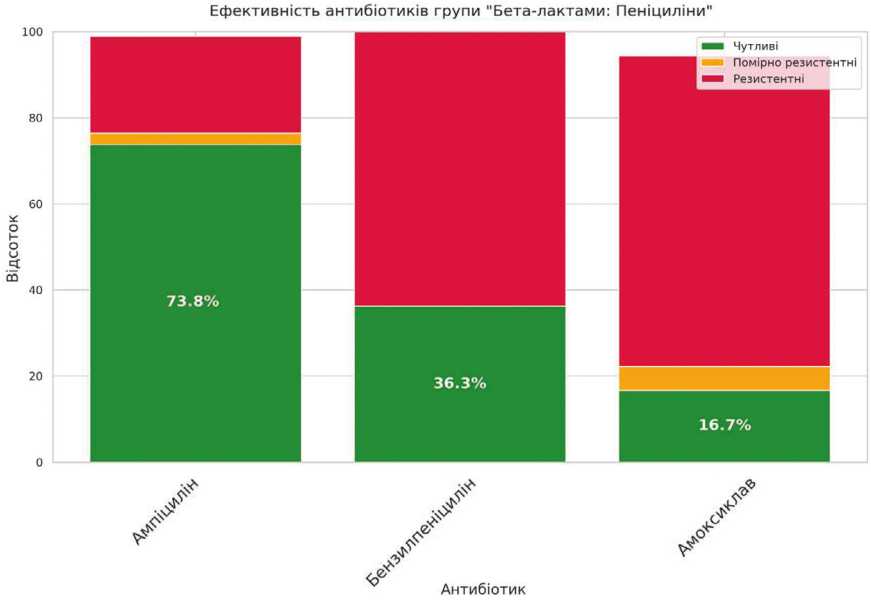

Figure 12. Effectiveness of Penicillin Group Antibiotics

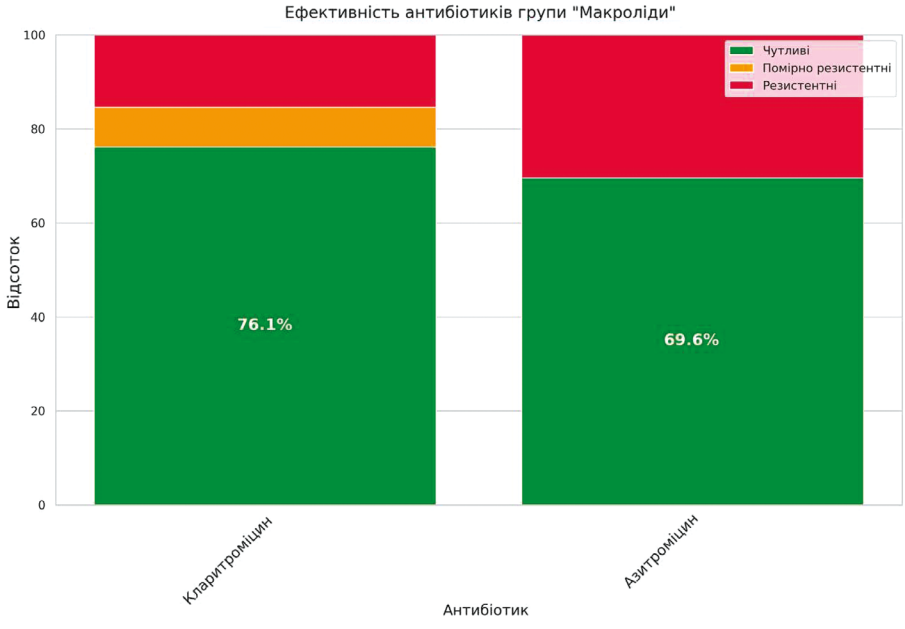

Figure 13. Effectiveness of Macrolide Group Antibiotics

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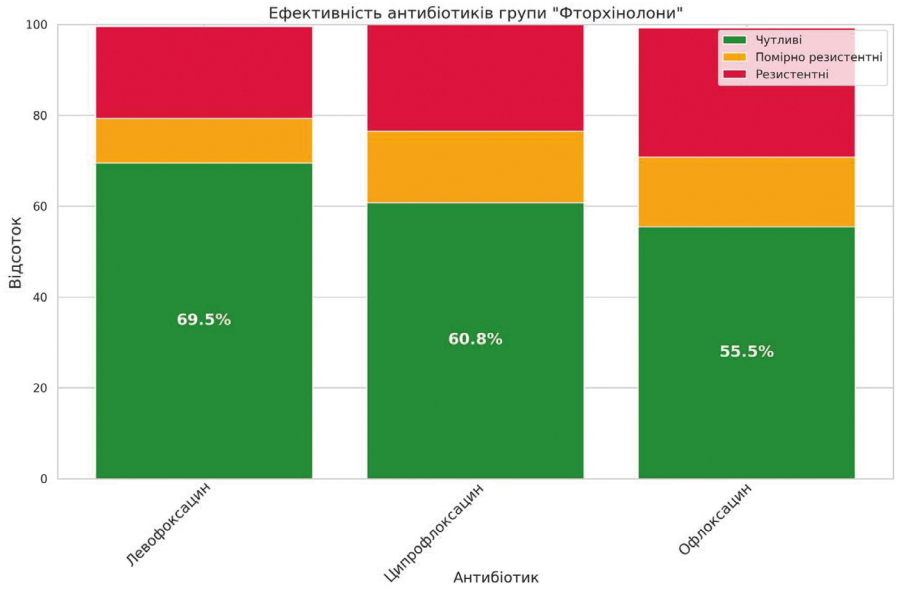

Figure 14. Effectiveness of Fluoroquinolone Group Antibiotics

resistance. The final distribution can be reviewed in Figure 15.

Regarding the carbapenem group, meropenem demonstrates significantly higher effectiveness compared to imipenem. Imipenem has a substantial level of resistance, which may limit its clinical applicability in some cases. The data are presented in Figure 16.

Regarding the azole group of antifungal agents, clotrimazole (100%) and ketoconazole (90%) exhibit the highest susceptibility, while itraconazole (13.3%) shows the lowest, making its use in clinical practice questionable. A detailed analysis is presented in the diagram (Figure 17).

After evaluating all baseline parameters, a linear regression model was developed to predict

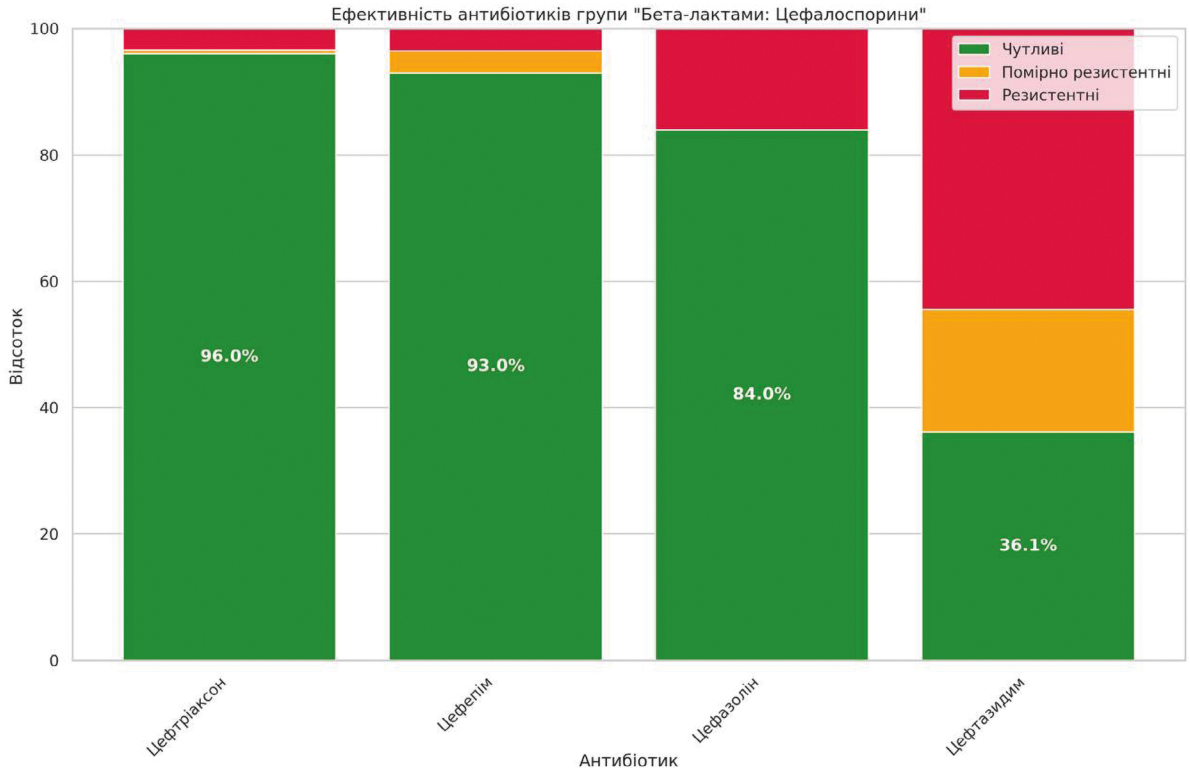

Figure 15. Effectiveness of Cephalosporin Group Antibiotics

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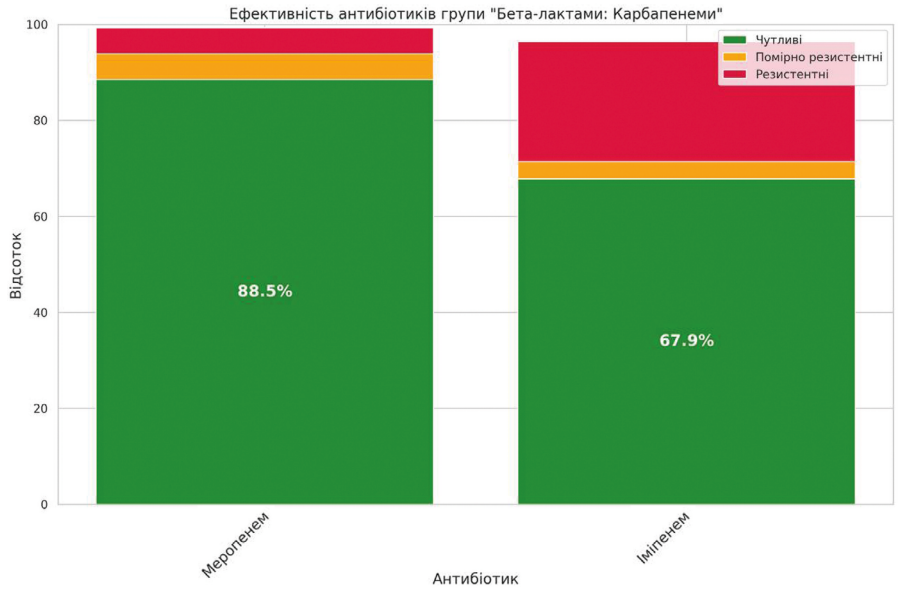

Figure 16. Effectiveness of Carbapenem Group Antibiotics

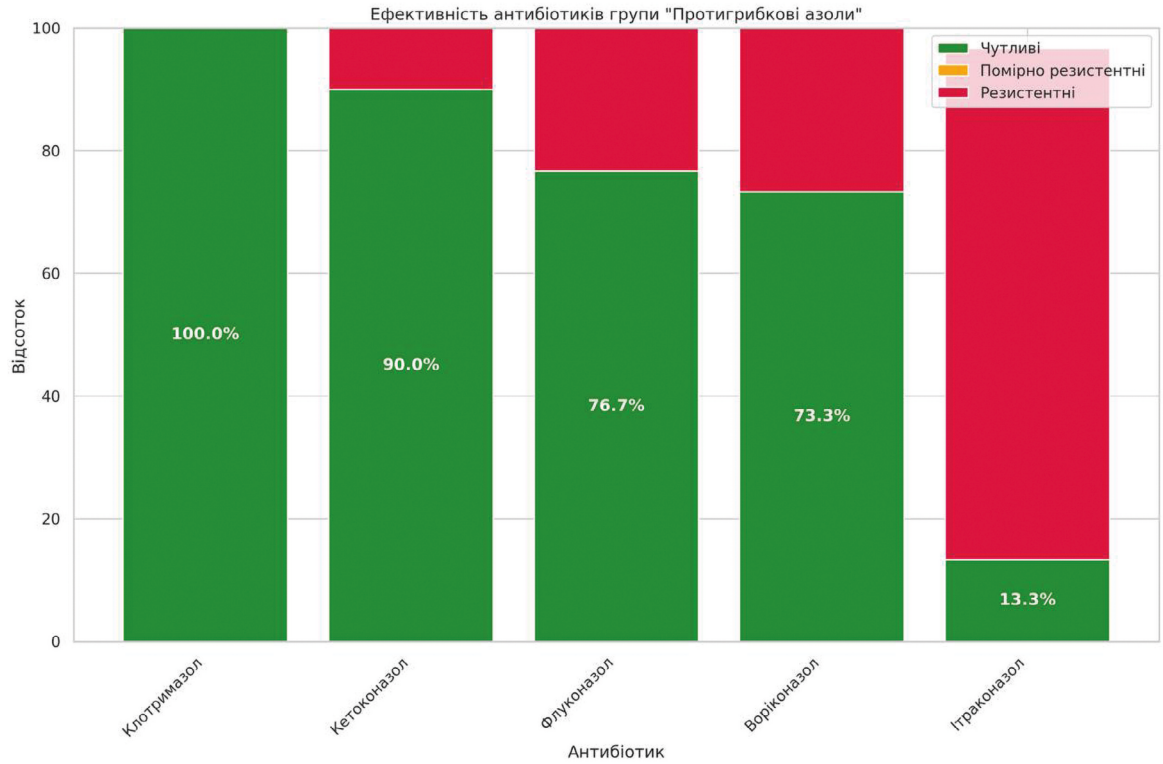

Figure 17. Effectiveness of Antifungal Agents

antibiotic resistance over time. Accordingly, the highest increase in resistance is forecasted for ampicillin (30.1%), which may indicate a rapid development of microbial resistance to this drug. In contrast, cefepime and clarithromycin show a predicted decrease in resistance levels, making them potentially more stable for future use (Figure 18).

Discussion

The study conducted at the Brovary Multidisciplinary Clinical Hospital between 2024 and 2025 highlights regional features of antibiotic resistance (ABR) in pharyngeal infections in the Kyiv region. Analysis of 255 throat swabs revealed a predominance of gram-positive bacteria, particularly *Streptoco-*

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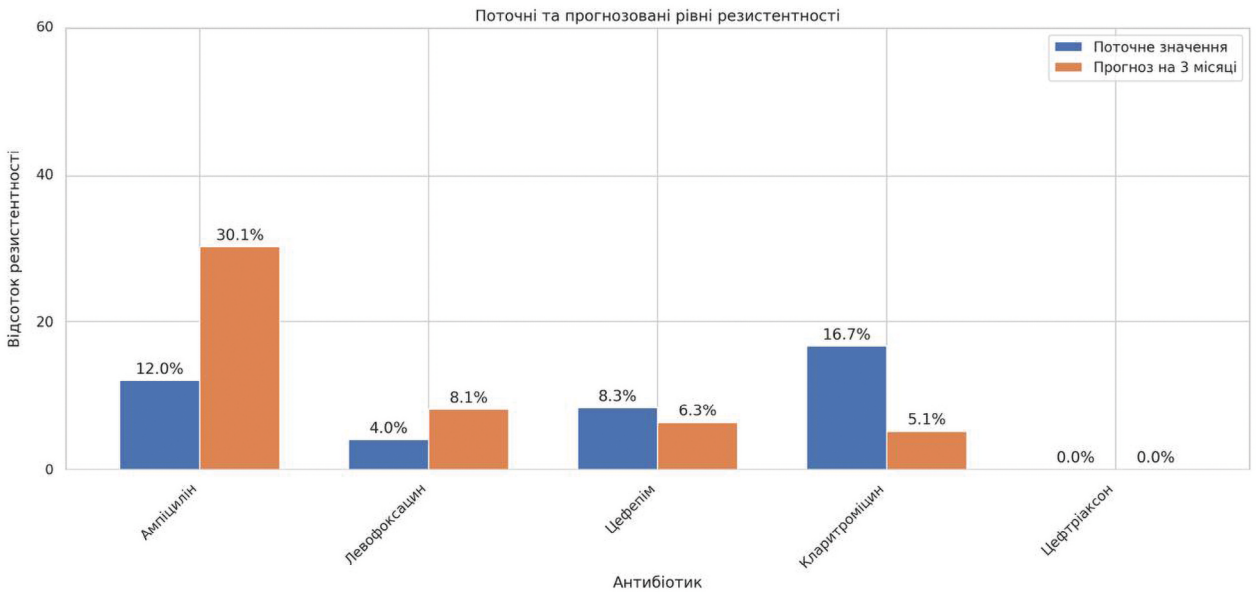

Figure 18. Current and Predicted Resistance Levels

ccus (gram-positive) (72.1%), which aligns with international data on the dominance of streptococci as the primary pathogens in pharyngitis and tonsillitis [8]. The low frequency of *Pseudomonas aeruginosa* (0.4%) reflects its greater prevalence in nosocomial settings, as noted by Bassetti et al. (2019), where gram-negative bacteria are more commonly associated with infections in intensive care units [1].

The seasonal dynamics identified in the study indicate peaks in activity for *Streptococcus* (gram-positive) in July (33%), *Candida albicans* in June (15%), and Staphylococcus aureus in August and November (9% and 8%, respectively). These fluctuations may be linked to climatic factors, including high temperatures and humidity during the summer, which promote microbial growth, as emphasized by Berkow and Lockhart (2017) for fungal infections [3]. The reduced activity of microorganisms in winter (December, 2%) may reflect lower circulation of pharyngeal infections during the cold season, warranting further investigation to develop seasonally adapted prevention strategies.

The high multiple antibiotic resistance (MAR) index in *Citrobacter* (0.70) confirms its status as a problematic pathogen, as noted by Gao et al. (2019), which highlights its multidrug resistance to cephalosporins and amoxicillin-clavulanate [7]. Moderate resistance in *Pseudomonas aeruginosa* (MAR 0.38) and *Staphylococcus haemolyticus* (MAR 0.27) points to challenges in treating infections caused by these microorganisms, especially in settings with limited access to broad-spectrum antibiotics [1]. The higher MAR index for fungi (0.32) compared to bacteria (0.20) is consistent with global trends of increasing resistance to azoles, particularly fluconazole, as confirmed by Castanheira et al. (2017) [5].

The effectiveness of antibiotics for empirical therapy varies by pathogen. For *Streptococcus* (gram-positive), amikacin (100%), ceftriaxone (98.5%), and cefepime (94.7%) showed high susceptibility, making them optimal for treating streptococcal infections. The complete susceptibility of *Staphylococcus aureus* to levofloxacin, meropenem, and ofloxacin (100%) aligns with findings by Diekema et al. (2019), which note the effectiveness of fluoroquinolones and carbapenems [6]. For fungal infections, clotrimazole (100%) and ketoconazole (90%) proved most effective, while the low susceptibility to nystatin (53.3%) and itraconazole (13.3%) suggests limited applicability, consistent with the rising resistance to azoles [5].

Correlation analysis revealed a high positive correlation between fluconazole and ketoconazole (1.00), imipenem and meropenem (0.69), levofloxacin and ciprofloxacin (0.44), levofloxacin and ofloxacin (0.77), ofloxacin and linezolid (1.00), imipenem and clarithromycin

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(1.00), and imipenem and ceftriaxone (1.00). A negative correlation between azithromycin and vancomycin (-0.35) supports the potential use of vancomycin as an alternative when resistance to azithromycin is present. High resistance to clarithromycin (54.3% in *Streptococcus* (gram+), 66.7% in *S. aureus*) and amoxicillin-clavulanate (83.3% in *Enterobacter*) underscores the need to limit their use, as recommended by ESCMID guidelines [8] and WHO [1].

Limitations of the study include the small number of tests for some antibiotics (e.g., amikacin for *Streptococcus* (gram+)) and the monocentric nature of the investigation. Therefore, further multicenter studies with larger samples are necessary to validate the findings.

Conclusions

The study revealed that *Streptococcus* (gram-positive) is the most common pathogen causing pharyngeal infections (72.1%), while *Pseudomonas aeruginosa* was the least frequent (0.4%), indicating the dominance of gram-positive bacteria in community-acquired pharyngeal infections in the region.

A clear seasonal dependency in the spread of microorganisms was identified: the peak activity of *Streptococcus* (gram-positive) occurs in July (33%), *Candida albicans* in June (15%), and *Staphylococcus aureus* in August and November (9% and 8%, respectively). The lowest activity of all microorganisms is observed in winter (December, 2%), highlighting the need for seasonally adapted prevention and treatment strategies.

The highest multiple antibiotic resistance (MAR) index was demonstrated by *Citrobacter* (0.70), followed by *Pseudomonas aeruginosa* (0.38) and *Staphylococcus haemolyticus* (0.27). The average MAR index for fungi (0.32) exceeds that for bacteria (0.20), indicating a higher resistance level among fungal pathogens, primarily to azoles.

Streptococcus (gram-positive) showed high susceptibility to amikacin (100%, 8 tests), ceftriaxone (98.5%, 131 tests), and cefepime (94.7%, 171 tests), making them optimal for empirical therapy, though the data for amikacin require further confirmation due to study limitations.

For *Staphylococcus aureus*, the most effective antibiotics were levofloxacin, meropenem, and ofloxacin (100% susceptibility).

Clotrimazole (100%) and ketoconazole (90%) emerged as the most effective antifungal agents. Nystatin (53.3%) and itraconazole (13.3%) have limited effectiveness due to high resistance.

A high positive correlation was found between fluconazole and ketoconazole (1.00), imipenem and meropenem (0.69), and levofloxacin and ciprofloxacin (0.44), reflecting shared resistance mechanisms. A negative correlation between azithromycin and vancomycin (-0.35) suggests the potential effectiveness of vancomycin as an alternative when resistance to azithromycin is present.

High resistance to clarithromycin (54.3% in *Streptococcus* (gram+), 66.7% in *S. aureus*), amoxicillin-clavulanate (83.3% in *Enterobacter*), and fluconazole (46.7% in *Candida albicans*) indicates the need to restrict their use in empirical therapy.

The highest increase in resistance is forecasted for ampicillin (30.1%), pointing to the need for enhanced control over its use. In contrast, cefepime and clarithromycin show a predicted decrease in resistance, which may reflect the effectiveness of local antibiotic therapy protocols.

Ethical Approval

The study was approved by the Bioethics Committee of the Bogomolets National Medical University (protocol №187 23.09.2024) and complies with the requirements of the Helsinki Declaration. Since the study is retrospective, obtaining informed consent from patients was not required.

Funding

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Conflict of Interest

The authors declare no conflicts of interest in conducting the research, authorship, or publication of this article.

Consent for Publication

All authors have reviewed the manuscript text and provided consent for its publication.

AI Disclosure

The authors used ChatGPT (OpenAI) for language editing of the English text. The authors

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reviewed and verified all AI-generated content to ensure accuracy and integrity.

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REFERENCES

1. World Health Organization. Antimicrobial resistance: global report on surveillance. Geneva: World Health Organization; 2014. Available from: https://www.who.int/publications/i/item/9789241564748.
2. Jones RN, Castanheira M, Rhomberg PR, Woosley LN, Pfaller MA. Activity of newer antimicrobial agents tested against contemporary clinical isolates of Staphylococcus aureus from a global surveillance program (2017). Diagn Microbiol Infect Dis. 2019;94(2):195-199.
3. Pfaller MA, Carvalhaes CG, Smith CJ, Diekema DJ, Castanheira M. Bacterial and fungal pathogens isolated from patients with bloodstream infection: frequency of occurrence and antimicrobial susceptibility patterns from the SENTRY Antimicrobial Surveillance Program (2016-2017). Diagn Microbiol Infect Dis. 2020;97(2):115016. doi: 10.1016/j.diagmicrobio.2020.115016. PubMed ID: 32111415.
4. World Health Organization. Global action plan on antimicrobial resistance. Geneva: World Health Organization; 2015. Available from: https://www.who.int/publications/i/item/9789241509763.
5. Bassetti M, Vena A, Croxatto A, Righi E, Guery B. How to manage Pseudomonas aeruginosa infections. Drugs Context. 2018;7:212527. doi: 10.7573/dic.212527. PubMed ID: 29872449.
6. Berkow EL, Lockhart SR. Fluconazole resistance in Candida species: a current perspective. Infect Drug Resist. 2017;10:237-245. doi: 10.2147/IDR.S118892. PubMed ID: 28814889.
7. Gao X, Wang H, Wang J, Wang C, Gao D, Liu M, Liu F, Yu S, Zeng J, Zeng Z. First report of a Citrobacter freundii strain carrying blaNDM-1 from a patient with chronic obstructive pulmonary disease in China. Infect Drug Resist. 2019;13:1089-1095.
8. Castanheira M, Deshpande LM, Mendes RE, Canton R, Sader HS, Jones RN. Variations in the occurrence of resistance phenotypes and carbapenemase genes among Enterobacteriaceae isolates in 20 years of the SENTRY Antimicrobial Surveillance Program. Open Forum Infect Dis. 2019;6(Suppl 1):S23-S33. doi: 10.1093/ofid/ofy347. PubMed ID: 30895212.
9. Diekema DJ, Pfaller MA, Shortridge D, Zervos M, Jones RN. Twenty-year trends in antimicrobial susceptibilities among Staphylococcus aureus from the SENTRY Antimicrobial Surveillance Program. Open Forum Infect Dis. 2019;6(Suppl 1):S47-S53. doi: 10.1093/ofid/ofy270. PubMed ID: 30895214.
10. Pelucchi C, Grigoryan L, Galeone C, Esposito S, Huovinen P, Little P, et al.; ESCMID Sore Throat Guideline Group. Guideline for the management of acute sore throat. Clin Microbiol Infect. 2012;18(Suppl 1):1-28. doi: 10.1111/j.1469-0691.2012.03766.x. PubMed ID: 22432746.

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Особливості регіональної антибіотикорезистентності при фарингеальних інфекціях

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Анотація: *Антибіотикорезистентність (АБР) є глобальною проблемою для населення. Всесвітня організація охорони здоров'я (ВООЗ) прогнозує, що до 2050 року АБР може спричинити 10 мільйонів смертей щорічно, якщо не вжити заходів протидії (WHO, 2019). Зростання кількості мультирезистентних (МР) бактерій і грибків ускладнює стратегії лікування, особливо в лікувально-профільних закладах, в яких за різними даними, поширені нозокоміальні інфекції. Проаналізувати результати бактеріологічного дослідження мазків із зіву з антибіотикограмою при захворюваннях глотки та на основі даних аналізу розробити рекомендації для емпіричної антибіотикотерапії. На базі КНП «Броварська багатопрофільна клінічна лікарня» з 2024 по 2025 роки було проведено 255 мазків із зіву з посівом для визначення бактеріологічного складу слизової оболонки глотки та антибіотикорезистентності. Ізоляти ідентифікували за допомогою стандартних мікробіологічних методів, таких як культивування на поживних середовищах і біохімічні тести. Для оцінки стійкості до антибіотиків використовували метод визначення мінімальної інгібуючої концентрації (MIC) або дискодифузійний метод (метод Кірбі-Бауера). Тестування проводили на панелі антибіотиків. Результати інтерпретували за стандартами, такими як CLSI (Clinical and Laboratory Standards Institute), щоб класифікувати штами як чутливі, помірно чутливі або стійкі. Для комплексного аналізу мікробіологічних даних та профілів антибіотикорезистентності використовувалась багаторівнева статистична методологія. Аналіз здійснювався з використанням мови програмування Python 3.9 та спеціалізованих бібліотек для наукової обробки даних (NumPy, SciPy, Pandas та scikit-learn; візуалізація даних проводилася засобами Matplotlib та Seaborn.). Протигрибкові препарати - клотримазол (100%) та кетоконазол (90.0%) - показали найвищу ефективність для лікування грибкових інфекцій. Цефтазидим, ванкоміцин, бензилпеніцилін та кліндаміцин показали низьку ефективність (менше 50%), що може свідчити про високу резистентність мікроорганізмів до цих препаратів. Амікацин, цефтріаксон та цефепім є найефективнішими антибіотиками для В-гемолітичного стрептококу з точки зору чутливості. Staphylococcus aureus має повну чутливість до левофлоксацину, офлоксацину та меропенему. Дослідження підкреслює серйозність проблеми антибіотикорезистентності та необхідність раціонального використання антимікробних препаратів у клінічній практиці.*

Ключові слова: антибіотикорезистентність, антибіотики, бактерії, глотка, грибки, захворювання глотки, тонзиліт, ротова порожнина, фарингіт