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Short communication

Antimicrobial susceptibility trends of *escherichia coli* in urinary tract infections: A 4-year retrospective study at Biotek laboratory, Skopje (2021–2024)

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Introduction

Urinary tract infections (UTIs) are among the most common bacterial infections worldwide, with a particularly high incidence in women and elderly patients. In North Macedonia, UTIs represent one of the leading causes for outpatient visits and antibiotic prescriptions. *Escherichia coli* is the predominant uropathogen, responsible for approximately 80% of community-acquired cases.

The growing challenge of antimicrobial resistance (AMR) has complicated empirical therapy. Inappropriate prescribing, self-medication, and the widespread use of broad-spectrum antibiotics during the COVID-19 pandemic have accelerated resistance trends. Continuous surveillance of local resistance patterns is therefore essential for guiding clinicians in selecting effective empirical therapy.

This study provides a retrospective analysis of *E. coli* susceptibility trends at Biotek Laboratory in Skopje over a 4-year period (2021–2024), focusing on commonly prescribed antibiotics. The findings aim to support rational prescribing and antimicrobial stewardship in private healthcare settings.

Materials and methods

Microbiological reports from urine cultures processed at Biotek Laboratory between January 2021 and December 2024 were retrospectively analyzed. Identification of *E. coli* isolates was performed using standard microbiological procedures. Antimicrobial susceptibility testing was conducted using VITEK 2 automated systems and Kirby-Bauer disk diffusion, interpreted according to EUCAST (2024) guidelines.

The antibiotics evaluated included: Ampicillin, Amoxicillin, Amoxicillin/clavulanic acid, Ciprofloxacin, Trimethoprim/ sulfamethoxazole, Nitrofurantoin, Fosfomycin, and selected cephalosporins (Ceftriaxone, Cefotaxime, Ceftazidime).

Results and discussion

Between 2021 and 2024, more than ten thousand *E. coli* isolates were recovered from urinary tract infections at Biotek Laboratory. This large dataset allowed us to observe clear year-to-year shifts in antimicrobial susceptibility.

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The story begins with the traditional penicillins, Ampicillin and Amoxicillin. Already in 2021, resistance was alarmingly high, with more than half of isolates unaffected by therapy. By 2024, resistance exceeded 70%, confirming that these agents have lost their clinical relevance for empirical treatment.

A more dramatic change unfolded with Amoxicillin/clavulanic acid. In the early years of the study, this combination appeared reliable, with sensitivity rates above 80–90%. Yet, beginning in 2023, its effectiveness collapsed. By 2024, only one-third of isolates remained sensitive, while more than half were classified as intermediate. This sudden shift suggests the emergence of new resistance mechanisms, likely linked to ESBL-producing strains, and highlights the fragility of relying on this drug as a cornerstone of therapy.

Fluoroquinolones, represented by Ciprofloxacin, showed a slower but steady decline. Resistance rose from 18% in 2021 to over 25% in 2024. Although not as abrupt as the changes seen with amoxicillin/clavulanic acid, this creeping resistance is worrisome given ciprofloxacin's role as a second-line agent.

Similarly, Trimethoprim/ sulfamethoxazole demonstrated a gradual erosion of efficacy, with resistance climbing from 20% to more than 31% over the study period. Once considered a cost-effective option, its declining utility now limits its role in empirical therapy.

In contrast, two agents stood out for their stability: Nitrofurantoin and Fosfomycin. Across all four years, sensitivity consistently remained above 95%. Their resilience against resistance pressures underscores their value as first-line treatments for uncomplicated UTIs, fully aligned with WHO recommendations.

The third-generation cephalosporins (Ceftriaxone, Cefotaxime, Ceftazidime) maintained high sensitivity throughout the study, generally above 94%. However, the potential emergence of ESBL-producing strains means that vigilance is required, as these agents could quickly lose their effectiveness if resistance spreads.

Taken together, the data reveal a dynamic landscape: persistent high resistance to older penicillins, a sudden collapse in amoxicillin/clavulanic acid efficacy, gradual erosion of fluoroquinolone and trimethoprim/ sulfamethoxazole effectiveness, and stable performance of nitrofurantoin and fosfomycin. These contrasting trajectories emphasize the importance of continuous surveillance and the need for adaptive prescribing policies.

Conclusion

The study underscores the dynamic nature of *E. coli* resistance in Skopje. Rising resistance to ciprofloxacin and trimethoprim/sulfamethoxazole necessitates a re-evaluation of empirical protocols. The dramatic decline in amoxicillin/clavulanic acid efficacy in 2023–2024 is particularly alarming and warrants further molecular investigation into resistance mechanisms.

Conversely, nitrofurantoin and fosfomycin remain highly effective and should be prioritized for uncomplicated UTIs. Pharmacists and clinicians must advocate for culture-based treatment, rational antibiotic use, and patient education to mitigate further resistance spread.

Future research should include molecular characterization of resistant strains and expanded surveillance across multiple institutions in North Macedonia to provide a comprehensive national picture of AMR trends.

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