Objective: In our study, we aimed to evaluate the prevalence of microorganisms, antibiotic resistance rates, and changes over a five-year period in order to plan timely and appropriately the treatment of urinary tract infections in children.

Material and Methods: In this retrospective study, data were obtained by screening the microbiology laboratory records from the automation system of our hospital. Urine samples were collected by the midstream urine or bag culture. 105 colonies with a single microorganism in a urine culture were evaluated as positive urine culture. A total of 4938 urine cultures were retrospectively screened over a five-year period.

Results: Of the total 613 (12.4%) positive urine cultures, 83.4% were identified as gram-negative and 16.6% as gram-positive. The most common bacteria in gram-negative growth was *Escherichia coli* (68.3%), followed by *Proteus* spp. (16.4%) and *Klebsiella* spp. (10.6%). The most common bacteria in gram-positive agents was *Enterococcus* spp. 42.2%. While the ratio of the extended-spectrum beta-lactamase (ESBL) (+) organisms in 2013 was 9/96 (9.4%), it was found to be 22/102 (21.6%) in 2017. The highest ampicillin resistance was observed in *Klebsiella* strains (79.6%) and the lowest in *Proteus* strains (44%). Increased ampicillin resistance (54.2% to 66.7%) and decreased trimethoprim/sulfamethoxazole resistance (54.2% to 45.1%) were found over the years.

Conclusion: We think that aminoglycosides and nitrofurantoin can be effectively used as an alternative option in empirical treatment due to increased resistance to ESBL, ampicillin, and amoxicillin clavulanate. Antibiotic selection should be customized according to the results of urine culture antibiogram.

Keywords: Antibiotic resistance, child, urinary tract infections

Correspondence Address/Yazışma Adresi
Çiğdem Eda Balkan
Kafkas Üniversitesi Araştırma ve Uygulama Hastanesi,
Tibbi Mikrobiyoloji Laboratuvarı,
Kars-Türkiye
E-mail: cigdemedabalkan@gmail.com
Received: 07.02.2020  Accepted: 24.04.2020  Available Online Date: 27.11.2020

©Copyright 2020 by Pediatric Infectious Diseases and Immunization Society. Available online at www.cocukenfeksiyon.org
**Introduction**

Urinary tract infections (UTIs) are among the most common infections in childhood and an important cause of morbidity. Failure to properly and timely treat these infections with appropriate antibiotics can lead to serious consequences, such as renal failure, high blood pressure, and retardation in growth and development (1,2). UTIs are difficult to diagnose since they may occur with non-specific symptoms during infancy (3). Empirical treatment is recommended for these patients due to complications known in clinical practice. Most commonly, ampicillin, amoxicillin clavulanic acid, trimethoprim-sulfamethoxazole (TMP-SMX) and cephalosporin group antibiotics are preferred in empiric treatment (4). However, it is well evidenced that empiric treatments eventually lead to severe antibiotic resistance (5). Therefore, it is necessary to investigate the organisms and antibiotic resistance of UTIs in different geographical regions to determine the appropriate antibiotic in order to significantly reduce morbidity and mortality. The aim of our study was to identify the optimum antibiotic regimen for our region by investigating the microorganisms that caused UTIs in the study area, the antibiotic resistance rates, and changes over a five-year period.

**Materials and Methods**

After obtaining the approval of the regional ethics committee (25.07.2018/80576354-050-99/144), patients, aged 0-16 years, admitted to the pediatric outpatient clinic of our hospital between January 1, 2013 and January 1, 2018 were included in the study. Data were obtained by screening the microbiology laboratory records from the automation system of our hospital. The urine samples were kept in 5% blood agar and eosin methylene blue agar (EMB) for 18-24 hours at 37°C. The microorganisms reproducing in culture were identified by a conventional method using the IMVIC tests. Antibiotic susceptibilities were determined by the Kirby-Bauer disk diffusion method on the Mueller-Hinton agar based on the EUCAST criteria. The Phoenix system (PHX) was used for manually unidentifiable bacteria. PHX is a fully automated system for the rapid identification of bacteria and antimicrobial susceptibility testing. The presence of 10^5 colonies with a single microorganism was evaluated as positive urine culture. Urine samples were collected by the midstream urine or bag culture. Urine was collected with bag culture in children under 2 years old or who were not toilet trained yet. In children over the age of 2 or with toilet training, instructions were explained to their families and urine was collected by taking clean midstream urine. Patients with recurrent UTIs or urinary tract anomalies, those that required urinary catheters, and those that were in intensive care unit were excluded from the study. A total of 4,938 urine cultures were retrospectively screened over a five-year period. Since only samples sent to the laboratory were studied, patient consent was not required.

**Results**

A total of 4,938 urine samples obtained from patients aged 1 month to 16 years were analyzed. Growth was seen in 613 samples (12.4%), of which 83.4% were gram-negative and 16.6% were gram-positive. The number of male and female patients with positive urine cultures was 251 (40.9%) and 362 (59.1%), respectively. The age of the patients was 55.11 ± 48.18 months. While 38.7% of the patients were ≤ 2 years old, 61.3% were over two years of age. The proportion of boys under two years was greater than girls at 57%, while the ratio of girls over two years of age was 72.6%.

The microorganisms identified were Escherichia coli in 60% of the patients (n= 349), Proteus spp. in 15% (n= 84), Klebsiella spp. in 9% (n= 54), and Enterococcus spp. in 8% (n= 43) (Figure 1). Gram-negative bacteria were the most frequent isolates, with E. coli 68.3% being the most common, followed by Proteus spp. and Klebsiella spp. at 16.4% and 10.6%, respectively. The increase in Klebsiella strains was statistically significant over the years (p= 0.00) (Table 1). Extended-spectrum beta-lactamase (ESBL) positivity was not detected in gram-positive bacteria and was only found in gram-negative bacteria. The incidence of ESBL positivity was 14.9% for E. coli and 7.4% for Klebsiella spp. While the ratio of ESBL (+) organisms was 9/96 (9.4%) in 2013, it increased to 22/102 (21.6%) in 2017 (Figure 2).

In gram-positive microorganisms, Enterococcus was the most common agent seen at a rate of 42.2%, followed by coagulase-negative staphylococcus (CNS) at 23.5%, Staphylococcus aureus at 22.5%, and Streptococcus spp. at 7.8%. Over the five-year period, the number of methicillin-resistant strains increased (Table 2). No distinction between agent and contamination was made in CNS. Urine culture was only requested for patients with clinical suspicion. In order to prevent contamination, the patients were asked to wash the area with soapy water before urination. Antiseptics were not considered as appropriate to use before urine collection as it could cause false negatives.

Among the gram-negative bacteria, there was high resistance to ampicillin, amoxicillin clavulanate, and TMP-SMX at rates of 58.3%, 28%, and 42.2% respectively. While there was low resistance to amikacin, meropenem, piperacillin at 3.1%, 4.1%, and 2.2%, respectively. Gentamicin resistance was seen in 7.4% of the patients and ceftriaxone resistance in 20.7%. The incidence of ampicillin resistance increased from 54.2 to

**Statistical Analysis**

The Statistical Package for the Social Sciences (SPSS ver. 20.0 Inc. Chicago, IL, USA) 22.0 package program was used for all statistical evaluations. The Kolmogorov-Smirnov test was conducted to test the normality assumption, and descriptive and frequency analyses and the chi-square test were used for the comparison of categorical variables.
**Table 1.** Distribution of gram-negative bacteria by years

|                          | 2013 (n) | 2014 (n) | 2015 (n) | 2016 (n) | 2017 (n) | Total |
|--------------------------|----------|----------|----------|----------|----------|-------|
| *Escherichia coli*       | 62       | 86       | 71       | 67       | 63       | 349   |
| *Proteus spp.*           | 21       | 9        | 16       | 21       | 17       | 84    |
| *Klebsiella spp.*        | 8        | 4        | 8        | 17       | 17       | 54    |
| *Pseudomonas aeruginosa* | 1        | 3        | 3        | 0        | 3        | 10    |
| Diğer*                  | 4        | 5        | 0        | 3        | 2        | 14    |
| **Total**                | 96       | 107      | 98       | 108      | 102      | 511   |

* Other: *Enterobacter, Morganella, and Citrobacter* (p < 0.05)

**Figure 1.** Distribution of microorganisms isolated from urine cultures.

**Figure 2.** ESBL positivity over five years.
66.7% over the five years while TMP-SMX resistance was reduced from 54.2 to 45.1%, phosphomycin resistance from 22.9 to 11.8%, cefotaxime resistance from 24 to 15.7%, and gentamicin resistance from 9.4 to 4.9% (Figure 3).

When antibiotic resistance rates of the most common gram-negative microorganisms were investigated, ampicillin resistance in *E. coli* strains was 57.6%, amikacin resistance was 2.1%, amoxicillin-clavulanate resistance was 29.1%, and TMP-SMX resistance was 57.2%. For the *Proteus* strains, amikacin resistance was seen at a rate of 6.1%, cefotaxime resistance at 21.4%, and TMP-SMX resistance at 54.8%. Ampicillin resistance had the highest incidence among *Klebsiella* strains (79.6%) and the lowest in *Proteus* strains (44%). Piperacillin resistance was not detected in any of the *Proteus* strains, while it was found in 1.9% of the *E. coli* strains and 2.6% of *Klebsiella* spp. Nitrofurantoin resistance was most common in *E. coli* at 5.6%. Ceftriaxone resistance was also most frequently seen in *E. coli* at 24.4%, but phosphomycin resistance had the highest incidence in *Proteus* strains at 15.5% (Table 3).

In gram-positive bacteria, resistance to penicillin, ampicillin, erythromycin, cefoxitin, clindamycin, and TMP-SMX was found to be 55.6%, 48.5%, 49.5%, 32.3%, 39.6%, and 44.1%, respectively. Vancomycin, linezolid, and cefepime resistance was low, seen in 1%, 7.1%, and 8.6% of the samples, respectively. Over the five years, penicillin, ampicillin, erythromycin, cefoxitin, and clindamycin resistance was found to decrease (Figure 4). Since only samples sent to the laboratory were studied retrospectively, patient consent was not required.

**Discussion**

UTIs are among the most common infections in children. They can lead to significant complications if not treated timely with appropriate antibiotics. Since they constitute an important cause of morbidity when untreated, empiric treatment is recommended. Amoxicillin-clavulanate, TMP-SMX, cefuroxime, and cefixime are the most commonly used agents for oral treatment while ceftriaxone, cefotaxime, gentamicin, and piperacillin are mostly preferred for parenteral treatment. However, empiric treatment has brought along
the problem of antibiotic resistance over time (5-7). Therefore, it is important to determine the patient’s age, sex, regionally the most common microorganism, and antibiotic resistance rate.

UTIs are more common in girls than in boys. However, in younger children (under two years), the situation is the opposite (8). In the current study, 59.1% of the patients were females. In boys under two years of age, UTIs were more common at 57%, whereas over two years, this rate was 72.3% in girls. The age range of our patients was 1 month-16 years (mean 55 months).

The most common cause of UTIs in children are gram-negative bacilli with *E. coli* being the most frequent agent (9). Although *E. coli* is the most common bacteria in many studies conducted in Turkey, the second and third frequent bacteria vary according to the geographical region. In our study, we detected the second most common agent as *Proteus* spp. and the third as *Klebsiella* spp., which is consistent with the

| Antibiotic         | *Escherichia coli* % | *Proteus* spp. % | *Klebsiella* spp. % |
|--------------------|----------------------|------------------|---------------------|
| Ampicillin         | 57.6                 | 44               | 79.6                |
| Amikacin           | 2.1                  | 6.1              | 3.7                 |
| Amoxicillin-clavulanate | 29.1               | 12.2             | 31.5                |
| Cefotaxime         | 22.9                 | 21.4             | 27.8                |
| Ceftriaxone        | 24.4                 | 9.5              | 27.8                |
| Ciprofloxacin      | 9.2                  | 3.6              | 3.7                 |
| Ertapenem          | 6                    | 2.4              | 5.6                 |
| Imipenem           | 2                    | 1.8              | 1.9                 |
| Phosphomycin       | 13.2                 | 15.5             | 13                  |
| Gentamicin         | 6.3                  | 9.5              | 9.3                 |
| Nitrofurantoin     | 5.2                  | 13.6             | 16.7                |
| Norfloxacin        | 7.7                  | 9.5              | 9.3                 |
| Meropenem          | 4                    | 3                | 1.9                 |
| Levofoxacin        | 8.7                  | 3.6              | 1.9                 |
| Piperacillin       | 2.6                  | 0                | 1.9                 |
| TMP-SMX            | 57.2                 | 54.8             | 64.8                |

Figure 4. Antibiotic resistance of gram-positive bacteria over five years.

Table 3. Antibiotic resistance rates of the most common gram-negative bacteria
reports of Ipek et al. and Senel et al. (10,11). In some studies, Klebsiella spp. take the second place, while Enterobacter spp. rank third (12,13). In another study, CNS were found to be the second most common bacteria (14). In the current study, we determined the most common agent among gram-positive bacteria as Enterococcus. Despite the availability of similar data in the literature, there are also studies that have reported CNS and S. aureus strains to be the most common gram-positive bacteria (15,16). We also found an increase in Klebsiella strains and methicillin-resistant forms of Staphylococcus spp. over the years. The resistance of Klebsiella strains to common antibiotics was higher than E. coli. These two findings suggest that rational antibiotic use should be encouraged.

Another problem was the increase in ESBL-positive bacteria. The production of beta-lactamase is one of the most important resistance mechanisms of gram-negative bacteria against beta-lactam antibiotics. If a bacterium is synthesizing beta-lactamase, it can cleave the amide bonds in the beta-lactam ring of the beta-lactam group of antibiotics and make this antibiotic ineffective. This acquired property can be synthesized by the genetic structure of the bacteria and transferred (17). In studies, ESBL positivity in E. coli isolates has ranged from 13% to 20.8% of the urine cultures while a meta-analysis has reported that ESBL incidence reached 28.4% (18-20). In our study, ESBL positivity was 14.9% for E. coli strains and 7.4% for Klebsiella strains, and it was 9.4% in 2013 and 21.6% in 2017. Although this is consistent with the literature, the increase over the years is worrying.

In gram-negative bacteria, resistance to ampicillin, amoxicillin-clavulanate, and TMP-SMX, which are the most preferred oral drugs, has been reported to be high in many studies (21-27). In the current study, in agreement with the literature, ampicillin resistance was found to be 57.6%, amoxicillin-clavulanate resistance was 29.1%, and TMP-SMX resistance was 57.2% in E. coli strains. The highest ampicillin resistance was observed in Klebsiella strains (79.6%) and the lowest in Proteus strains (44%). In previous studies, the ampicillin resistance rate of Klebsiella strains has been reported to be 93.2% by Çoban et al., 88.2% by Güner et al., 67% by Mir et al., and 76% by Yaşar et al. (24,27-29). Although there was an increase in ampicillin resistance in our study, TMP-SMX resistance decreased but remained high at 45.1% in 2017. On the other hand, it was positive to see that phosphomycin, cefotaxime and gentamicin resistance had decreased.

In this study, gram-negative bacteria had the lowest resistance to amikacin, meropenem and piperacillin, and oral nitrofurantoin. Before 2010, there were studies reporting no meropenem and amikacin resistance. However, in recent studies, resistance to these agents has been reported with increasing frequency. Our results were in agreement with those reported in studies conducted in Turkey (30,31,33). Most common bacteria and antibiotic resistance rates in some recent studies are listed in Table 4.

We found among the gram-positive agents that resistance to penicillin, ampicillin and TMP-SMX was high; whereas, vancomycin, linezolid and cefepime resistance was low. In studies conducted, while penicillin resistances are generally high, ampicillin resistances vary from region to region. In a study by Kalal et al., the ampicillin and ciprofloxacin resistance of Enterococcus strains has been determined as 87.5% and 75%, respectively while these rates have been found as 20% for both antibiotics in the study by Saeed et al. (32, 34). Özdem et al. have not found vancomycin resistance, but observed ampicillin resistance at a rate of 6.3%, penicillin resistance at 47.2% and TMP-SMX resistance at 14.8% (35). Similarly, Yenikeşirli et al. havew found no resistance to vancomycin, but calculated ampicillin, penicillin and ciprofloxacin resistance rates as 8.7%, 60.9% and 15.2%, respectively (36). Vancomycin-resistant enterococci strains present as an important problem, especially in patients in intensive care, with significant risk factors being the use of multiple parenteral antibiotics, application of invasive procedures, and underlying secondary diseases (37,38). Vancomycin resistance is not expected in patients referred from outpatient clinics (39). In the current study, patients with recurrent UTIs, those receiving intensive care, and those that required the use of a catheter were not included. We found vancomycin resistance and cefepime resistance rates to be low at 1% and 9.2%, respectively, but ampicillin resistance was higher than previously reported in studies conducted in Turkey. A positive finding was that penicillin, ampicillin and cefotaxime resistance was observed to decrease over the five years. However, the presence of vancomycin resistance albeit at low rates and high resistance to common antibiotics (ampicillin, TMP-SMX) were concerning.

A limitation of our study was that we were not able to evaluate the symptoms and findings of the patients when they gave the urine samples; thus, there was the possibility of growth with incompatible with the clinical findings. Another limitation was that the collected urine was not removed by catheter or by suprapubic aspiration. So, the risk of contamination was high due to the midstream urine or bag culture.

This is the first comprehensive study conducted in our region investigating urine culture and antibiotic resistance of children. Based on the results we obtained, we consider that aminoglycosides and nitrofurantoin should be preferred in empirical treatment due to the increased resistance to ESBL, ampicillin, amoxicillin clavulanate, and ceftriaxone. Antibiotic selection should be customized according to the results of urine culture antibiogram and rational antibiotic use should be encouraged considering the high rates of unnecessary use of antibiotics. Our study could be further elaborated by eliminating contamination. Biochemical markers will be useful for future studies.
Table 4. Antibiotic resistance rates according to some recent studies

| Year       | Number of significant growth/Total collected sample | Method of urine collection  | Most common bacteria | ESBL (+) (%) | Highest Antibiotic Resistance % (according to the most common bacteria) | Lowest Antibiotic Resistance % (according to the most common bacteria) |
|------------|----------------------------------------------------|----------------------------|----------------------|--------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Temiz et al. 2008 | 889/6535                                          | Bag culture/midstream urine | *E. coli*            | -            | Ampicillin (76.1%)                                                        | Amikacin (0%)                                                         |
| Üstün et al. 2009 | 175                                               | Midstream urine/ catheterisation | *E. coli*            | -            | Ampicillin (48%)                                                           | Gentamicin (8%)                                                       |
| Deveci et al. 2010 | 483/14301                                         | Bag/midstream/suprapubic aspiration | *E. coli*            | 13           | Ampicillin (71%)                                                           | Amikacin (11.1%)                                                      |
| Şanlı et al. 2010 | 1015 Gram-negative agent                          | Bag/midstream/catheterisation/suprapubic aspiration | *E. coli*            | -            | Cefamandole (94%)                                                         | Cefoxitin (5.5%)                                                      |
| Salkuz et al. 2010 | 51                                                | Bag culture/midstream urine  | *E. coli*            | -            | Cefotaxime (94%)                                                          | Cefoxitin (5.5%)                                                      |
| Erdoğan et al. 2011 | 2544                                              | Bag culture/midstream urine  | *E. coli*            | 0.1-0.6      | Ceftriaxone (94.9%)                                                      | Cefoxitin (5.5%)                                                      |
| Güner et al. 2012 | 362                                               | Bag culture/midstream urine  | *E. coli*            | 20.8         | Sefuroxim (100%)                                                        | Amikacin (7.8%)                                                      |
| Gündem et al. 2013 | 392/10691                                         | Urine bag                   | *E. coli*            | -            | Cefuroxime (94.9%)                                                      | Cefoxitin (5.5%)                                                      |
| Aylanç et al. 2014 | 217                                               | Bag/midstream/catheterisation/suprapubic aspiration | *E. coli*            | -            | Cefuroxime (94.9%)                                                      | Cefoxitin (5.5%)                                                      |
| Saeed et al. 2015 | 130/300                                           | Bag/midstream/catheterisation | *E. coli*            | -            | Cefuroxime (94.9%)                                                      | Cefoxitin (5.5%)                                                      |
| Ekwealor et al. 2016 | 215                                               | Midstream/bag                | *S. aureus*          | -            | Amoxicillin (95.8%)                                                      | Gentamicin (34.5%)                                                    |
| Kalal et al. 2017 | 62/342                                            | Bag culture/midstream urine  | *E. coli*            | -            | Cefuroxime (94.9%)                                                      | Gentamicin (34.5%)                                                    |
| Yaşar et al. 2018 | 518/1711                                          | Bag culture/midstream urine  | *E. coli*            | -            | Cefuroxime (94.9%)                                                      | Gentamicin (34.5%)                                                    |
| This Study 2020 | 613/4938                                          | Bag culture/midstream urine  | *E. coli*            | 14.9         | Cefuroxime (94.9%)                                                      | Gentamicin (34.5%)                                                    |
Ethics Committee Approval: Ethical approval for this study was obtained from Kafkas University Faculty of Medicine Ethical Committee (Decision Number: 08576354-050-99-144, Date: 25.07.2018)

Informed Consent: The verbal and written informed consent was taken from the children’s mothers.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - HBB; Design - HBB; Supervision - ÇEB, HBB; Resources - ÇEB, HBB; Data Collection and/or Processing - ÇEB, HBB; Analysis and/or Interpretation - ÇEB, HBB; Literature Review- ÇEB, HBB; Writing - ÇEB, HBB; Critical Review - ÇEB, HBB.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Okarska-Napiéralska M, Wasilewska A, Kuchar E. Urinary tract infection in children: Diagnosis, treatment, imaging-Comparison of current guidelines. J Pediatr Urol 2017;13:567-73. [CrossRef]
2. Elder JS. Urinary tract infections. In: Kliegman RM, Stanton BF, St Geme JW (eds.). Nelson Textbook of Pediatrics. 19th ed. Philadelphia: Elsevier Saunders, 2011:1829-34. [CrossRef]
3. Korbel L, Howell M, Spencer JD. The clinical diagnosis and management of urinary tract infections in children and adolescents. Paediatr Int Child Health 2017;37:273-9. [CrossRef]
4. O’Brien K, Stanton N, Edwards A, Hood K, Butler CC. Prevalence of urinary tract infections. J Pediatr Inf 2020;14(3):e129-e137
5. Aykan B, Çiftci İH. Türkiye’de idrar kültürlerinden izole edilen etkenler ve antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
6. Deveci Ö, Yula E, Tekin A. İdrar kültürlerinden izole edilen Escherichia coli suşlarında beta-laktamaz sıklığı ve antibiyotik direnci. J Clin Exp Infect 2010;1:182-6. [CrossRef]
7. Yaşar A, Başaran Ö, Çakar Y, Saleh M, Kocamaz H, Baskın E. Antimicrobial resistance patterns of Escherichia coli strains isolated from urine cultures in Turkey: a meta-analysis. Mikrobiyol Bul 2013;47:603-18. [CrossRef]
8. Cohen PA, Ugwu MC, Ezeobi I. Antimicrobial evaluation of bacterial isolates from urine specimen of patients with complaints of urinary tract infections in Akwa, Nigeria. Int J Microbiol 2016:1-6. [CrossRef]
9. Deveci Ö, Yula E, Tekin A. İdrar kültürlerinden izole edilen Escherichia coli suşlarına Antibiyotik direnci. J Clin Exp Infect 2010;1:182-6. [CrossRef]
10. Çoban B, Ülkü N, Kaplan H, Topal B, Erdoğan H, Baskın E. Five-year assessment of causative agents and antibiotic resistances in urinary tract infections. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
11. Yuksel S, Ozturk B, Kavaz A, Ozcakar ZB, Acar B, Guriz H, et al. Antibiotic resistance of urinary tract pathogens and evaluation of empirical treatment in Turkish children with urinary tract infections. Int J Antimicrob Agents 2006;28:413-6. [CrossRef]
12. Güneş H, Donma MM, Nalbantoglu B. Namık Kemal Üniversitesi Araştırmalar ve Uygulama Hastanesi’ne başvuran çocuklarda idrar örneklerinden izole edilen etken ve antibiyotik direnç durumları. Cumhuriyet Med J 2013;35:1-8. [CrossRef]
13. Çebe A, Ayvaz A, Yildiz N, Çetinkaya S. Sivas ilinde çocukluk çağı idrar yolu enfeksiyonlarında idrar kültür sonuçları: İlk tedavi seçimi nasıl olmalıdır? Van Tip Dergisi 2008;15:7-12. [CrossRef]
14. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
15. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
16. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
17. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
18. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
19. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
20. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
21. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
22. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
23. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
24. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
25. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
26. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
27. Aykan B, Çiftçi İH. Türkiye’de idrar kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
28. Aykan B, Çiftçi İH. Türkiye’de idrar Kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
29. Aykan B, Çiftçi İH. Türkiye’de idrar Kültürlerinden izole edilen Escherichia coli suşlarına antibiyotik direnci. J Microbiol Infect Dis 2011;1:17-21. [CrossRef]
30. Üstün C, Demir YS, Demir S, Demirören S, Kurtoğlu MG. Pediyatrik yaş grubu toplum kökenli üriner sistem enfeksiyonlarından izole edilen Escherichia coli ve Klebsiella spp. suşlarının in-vitro antibiyotik direnci. ANKEM Derg 2009;23:155-60. [CrossRef]

31. Temiz H, Akkoç H, Gül K. Laboratuarımızda idrar kültürlerinden izole edilen gram negatif bakterilerde antibiyotiklere direnç. Dicle Tip Dergisi 2008;35:234-9. [CrossRef]

32. Saeed CH, Al-Otraqchi KIB, Mansoor IY. Prevalence of urinary tract infections and antibiotics susceptibility pattern among infants and young children in Erbil city. Zanco J Med Sci 2015;19:915-22. [CrossRef]

33. Salduz ZİY, Yiğit Ö. Antibiotic susceptibility of bacteria isolated from children with urinary tract infection. J Pediatr Inf 2010;4:138-42. [CrossRef]

34. Kalal BS, Patel RB. Microbiological and antimicrobial profile of urinary tract infection in children from a teaching hospital in South India. J Pediatr Inf 2017;11:19-22. [CrossRef]

35. Özdem B. Which antibiotics should be the first choice for empiric therapy of urinary tract infections? Ankara Med J 2016;16:41-50. [CrossRef]

36. Yenişehirli G, Yenişehirli A, Bulut Y, Özveren G. İdrar kültürlerinden izole edilen enterokok suşlarında antimikrobiyal direnç. Klimik Dergisi 2016;29:112-6. [CrossRef]

37. Barış A, Bulut ME, Öncül A, Bayraktar B. Distribution of clinical isolates at species level and their antibiotic susceptibilities in intensive care units patients. J Turk Soc Intens Care 2017;15:21-7. [CrossRef]

38. Mete E, Kaleli İ, Cevahir N, Demir M, Akkaya Y, Satılmış ÖK. Evaluation of virulence factors in enterococcus species. Mikrobiyol Bul 2017;51:101-14. [CrossRef]

39. Kalaycı Ö, Yurtsever SG, Güngör S, Uzun B, Kurultay N. Evaluation of in vitro antibiotic sensitivity of enterococci isolated from urine samples. Klimik Dergisi 2011;24:105-7. [CrossRef]