

Antibiotic Resistance in Urinary Isolates of *Escherichia coli* from College Women with Urinary Tract Infections[∇]

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Of 176 urine isolates from female students positive for *Escherichia coli*, 29.6% were trimethoprim-sulfamethoxazole resistant and none were nitrofurantoin resistant. Among students with a history of urinary tract infection (UTI) ($n = 119$), resistance to ciprofloxacin was 11.8%, compared to 1.8% among those without prior UTI. Nitrofurantoin should be considered for empirical therapy of lower tract UTI.

Urinary tract infections (UTIs) are a common cause of morbidity in women (7). The majority of cases involve only the lower urinary tract, and the most common pathogen is *Escherichia coli* (9, 21). For uncomplicated infections, especially those without signs of upper tract infection, empirical therapy without culture and susceptibility analysis are recommended (3, 4, 19). Resistance to amoxicillin has been established for years, and resistance to trimethoprim-sulfamethoxazole (TMP-SMX) has emerged more recently, with rates of >20% in some areas (9). The Infectious Diseases Society of America recommends that in regions where resistance rates to TMP-SMX exceed 10% to 20%, TMP-SMX should not be used for empirical therapy (19). Fluoroquinolones, in particular ciprofloxacin, are used increasingly (10, 11), but resistance to ciprofloxacin is also increasing (12, 15).

College women have a high incidence of uncomplicated UTIs and are frequently treated empirically. Unfortunately, since studies of resistance patterns include mostly complicated UTIs in older women (9, 21), resistance may develop undetected among college students with lower tract UTIs.

The objective of this analysis was to determine resistance patterns among *E. coli* isolates from young women with UTIs in a college setting in the southeastern United States.

All urine isolates in this study were processed at the Duke University Clinical Microbiology Laboratory. The records of female students presenting to a university student health clinic with symptoms of UTI and who had urine culture and sensitivity results positive for *E. coli* were examined retrospectively. The susceptibilities to common antibiotics were analyzed and compared to those for all urinary *E. coli* isolates, as described in the antibiogram of the health system clinical microbiology laboratory. The clinical records were analyzed for the following variables: age, presence of a urinary anomaly, presence of upper UTI symptoms (fever or flank pain), and history of previous UTI.

Statistical analysis was performed using the chi-square test and the Fisher exact test for dichotomous variables.

Over the three calendar years 2005 to 2007, in the entire health system, there were 10,289 urinary isolates positive for *E. coli*, which were analyzed for antibiotic susceptibilities. One hundred seventy-six isolates of culture-positive UTI were obtained from 167 female patients presenting to the student health clinic. The average age (\pm standard deviation) was 22.0 (\pm 6.2) years. Ampicillin resistance occurred in 3,857 (37.5%) of the health system isolates and 65 (37%) of the students ($P = 0.88$). TMP-SMX resistance occurred in 2,877 (30.0%) of the health system isolates and 54 (29.6%) of the students ($P = 0.43$). Nitrofurantoin resistance occurred in 282 (2.7%) of the health system isolates and none (0%) of the students ($P = 0.23$). Ciprofloxacin resistance occurred in 2,065 (20.1%) of the health system isolates and 12 (6.8%) of the students ($P < 0.0001$).

None of the 176 college student UTI records showed anatomical abnormalities or renal insufficiency. Forty-two (23.9%) isolates were from patients who had symptoms of fever and/or flank pain. There was no significant difference in antibiotic resistance between isolates from patients with and without those symptoms.

Among the 176 episodes of UTI, 119 (67.6%) had been preceded by a prior UTI and 57 (32.4%) had not. Resistance to ampicillin occurred in 41 (34.5%) episodes among patients with a prior history of UTI, compared to 26 (45.6%) episodes among patients without a prior history ($P = 0.15$). Resistance to TMP-SMX occurred in 32 (26.9%) episodes among patients with a prior history of UTI, compared to 22 (38.6%) episodes among patients without a prior history ($P = 0.11$), and resistance to ciprofloxacin occurred in 14 (11.8%) episodes among patients with a prior history of UTI, compared to 1 (1.8%) episode among those without a prior history ($P = 0.04$). There was no resistance to nitrofurantoin. A total of 7 of the 11 (63.6%) isolates resistant to ciprofloxacin were also resistant to ampicillin and TMP-SMX.

Among the student health isolates, resistance to ciprofloxacin was 5/50 (10.2%) in 2005; 3/46 (6.7%) in 2006; and, 4/80 (5.0%) in 2007 ($P > 0.05$ for trend).

The Infectious Diseases Society of America has recommended that when resistance to TMP-SMX is greater than 10

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to 20%, TMP-SMX should not be used as first-line empirical therapy (19). As this study shows a resistance level of 29.6%, which is higher than levels from recent studies (2, 8, 20), TMP-SMX is no longer ideal for first-line therapy.

The rate of resistance to ciprofloxacin (6.8%) was concerning, as ciprofloxacin is now the most commonly prescribed therapy for UTIs (8, 11). Furthermore, resistance to ciprofloxacin was particularly common among women with a history of prior UTI (11.8%). Thus, resistance to fluoroquinolones may be a significant issue only in higher-risk groups, including patients with histories of prior UTI and antibiotic use (1). Another interesting observation is that, of the isolates associated with infections causing flank pain or fever, none displayed resistance to ciprofloxacin. This is consistent with observations that virulent strains might be less resistant to antimicrobials than strains causing only colonization or lower tract UTI (13, 16).

This study likely overestimates the prevalence of antibiotic resistance in *E. coli*, as patients who responded to empirical therapy, and presumably had susceptible organisms, would not have had urine culture and sensitivity tests performed and would not have been included in the study. In order to assess resistance rates in this lower-risk group, we have initiated a prospective study of the urine isolates of all symptomatic students. A prospective study may determine whether resistance to ciprofloxacin develops among patients with a history of treatment of UTIs, as this study suggests.

In conclusion, in college women with culture-positive UTIs at the study institution, resistance to TMP-SMX has approached 30%, so this agent should no longer be used for empirical therapy. Ciprofloxacin may be appropriate for empirical therapy in women without previous UTIs. There was not a single case of resistance to nitrofurantoin, suggesting that this agent should be strongly considered as a first-line empirical treatment for uncomplicated lower UTIs (5, 6, 14, 17, 18).

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