

30% [8]. A recent hospital based cross-sectional quantitative study from Ujjain, India, depicted that ORS, antimicrobials, probiotics and racecadrotil was used in 58%, 71%, 68% and 19% of cases, respectively [9], in present study it was 90.2%, 82.5%, 56.4% and 22.7%, respectively.

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Trend of Antibiotic Resistance in Children with First Acute Pyelonephritis

There have been many recent reports of increasing antimicrobial resistance among uropathogens. In this study, we reviewed medical records of children (<18 yr age) with first acute pyelonephritis admitted to our Institution between January 2005 to December 2009. 411 children (189 girls) were studied and increasing trend in bacterial resistance toward co-trimoxazole, 2nd and 3rd generation cephalosporins and gentamicin were observed.

Key words: Antibiotic, Child, Pyelonephritis, Resistance, Serbia.

Prompt treatment of childhood acute pyelonephritis is likely to reduce the risk of permanent renal scarring [1]. Increased antimicrobial resistance, especially the resistance against broad-spectrum beta-lactams (ESBL) uropathogens has jeopardized the antibiotic treatment of UTI in children [2]. The aim of this study was to assess the changing trend of local resistance patterns of urinary pathogens to commonly used anti-microbial agents in Serbia during the last 5 years in children with acute pyelonephritis.

Medical records from January 2005 to December 2009 of all children aged less than 18 years of age admitted to the Nephrology or Pediatrics Department at the University Children's Hospital in Belgrade for their first acute pyelonephritis were reviewed ($n=411$; 189 girls; median age 4 mo; range 0.1-112 mo). Two different periods, early (from January 2005 to December 2007) and late (from January 2008 to December 2009), were studied. The following antimicrobial agents were tested: ampicillin

(AMP), a combination of sulphametho-xazole and trimethoprim (TMP-SMZ), cephalexin, ceftriaxone, cefotaxime, ceftazidime, gentamycin, amikacin and ciprofloxacin. Multi-drug resistance was defined when resistance to at least three different groups of antibiotics was apparent.

When early and late study periods were compared increasing trends in bacterial resistance patterns were observed towards TMP-SMX, 2nd and 3rd generation cephalosporins and gentamicin as well as in multidrug resistance, while a decreasing trend was seen towards amikacin and unchanged towards ciprofloxacin (**Table I**). The majority of ESBL (+) *E. coli* strains were multi-resistant (56.5 % in early and 66.23% in late period), while only 3.4% and 5.6% of ESBL (-) strains, respectively.

In poor and underdeveloped countries, overall prevalence of antimicrobial resistance is notably high, reflecting irrational and inordinate use of anti-microbial

TABLE I CLINICAL CHARACTERISTICS IN THE TWO STUDY PERIODS

	2005-2007 (n=136)	2008-2009 (n=275)
Gender, M/F (%)	51.5/48.5	55.3/44.7
Age (months)	3 (0.5-9.0)	4.5 (1.0-7.5)
ESBL (+) UTI (%)	23.5	63.6
Abnormal renal US (%)	37.4	26.7
VUR (%)	31.7 (63)	29 (158)
Urinary pathogens (%)		
<i>E.coli</i>	82.3	88.0
<i>Klebsiella</i>	6.1	7.3
<i>Enterococcus</i>	3.7	2.5
<i>In vitro</i> resistance (%)		
Ampicillin	85.8	98.0
TMP-SMZ*	38.5	59.2
Cephalexin*	30.8	69.3
Cephtriaxone*	34.0	67.0
Cefotaxime*	26.5	65.0
Ceftazidime*	42.6	62.7
Gentamicin*	33.1	56.3
Amikacin [§]	17.9	8.5
Ciprofloxacin	0.9	0.9
Multidrug resistance [#]	16.9	44.7

US, Ultrasound; TMP-SMZ co-trimoxazoles, VUR, vesicoureteral reflux; ESBL (+) UTI, Urinary tract infections caused by ESBL-producing microorganisms; 2005-2007 vs 2008-2009 Practice: * <0.001; # <0.01; § <0.05.

agents [3]. We observed about 50% resistance towards TMP/SMX in this study, similar to that reported in Turkey [4], Greece [5], England [6], Belgium [7] and Taiwan [3], but less common than in Cambodia [8], Central African Republic [9] and Pakistan [10]. Thus, the use of TMP-SMZ as a single agent for empiric treatment of pediatric UTI would not cover half of the uropathogens. We also found increased resistance towards gentamicin, while amikacin remained suitable for empiric treatment of acute pyelonephritis. In general, we observed the striking increasing trend for ESBL (+) and for multi-drug-resistant uropathogens during the late study period compared to the early period. The increased uropathogen resistance trend demonstrated by our study could be linked to non-

restricted use of antibiotics in Serbia by physicians as well as to high degree of self-medication in the population.

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