Antibiotic Susceptibility Patterns of Community-Acquired Urinary Tract Infection Isolates from Female Patients on the US (Texas)-Mexico Border

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ABSTRACT

Monitoring antibiotic susceptibility patterns of uropathogens at a local level yields important information regarding emerging problems of antibiotic resistance and provides assistance in managing empirical therapy. The purpose of this study was to evaluate the susceptibility of bacterial strains isolated from female patients with community-acquired urinary tract infections (UTIs) in a US-Mexico border city (El Paso, Tex). The study was conducted at a university affiliated community hospital that serves the city and surrounding areas. A retrospective case series from July 2000 through June 2001 identified a total of 880 patients with a positive urine culture and a colony count of $\geq 10^4$ CFU/mL. There were 888 bacterial isolates collected from these 880 cultures.

The predominant species was *Escherichia coli,* representing 71.3% of the isolates, followed by *Klebsiella pneumoniae* (9.0%), *Enterococcus* spp. (5.0%), coagulase-negative staphylococci (2.8%), *Citrobacter* spp. (2.6%), *Enterobacter* spp. (2.3%), *Proteus mirabilis* (1.9%), *Pseudomonas aeruginosa* (1.2%), *Staphylococcus aureus* (1.1%), other gram-negative spp. (1.1%), *Klebsiella* spp. (0.9%), *Proteus* spp. (0.5%), and other gram-positive spp. (0.3%). Trimethoprim-sulfamethoxazole, which has been a first line empiric agent for urinary tract infections, showed relatively poor activity against *E. coli* isolates (73.5% susceptibility). However, alternative empiric drugs such as nitrofurantoin, ciprofloxacin and ofloxacin showed good activity against *E. coli* (98.1%, 93.7% and 92.9% susceptibility, respectively). These findings indicate that continued surveillance at a local level is essential to maintaining the efficacy and safety of empirical therapy for UTIs.

INTRODUCTION

In the United States, urinary tract infections (UTIs) remain a leading cause of morbidity and health-care expenditure for people of all age groups.[1] UTIs account for approximately 11.3 million office visits, with an overall annual cost of 1.6 billion dollars to the US health-

Table 1. Frequency of community-acquired uropathogens.

Organism Rank	No. of Isolates (%)
1. *E. coli*	633 (71.3)
2. *Klebsiella pneumoniae*	80 (9.0)
3. *Enterococcus* spp.[a]	44 (5.0)
4. Coagulase-Negative Staphylococci (CoNS)[b]	25 (2.8)
5. *Citrobacter* spp.[c]	23 (2.6)
6. *Enterobacter* spp.[d]	20 (2.3)
7. *Proteus mirabilis*	17 (1.9)
8. *Pseudomonas aeruginosa*	11 (1.2)
9. *Staphylococcus aureus*	10 (1.1)
10. Other gram-negative spp.[e]	10 (1.1)
11. *Klebsiella* spp.[f]	8 (6.9)
12. *Proteus* spp.[g]	4 (0.5)
13. Other gram-positive spp.[h]	3 (0.3)

[a]Includes E. faecalis (39) and E. faecium (5).

[b]Includes S. epidermidis (12), S. hominis (2), S. haemolyticus (3), S. warneri (2), S. auricularis (3), S. saprophyticus (2), and S. capitis (1).

[c]Includes C. braakii (15), C. freundii (6), and C. koseri (2).

[d]Includes E. cloacae (9), E. aerogenes (10), and E. taylorae (1).

[e]Includes Serratia marcescens (1), Burkholderia cepacia (4), Acinetobacter baumannii (1), Morganella morganii (3), and Providencia rustigianii (1).

[f]Includes K. oxytoca (4), K. ornithinolytica (2), and Klebsiella spp. (2).

[g]Includes P. vulgaris (2) and P. penneri (2).

[h]Includes S. agalaciae (Group B) (1), S. bovis (1), and S. pneumoniae (1).

care system.[2] An estimated 50% of women will experience at least one UTI at some point in their lifetime,[3] and between 20% and 40% of women will have recurrent episodes.[4,5]

Complicating this situation is the emerging pattern of antimicrobial resistant UTIs.[6-8] These microbial resistant organisms result in significantly more morbidity, mortality, and cost than those due to susceptible bacteria.
Because most UTIs are treated empirically, the selection of an antimicrobial agent should be determined not only by the most likely pathogen but also by its expected susceptibility pattern. It is important to realize that there may be marked differences in antibiotic resistance patterns between various geographic areas. In this US-Mexico border region (El Paso, Tex – Cd. Juarez, Chih.), we are concerned that antimicrobial resistance might emerge as a result of factors such as the over-the-counter sale of antibiotics in Mexico and self-treatment with antibiotics.

The aim of this study was to determine the antibiotic susceptibility pat-

terns of recent community-acquired urinary tract isolates from female patients identified by one large clinical laboratory in this border area. Analysis of this antimicrobial susceptibility data provides information for comparison with national trends and will allow the rational selection of antibiotics for empiric treatment of UTIs in this region.

METHODOLOGY

Source of Data and Data Collection

This study was approved by the Institutional Review Board of Texas Tech University Health Sciences Center?El Paso and was conducted at Thomason Hospital, a 335-bed university affiliated county hospital that serves the city and the surrounding rural area. The study population consisted of all female patients having positive community-acquired urine cultures with a colony count of $\geq 10^4$ CFU/mL. Community acquired isolates were defined as either a culture collection from a patient not admitted to the hospital or a culture taken from a patient within 48 hours of hospital admission. These patients were identified from computerized laboratory reports. The study was retrospective with an observation period of 1 year (July 1, 2000 through June 30, 2001).

Antibiotic susceptibility at the hospital laboratory is determined by a broth microdilution method using dehydrated panels provided by a commercial testing system (Dade Behring Inc.). Bacteria are classified as susceptible, intermediate, or resistant to antimicrobial agents in accordance with current National Committee for Clinical Laboratory Standards (NCCLS) recommendations.

Demographic information (age, race, and culture collection site) and clinical data (medical diagnosis and antibiotics prescribed) were obtained from the patient's medical record. It was also noted whether the patient was admitted from a family home, long-term care facility, or other residence (eg, homeless shelter).

Statistical Analysis

Frequencies were determined for uropathogen occurrence, their susceptibility patterns and their distribution among patient demographic parameters.

RESULTS

Patient Demographics

From July 1, 2000 through June 30, 2001, a total of 880 patients with a positive urine culture and a colony count of $\geq 10^4$ CFU/mL were identified. Ages ranged from 4 days to 100 years with an average age of 40.8 years. The age distribution was 5.3% for patients aged ≤1 year, 4.1% for 2 to 14 years, 71.4% for 15 to 64 years, and 19.2% for ≥65 years. As for ethnicity, there were 793 Hispanics (90.1%) and 87 Non-Hispanics (9.9%). Patients were admitted from family homes (871), long-term care facilities (5), and other hospitals (46).

Cultures were obtained from these 880 patients at the following locations: Outpatient: emergency room (470 patients, 53.4%), Inpatient Services: internal medicine (182, 20.7%), surgery (70, 8.0%), pediatrics (43, 4.9%), obstetrics (81, 9.2%), intensive care unit (8, 0.9%), labor and delivery (24, 2.7%), and orthopedics (2, 0.2%).

Empirical therapy was initiated in 74.4% of the patients. The most common antibiotic given in the ER was nitrofurantoin (52.9%). On the inpatient wards levofloxacin (54.5%) was the most frequently administered drug.

Urine Culture Results

There were a total of 888 bacterial isolates obtained from the 880 cultures. A single bacterial isolate was recovered from the urine of 872 patients. Two bacterial isolates were identified on culture of urine from 8 patients. One hundred

nine (12.3%) bacterial isolates had a colony count between 10,000 to 70,000 CFU/mL and 779 (87.7%) bacterial cultures had a colony count of ≥ 100,000 CFU/mL. Table 1 illustrates the overall frequency and rank order of community-acquired uropathogens. As expected *E. coli* was the most frequently reported isolate (71.3%).

Antimicrobial Susceptibility

Antimicrobial susceptibility results are summarized in Table 2. Approximately half of the *E. coli* isolates were resistant to ampicillin and tetracycline. Importantly, only 73.5% of *E. coli* were susceptible to trimethoprim-sulfamethoxazole (TMP-SMX). The best activity against *E. coli* (>95% susceptible) was attained with cefotaxime, cefotetan, cefuroxime, amikacin, gentamicin, tobramycin, and nitrofurantoin.

DISCUSSION

This study was conducted in El Paso, Texas. El Paso is located in the western tip of Texas and is a border city adjacent to Juarez, Chihuahua (Mexico) and southern New Mexico. The El Paso-Juarez border is home to 1.9 million people and is the largest metropolitan area along the US-Mexico border.[9,10] It is estimated that there are 55 million legal northbound border crossings (Mexico into US) each year.[11]

A border city such as El Paso should be considered a unique entity as compared to other regions of the country. Antimicrobial resistance in this area may be associated with factors such as the over-the-counter sale of antibiotics in Mexico and resultant self-treatment with antibiotics. Many El Paso residents also obtain their medications in Juarez because of cost considerations. The potential for the amplification of antibiotic resistance in this area is compounded by the massive back-and-forth population movements and the high frequency of family and social contacts on both sides of the border. At this moment, there is no organized regional surveillance system along the US-Mexico border for evaluation of antimicrobial resistance.

In this study, gram-negative organisms accounted for 90.8% of the urinary tract isolates. The most frequent uropathogen was *E. coli* (71.3%). Karlosky et al[12] conducted a nation wide study looking at antimicrobial resistance among urine isolates of *E. coli* from female outpatients in the US from 1995 to 2001. For the year 2001, susceptibility rates among *E. coli* isolates to ampicillin (47.2% vs 62.1%), ciprofloxacin (93.7% vs 97.4%), nitrofurantoin (98.1% vs 98.3%), and TMP-SMX (73.5% vs 83.8%) slightly varied between our local study and Karlowsky's nationwide study, respectively. In this region ampicillin, ciprofloxacin and TMP-SMX are over-the-counter medication that can be easily obtained from the other side of the border (Mexico). This may be one of the reasons why the susceptibility rates were below those seen in the nationwide study.

Guidelines published by the Infectious Disease Society of America (IDSA) previously recommended TMP-SMX as a first line empiric agent for uncomplicated UTIs.[13] According to the IDSA guidelines, this treatment recommendation should only be considered in communities where the TMP-SMX resistance rates are less than 10 to 20%. Recently published studies have noted that resistance to TMP-SMX has increased in some regions of the United States.[12,14,15] Our study found that 26.5% of *E. coli* isolates were resistant to TMP-SMX. These findings indicate that initial empirical treatment with TMP-SMX is no longer appropriate in this area. Alternatives for empiric oral therapy of UTIs recommended by the IDSA are fluoroquinolones and nitrofurantoin.[13]

Table 2. Antimicrobial susceptibility among community-acquired uropathogens.

	Organism (no. isolated)																	
	E.coli (633)		*K. pneumoniae* (80)		*Enterococcus spp.* (44)		CoNS (25)		*Citrobacter spp.* (23)		*Enterobacter spp.* (20)		*P. mirabilis* (17)		*P. aeruginosa* (11)		*S. aureus* (10)	
	# T[a]	% S[b]	# T[a]	% S[b]	# T[a]	% S[b]	# T[a]	% S[b]	# T[a]	% S[b]	# T[a]	% S[b]	# T[a]	% S[b]	# T[a]	% S[b]	# T[a]	% S[b]
Ampicillin	633	47.2	80	6.3	44	93.2	21	9.5	—	—	20	10.0	17	76.5	—	—	10	0.0
Carbenicillin	575	48.0	70	7.1	—	—	—	—	22	59.1	18	77.8	16	81.3	—	—	—	—
Piperacillin	510	69.8	60	83.3	—	—	—	—	22	81.8	15	80.0	15	93.3	11	100	—	—
Oxacillin	—	—	—	—	—	—	15	0	—	—	—	—	—	—	—	—	10	90.0
Imipenem	—	—	—	—	—	—	15	0	—	—	—	—	—	—	11	90.9	9	88.9
Amox/K	—	—	—	—	—	—	15	0	—	—	—	—	—	—	—	—	10	80
Azetreonam	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	90.9	—	—
Cefazolin	580	92.8	70	91.4	—	—	15	0	—	—	18	33.3	15	46.7	—	—	10	90.0
Cephalothin	578	29.1	70	82.9	—	—	—	—	22	45.5	18	0	16	31.3	—	—	—	—
Cefotetan	576	99.7	70	98.6	—	—	—	—	22	100	18	77.8	16	87.5	—	—	—	—
Cefuroxime	633	98.6	80	96.3	—	—	—	—	23	95.7	20	80.0	17	94.1	—	—	—	—
Cefotaxime	631	99.7	80	100	—	—	15	0	23	95.7	20	95.0	17	100	11	9.1	10	90.0
Cefepime	—	—	—	—	—	—	15	6.7	—	—	—	—	—	—	11	90.9	10	90.0
Amikacin	632	100	80	98.8	—	—	—	—	23	95.7	20	100	—	—	11	100	—	—
Gentamicin	633	97.2	80	97.5	—	—	25	80.0	23	100	20	100.0	17	88.2	11	81.8	10	100
Tobramycin	632	98.6	80	97.5	—	—	—	—	23	100	19	100.0	17	94.1	11	90.9	—	—
Ciprofloxacin	632	93.7	80	92.5	44	75.0	25	64.0	23	91.3	20	95.0	17	88.2	11	90.9	10	90.0
Levofloxacin	—	—	—	—	44	81.8	25	64.0	—	—	—	—	—	—	—	—	10	90.0
Ofloxacin	575	92.9	70	91.4	—	—	—	—	22	90.9	18	94.4	16	87.5	—	—	—	—
Clindamycin	—	—	—	—	—	—	25	88.0	—	—	—	—	—	—	—	—	10	100
Vancomycin	—	—	—	—	44	100	25	100	—	—	—	—	—	—	—	—	10	100
Nitrofurantoin	628	98.1	79	87.3	43	97.7	23	95.7	22	95.5	19	100	17	0	—	—	10	90.0
Tetracycline	575	54.8	70	77.1	44	31.8	25	76.0	22	63.6	17	88.2	16	0	—	—	10	90.0
Rifampin	—	—	—	—	44	77.3	25	100.0	—	—	—	—	—	—	—	—	10	100
TMP-SMX	633	73.5	80	93.8	—	—	25	88.0	23	73.9	20	100	17	82.4	—	—	10	100

[a]Number of isolates tested against each antimicrobial agent; [b]Percent of isolates susceptible to antimicrobial agent; TMP-SMX = Trimethoprim-Sulfamethoxazole.

The fluoroquinolones tested in this study (ciprofloxacin and ofloxacin) showed good activity against *E. coli.* Ninety-three-point-seven percent (93.7%) and 92.9% of the *E. coli* strains were susceptible to ciprofloxacin and ofloxacin, respectively. Nitrofurantoin demonstrated excellent activity against *E. coli* isolates (98.1% susceptible), but this drug would not be recommended for serious upper urinary tract infections or for those cases with systemic involvement.

Urinary tract infections are the most common bacterial infections and can occur throughout the lifetime of an individual. Approximately 7 million Americans, mostly women, see a physician each year because of urinary tract infections. Urinary tract infections are often perplexing and painful. Treatment is usually initiated before urinary culture and sensitivity test results are available (if urine cultures are obtained). Therefore, it is important to monitor the status of antimicrobial resistance among uropathogens in order to improve treatment recommendations. Studies such as this one are useful in determining any local trends and risk factors for antimicrobial resistance that would not be apparent in national studies. Continued surveillance at both local and national levels is essential to maintaining the efficacy and safety of empirical therapy for UTIs.

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