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# ANTIMICROBIAL SUSCEPTIBILITY OF UROPATHOGENIC *STAPHYLOCOCCUS AUREUS* ISOLATED FROM PATIENTS WITH URINARY TRACT INFECTIONS ATTENDING MUHAMMADU SHUWA MEMORIAL HOSPITAL, MAIDUGURI.

Pharmaceutics

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## ABSTRACT

**Background**: *Staphylococcus aureus* (*S. aureus*) isolate from the urinary tract of most patients are becoming resistant to commonly used antibiotics. This pose a challenge for timely treatment. The present study was conducted to determine the resistance profile of the *S. aureus* isolates from Patients with Urinary Tract Infections (UTIs) attending Muhammadu Shuwa Memorial Hospital Maiduguri.

**Methods**: Midstream urine specimens of UTIs symptomatic patients from Muhammadu Shuwa Memorial Hospital, Maiduguri were collected, cultured, and screened for common pathogens using standard microbiological protocols. The antimicrobial susceptibility of identified *S. aureus* strains was evaluated using standard agar disc diffusion techniques.

**Results**: A total of 50 *S. aureus* strains were identified. None of the *S. aureus* isolates were susceptible to Amoxicillin (0%) and Ceftriaxone (0%); they showed 2% susceptibility to Co-trimoxazole and Erythromycin each, 42% to Chloramphenicol, 44% to Ciprofloxacin, 54% to Pefloxacin, 60% to Streptomycin, 72% to Ofloxacin, and 82% to Gentamycin. The isolates were commonly resistant to 9 (90%) of the ten classes of antimicrobial agents used in this study and all the isolates were multidrug-resistant.

**Conclusion**: There is need for continuous investigations on antimicrobial resistance profile of UTI for proper empiric treatment of uncomplicated UTIs. Thus, the need to adopt new strategies in the control of antibiotic resistance in the studied environment cannot be overemphasized.

## KEYWORDS

Staphylococcus Aureus, Uropathogenic, Antimicrobial Susceptibility, Muhammadu Shuwa Memorial Hospital, Multi-drug Resistance.

### Introduction

Staphylococcus genus is a heterogeneous group of bacteria consisting of 30 species. Being part of the microbiota of human body and commonly carried on the skin or in the nose of healthy individuals, *Staphylococcus aureus* (*S. aureus*) has been considered the most clinically important species, with broad presence in nature., which makes it easy to be transmitted by air or fomites from patients or carriers (Hardy, *et al*., 2004; Brown *et al*., 2003). It has been recognized as one of the most common cause of human infections, such as skin infections, wound infections, bacteremia and urinary tract infections (bacteriuria) (Steven, *et al*., 2015; Anupurba *et al*., 2003).

Urinary tract infections (UTIs) are among the most common bacterial infections diagnosed in community health practice (Foxman, 2010). Community-acquired urinary tract infections are often treated empirically with broad-spectrum antibiotics because point-of-care bacterial testing is unavailable. Several studies (Gupta, 2003; Akoachere, *et al*., 2012) show geographic variations in aetiologic agents of UTIs and their resistance patterns to antibiotics. Laboratory results of antimicrobial susceptibility testing with urinary tract infections are usually obtained two to three days after sampling; therefore, in the majority of community-acquired UTI (CAUTI) cases, treatment choice is empirically based on the predictable spectrum of aetiological microorganisms and available data reflecting antibiotic resistance of previous infections (Akoachere, *et al*., 2012). Considering that, as with many community-acquired infections, resistance rates to antimicrobials commonly used in treatment of UTI are increasing and susceptibility of microorganisms shows significant geographical variation (Guptal, *et al*., 1999). Therefore, studies aimed at increasing knowledge of local aetiologic agents of UTIs and their resistance patterns to antibiotics are necessary to guide clinicians in empiric treatment. Recent studies (Nkwelang, *et al*., 2009; Ndip, *et al*., 2005) showed a growing problem of antibiotic resistance globally, thereby establishing a need for continuous surveillance of antibiotic susceptibility of uropathogens. This study was to determine the prevalence of uropathogenic *S. aureus* and their susceptibilities to commonly empirically prescribed antibiotics in MMSHM in order to generate data that will improve the efficacy of the empiric treatment of this infection.

### Materials and Methods

The study population was composed of 200 patients with UTI seeking medical attention attending out-patient clinics in Muhammadu Shuwa Memorial (a secondary health facility) Hospital, Maiduguri metropolis. The criteria for patient inclusion was as outlined by Nzalie *et al*. (2016). Concisely, we included patients who presented with UTI symptoms and whose urine samples showed significant bacterial growth ($\geq 10^5$ CFU/mL) associated with a white blood cell count of $>10^4$/mL. We did not excluded any patient based on prior antibiotic treatment.

### Sample Collection:

After verbal informed consent was obtained from all patients prior to specimen collection they were taught how, the clean-catch midstream technique as described by Ochada *et al*. (2015) was used to collect urine samples of at least 20mL into a sterile Universal container (Steriling, UK). For female patients, after proper positioning of the thigh, they were instructed to spread the labia and clean the area with soaped swabs, then pass a small amount of urine into the toilet, and finally urinate into the container. For male patients, after hand washing, a clean-catch midstream urine sample was collected after retraction of the prepuce (if present) and cleaning of the glans with soaped swabs.

### Sample Processing, Identification and Maintenance:

A calibrated loop method was used for the isolation of bacterial pathogens from urinary samples. A sterile 4.0mm platinum wired calibrated loop was used which delivered 0.001mL of urine. Simultaneously, a loopful urine sample was plated on Cystine-Lactose-Electrolyte Deficient (CLED) agar, Mannitol Salt (MSA) agar, MacConkey agar, and blood agar medium (Biotech Laboratories Ltd. UK). The inoculated plates were incubated at 37 C for 24 h and for 48 h in negative cases. The number of isolated bacterial colonies was multiplied by 1000 for the estimation of bacterial load/mL of the urine sample. A specimen was considered positive for UTI if an organism was cultured at a concentration of $\geq 10^5$ cfu/mL or when an organism was cultured at a concentration of $10^4$ cfu/mL and >5 pus cells per high-power field were observed on microscopic examination of the urine as described by Prakash and Saxena (2013). Identification of bacterial

isolates to species level was done on the basis of their cultural and standard biochemical characteristics with the corresponding laboratory tests: catalase, coagulase, and DNase production for *Staphylococcus aureus* (Cheesbrough, 2010; Andreua *et al.*, 2005; and Cowan and Steel, 2004). The isolates were confirmed as *S. aureus* by employing API-Staph identification 25E system (BioMerieux, France) and pure isolates were maintained in nutrient agar slants and incubated at 37 C for 24 hrs. The isolates were transported on agar slant to the Microbiology Laboratory of the Faculty of Pharmacy, University of Maiduguri where they were kept in the refrigerator for further study.

**Antibiotic Susceptibility Testing:**

In the Microbiology Laboratory of Faculty of Pharmacy, University of Maiduguri, the antimicrobial susceptibility pattern of all the isolates to Amoxicillin (25µg), Ceftriaxone (30µg), Co-trimoxazole (25µg), chloramphenicol (30µg), Ciprofloxacin (5µg), Erythromycin (15µg), Gentamycin (30µg), Ofloxacin (5µg), perloxacin (5µg) and Streptomycin (10µg) all obtained from Oxoid (England) were determined using modified single disc diffusion technique in accordance to the guidelines of Clinical and Laboratory Standards Institute (CLSI, 2017). In brief, standardised overnight culture of each isolate (containing approximately $10^6$ cfu/ml) which was equivalent to 0.5 McFarland Standard was used to flood the surface of Mueller Hinton agar plates and excess drained off and dried while the Petri dish lid was in place. The standard antimicrobial discs were aseptically placed at reasonable equidistance on the inoculated plates and allowed to stand for I hr. The plates (prepared in duplicates) were then incubated at $37^0$C for 18-24 h. The diameter of the zone of inhibition produced by each antimicrobial disc was measured with a ruler in millimeters. Breakpoints and interpretative for susceptibility/ resistance was based on the CSLI (2017) criteria. Standard strains of *E. coli* (ATCC 25922), and *S. aureus* (ATCC 25923) were used routinely in this study as control.

**Determination of Multiple Antibiotic Resistance Index**

The standard method as recommended by Krumpermann (1983) as described by Ehinmidu (2003) and modified by Tambekar *et al*. (2006) were employed in the determination of Multiple Antibiotic Resistance Index (MARI). The isolated *S. aureus* that where resistant to three or more antibiotics groups were considered multiple antibiotic resistant and the Multiple Antibiotic Resistance Index was determined using the formula;

MAR = x/y
Where:
X is number of antibiotics to which the isolate where resistance.
Y is the total number of antibiotics to which the test isolates has been evaluated for sensitivity.

**Statistical Analysis**

Statistical analysis was done using SPSS (version 20) to determine frequency distribution, mean, harmonic mean, standard deviation, analysis of variance (ANOVA), Duncan Multiple Range and Pearson correlation coefficient.

**Ethics:**

This study was approved by Advisory Board of the Muhammadu Shuwa Memorial Hospital, Maiduguri

**Results**

200 patients who fulfilled our inclusion criteria were sampled. Of these, 150 patients had urine samples that showed significant bacterial growth, giving us a prevalence of 75%. The age of our patients ranged from 15 to 63 years, with a mean of 39.2 ± 17.6 years and a median of 35 years. Of the 150 significant samples, 133 (88.7%) were from females while 17(11.3%) were from males. Analysing prevalence with respect to gender, females (88.7%) had a higher prevalence of infection than males (11.3%). UTI prevalence was significantly related to gender (ρ value = 0.002).

As shown in Table 1, among the 150 samples with significant bacterial growth, 50 (33.3%) of the isolated bacterial were *Staphylococcus aureus* and 42(84.0%) were from female while 8(16.0%) were male. Figure 1, shows the susceptibility of the isolates to antimicrobial agents. As shown, all the *S. aureus* isolates were resistance to Amoxicillin and Ceftriaxone. More than 50% of the isolates showed resistance to Co-trimoxazole and Erythromycin (98%) each, Chloramphenicol (58%), and Ciprofloxacin (56%). 46% showed Resistance to Pefloxacin, Streptomycin (40%), Ofloxacin (28%), while resistance to Gentamycin was 18%. Table 2 shows the Multiple Antibiotic Resistance Index and antibiogram of *S. aureus* resistant to antibiotic used during the study. From the Table, all the isolates had MARI of ≥ 0.3. Twelve (24%) of the isolates had MARI of 0.6 which is the most prominent. Ten (20%) had MARI of 0.8; 9 (18%) had 0.5, 7 (14%) had 0.4, and 0.9 respectively. Multi-drug resistance in this study was defined as resistance of an isolate to at least three classes of antimicrobial agents tested. All the isolates were multi-drug resistant (Table 2). Majority of the isolates, 12 (24%) were resistance to six of the ten antibiotic agents. Seven (14%) of the isolates were resistant to nine of the ten classes of agents used, while none showed resistance to the whole.

**Discussion**

This study reports the pattern of uropathogenic *S. aureus* causing UTI in Maiduguri metropolis and their antibiotic susceptibility. The prevalence of UTI recorded among the symptomatic patients in this study is 75.0%. The present study revealed *S. aureus* as uropathogens with a prevalence rate of 33.3% which is similar to the prevalence rate of 33.6% recorded in Yenagoa by Ononuga and Awhowho (2012). In addition, previous studies conducted in different part of Nigeria corroborates this prevalence rate. For example, Adeyemi *et al*. (2014) reported a recovery rate of 31.4% *S. aureus* in Bida, Niger State, while Okonko *et al*. (2009) in Ibadan, Akerele *et al*. (2000) in Benin-city and Kenechukwu *et al*. (2006) in Enugu reported prevalence rate of 34.2%, 35.6% and 33.9%. *S. aureus* respectively. In other part of the globe, Manikandan *et al*. (2001) in India, reported *S. aureus* of 20.5% prevalent pathogen in UTIs. In contrast to the present study, findings by various authors have reported lower recovery rate of uropathogenic *S. aureus*, these includes 13% recovery rate as reported by Khan *et al*. (2016) in Pakistan, 7.2% in Brazil (Cunha *et al*., 2016), while a range of 2.0% through 17.1% were reported in India (Shaifali, *et al*., 2012; Prakash and Sexena 2013; Mahroop Raja *et al*., 2015; Rangari *et al*., 2015; Imran *et al*., 2015). On the other side, Mofolorunsho and Colleagues (2015) reported higher recovery rate of 45.3% in Anyigba, Kogi-State North-Central Nigeria. Thus, these recent findings confirm *S. aureus* as an important aetiologic agent in UTIs in Maiduguri metropolis.

The gender distribution of patients in this study is consistent with other reported studies. In our study, the incidence of UTI was high among the females (88.7%) than males (11.3 %), thus, UTI prevalence was significantly related to gender ( value = 0.002). Factors such as short urethra and proximity to vestibule and the anal opening as well as sexual activity have been reported to influence the higher prevalence of UTI in females (Shaifali *et al*., 2012; Adedeji *et al*., 2009). Also, the similarities and differences in the type and distribution of uropathogens may result from different environmental conditions and host factors, practices such as health care and education programmes, socioeconomic standards and hygiene practices in each country (Amin *et al*., 2009). It is worthy of note to mention that our patients were from an insurgence raveled region (Northeastern, Nigeria), this must have compromised their hygiene practices such as hand washing and bathing habits, because accessibility to water becomes very challenging, and this sequentially could have exposed them to this high recovery rate of uropathogenic *S. aureus*.

As adduced by Ashkenazi *et al*. (1991), to ensure appropriate treatment, knowledge of the isolates is required and Oluremi *et al*. (2011), documented that the changing spectrum of microorganisms involved in UTI and emergence of resistance across institutions and geographical areas have made it imperative in the conduct of antibiotic susceptibility pattern study of these pathogens in various regions from time to time essential. The present study investigated the antibiotic susceptibility patterns as the knowledge of their antimicrobial susceptibility patterns in this locations may aid clinicians in choosing the appropriate antimicrobial empirical treatment. The study revealed that the most effective antibiotic for the isolated uropathogenic *S. aureus* within the period of study is Gentamicin (82.0%) susceptibility, this is followed by Ofloxacin (72.0%), and Streptomycin (60.0%). Thus, meaning that Gentamicin was the most active drug in this study showing the highest activity against the *S. aureus* isolates and would be a better choice for UTI therapy; it could be administered while awaiting the culture result. This observation is similar to previous studies (Rangari, *et al*., 2015; Al-Zoubi *et al*., 2015; Beyene and Tsegaye 2011; Uwaezuoke, and Ogbulie 2006). Various reasons must be responsible for the high susceptibility to these agents: One of such

reasons could be as documented by Abdu and Lamikanra (2016); that the aminoglycosides (Gentamycin and Streptomycin) appears to be infrequently used as they are administered parenterally, a dosage form which is far less amenable to self- medication than orally administered antibiotics in this locality, secondly, the cost to purchase Ofloxacin is about $60, making it very expensive for easy accessibility in a locality where people live below 1USD per day (Abdu and Lamikanra, 2016). Nevertheless, in contrast to the present findings, previous studies have reported lower susceptibility of uropathogenic *S. aureus* to these agents. Earlier study conducted in Maiduguri metropolis by Ismail *et al*. (2015) reported 52.4%, while in Southwestern, Nigeria, Ochada *et al*. (2015) reported 33.3% susceptibility to Gentamicin, and Ononuga and Awhowho (2012) reported 26.1% susceptibility in Yenagoa, Nigeria. Whereas in their studies, Mofolorunsho *et al*. (2015) in Kogi, Tula and Iyoha (2014) in Yola reported higher susceptibility values among uropathogenic *S. aureus* to Gentamicin-Streptomycin 100%-81% and 72.7%-86% respectively. These differences might be due to suggestions made by Al-Zoubi *et al*. (2015) which includes prolonged antibiotic treatment, age, type of infection and geographical variation.
The overall susceptibility rate to Ofloxacin (72.0%) found in this study was significant and higher than those reported by others (Imran *et al*., 2015, Ononuga and Awhowho, 2012). However, it is lower than that reported by Mofolorunsho *et al*. (2015). The susceptibility of the uropathogenic *S. aureus* isolates were low to Pefloxacin (54%) and Ciprofloxacin (46%) in this study, thus making them non-efficacious in the treatment of uropathogenic *S. aureus* in the studied environment. This is worrisome considering that fluroquinolones such as Ciprofloxacin were introduced into Nigerian hospitals barely a decade ago (Abdu, *et al*., 2016) and the ability of these organisms to spread easily by direct or indirect person-to-person contact with resultant therapeutic difficulties and considering that both Pefloxacin and Ciprofloxacin has been identified as the most effective anti-infective drug in southern Nigeria (Babafemi et al., 2014) just three years ago. From the low susceptibility of these isolates to both agents, if urgent measures would not be taken to arrest the situation, we may see the return of the era of the search for new drugs to fight uropathogenic infections. For about a decade, resistance of *S. aureus* to aminoglycosides and flouroquinolones has been a subject of discussion in which more findings suggests substantial resistance to these antibiotics (Rajaduraipandi, *et al*., 2006).

The susceptibility test results of *S. aureus* in the study showed that Chloramphenicol is 42%. This observation has been earlier reported in Maiduguri metropolis by Ismail *et al*. (2015). Despite the discourage in the use of Chloramphenicol due to its side effects, the organism's increasing rate of resistance to this agent might be due to the uncontrollable availability of the agent in sub-therapeutic quantity at every drug vendors in this environment which usually leads to their frequent and indiscriminate use in various diseased conditions (Okeke *et al*., 1999). Hence, the use of these agents in the empiric treatment of UTIs should be discouraged. However, our report is relatively lower than Ochada *et al*. (2015) in southwestern, Nigeria, who reported moderate susceptibility rate to chloramphenicol (58.3%) and is in disparity to Al-Zoubi *et al*. (2015) who reported a high susceptibility rate of Chloramphenicol (94.4%) in Jordan.

In the present study, very low susceptibility of the uropathogenic *S aureus* isolates were recorded to Co-trimoxazole and Erythromycin (2%) each. These findings validate the data from Mofolorunsho *et al*. (2015) and Ononuga, and Awhowho (2012). However, inconsistent with other studies, these isolates showed lower susceptibility to Co-trimoxazole (50.0%) and Erythromycin (58.9%) (Dibua *et al*., 2014; Al-Zoubi *et al*., 2015). Unlike previous studies, these isolates showed lowest rates of susceptibility to Co-trimoxazole and Erythromycin. Highest sensitivity (83.2-95.2%) for Co-trimoxazole (Al-Zoubi *et al*., 2015; Peixoto de Miranda *et al*., 2014) and (66.7 – 100%) for Erythromycin have also been reported (Rangari *et al*., 2015; Ochada *et al*., 2015; Peixoto de Miranda *et al*., 2014; Shaifali *et al*., 2012).

None of our isolates showed susceptibility to Amoxicillin (0%) and Ceftriaxone (0%) (Fig. 1) in the present study. This lowest susceptibility level may be attributed to the easy access to and indiscriminate use of these drugs in the Maiduguri metropolis. More so, that these drugs are commonly used for infections outside the urinary tract and with this pattern of resistance, it is recommended that Amoxicillin and Ceftriaxone should not be used as first line agents in the blind treatment of UTIs in the Maiduguri metropolis. This is more so, as infections caused by resistant pathogens have with them, higher rates of morbidity and mortality than do infections caused by susceptible pathogens (Paramythiotou and Routsi, 2016).

Multiple antibiotic resistance (MAR) index shows that all of the isolates were resistant to more than three antibiotics. Highest MAR index was observed in 7(14%) of the isolates where MAR index of 0.9 was recorded. This indicated that the isolates involved do not respond to the effect of nine of ten antibiotics tested. This could be attributed to possession of multiple resistance genes in the bacterial genome that enable them resist virtually all the antibiotics. This is in agreement with previous findings (Ismail, *et al*., 2015; Imran, *et al*., 2015; Ononuga and Awohowho, 2012). Earlier, Kaplan *et al*. (2005) reported that MAR by *S. aureus* is usually associated with increased expression of multiple antibiotic resistance genes, including those coding for aminoglycoside resistance. Over 80% of the isolates had MAR index ranging between 0.4 and 0.8. This highlighted the fact that, most of the antibiotics are non-effective to majority of the isolates. This could be linked to many factors including source of the isolates, its ability to evade antibiotic effects and variation in antibiotic concentration. Many studies have identified bacterial source as an important determinant of MAR especially due to *S. aureus* when it occurred in an infection. Studies by Rajaduraipandi, *et al*. (2006) reported MAR by clinical isolates of *S. aureus*. The observed MAR in this study is quite alarming, although it corroborates many findings in Nigeria (Ononuga and Temedie 2011; Olayinka *et al*., 2004) and other parts of the world (Al-Saimary, 2011; Al-Mendalawi, 2010; Shabina, *et al*. 2008). Many factors contribute to the emergence of MAR in *S. aureus* among which over prescribing of antibiotics by clinicians, over usage and incomplete course of antibiotics by patients, availability of the antibiotics could not be ignored in regions like ours. Environmental and personal hygiene can also contribute to the spread of resistant species among people especially in clinical settings. Mass campaign, regular training, and reformation of drug policies would to greater extent alleviate the increased spread of MAR isolates among the populace.

The findings have revealed that there is an urgent need for constant monitoring of susceptibility of pathogens in different populations to commonly used anti-microbial agents. The data of this study may be used to determine trends in antimicrobial susceptibilities, to formulate local antibiotic policies and overall to assist clinicians in the rational choice of antibiotic therapy to prevent misuse, or overuse, of antibiotics.

## Conclusion

This study concluded that *S. aureus* is an important uropathogens in Maiduguri metropolis. The isolated uropathogenic *S, aureus* showed highest sensitive to Gentamicin, Ofloxacin and Streptomycin. Finally, empirical antibiotic selection in treatment of UTI should be based on the knowledge of local prevalence of causative organisms and their antimicrobial sensitivities rather than on universal guidelines so as to reduce the incidence of resistance. Indiscriminate prescription and use of antibiotics should be discouraged by continuous public enlightenment on rational antibiotic use as well as adoption of strict national antibiotic policy to regulate the prescription, sale and use of antibiotics.

## Conflicts of Interest

No potential conflict of interest are declared for this paper.

## Tables and Figures:

**Table 1:** Age and sex distribution of patients with uropathogenic S. aureus infection in Muhammadu Shuwa Memorial Hospital, Maiduguri, Nigeria.

| Age (Yrs) | Male | Female | Total (%) |
|---|---|---|---|
| 10 - 19 | 0 | 5 | 5(10) |
| 20 - 29 | 3 | 9 | 12(24) |
| 30 - 39 | 3 | 20 | 23(54) |
| 40 - 49 | 2 | 5 | 7(14) |
| 50 and above | 0 | 3 | 3(6) |
| Total | 8 | 42 | 50(100) |

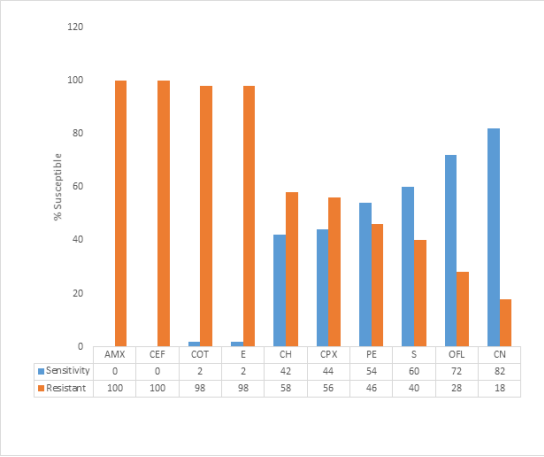


**Figure 1:** Antibiotic sensitivity pattern of patients with uropathogenic *S. aureus* infection in Muhammadu Shuwa Memorial Hospital, Maiduguri, Nigeria

**KEY**

AMX- Amoxicillin, CEF-Ceftriaxone, CH- Chloramphenicol, CN-Gentamycin, COT- Co-trimoxazole, CPX-Ciprofloxacin, E-Erythromycin, OFL- Ofloxacin, PE- Pefloxacin, and S- Streptomycin

**Table 2:** Multiple Antibiotic Resistance Index and Antibiogram Pattern of Multi-resistant *S. aureus* isolates form UTI in Muhammadu Shuwa Memorial Hospital, Maiduguri.

| No of Antibiotics | Antibiogram | No of Resistant Isolates | % | MAR |
|---|---|---|---|---|
| 4 | AMX, CEF, COT, E | 7 | 14.00 | 0.4 |
| 5 | AMX, CEF, CH, COT, E | 6 | 12.00 | 0.5 |
| | AMX, CEF, COT, E, PER | 2 | 4.00 | 0.5 |
| | AMX, CEF, COT, CPX, E | 1 | 2.00 | 0.5 |
| 6 | AMX, CEF, CH, COT, CPX, E | 2 | 4.00 | 0.6 |
| | AMX, CEF, CH, CN, COT, E | 1 | 2.00 | 0.6 |
| | AMX, CEF, COT, CPX, E, PER | 1 | 2.00 | 0.6 |
| | AMX, CEF, CH, COT, E, PER | 1 | 2.00 | 0.6 |
| | AMX, CEF, CH, COT, CPX,PER | 1 | 2.00 | 0.6 |
| | AMX, CEF, COT, E, OFL, PER | 1 | 2.00 | 0.6 |
| | AMX, CEF, CH, COT, E, S | 1 | 2.00 | 0.6 |
| | AMX, CEF, CH, E, OFL, S | 1 | 2.00 | 0.6 |
| | AMX, CEF, COT, E, PER, S | 1 | 2.00 | 0.6 |
| | AMX, CEF, COT, CPX, E, S | 2 | 4.00 | 0.6 |
| 7 | AMX, CEF, COT, CPX, E, OFL, PER | 1 | 2.00 | 0.7 |
| | AMX, CEF, COT, CPX, E, PER, S | 3 | 6.00 | 0.7 |
| | AMX, CH, CEF, COT, CPX, E, S | 1 | 2.00 | 0.7 |
| 8 | AMX, CEF, CH, CN, COT, CPX, E, PER | 2 | 4.00 | 0.8 |
| | AMX, CEF, CH, COT, CPX, E, OFL, PER | 1 | 2.00 | 0.8 |
| | AMX, CEF, CH, CN, COT, CPX, E, S | 1 | 2.00 | 0.8 |
| | AMX, CEF, COT, CPX, E, OFL, PER, S | 1 | 2.00 | 0.8 |
| | AMX, CEF, CH, COT, CPX, E, OFL, S | 1 | 2.00 | 0.8 |
| | AMX, CEF, CH, COT, CPX, E, PER, S | 1 | 2.00 | 0.8 |
| | AMX, CEF, COT, CPX, E, OFL, PER, S | 1 | 2.00 | 0.8 |
| | AMX, CEF, CH, COT, E, OFL, PER, S | 1 | 2.00 | 0.8 |
| | AMX, CEF, CH, COT, CPX, E, PER, S | 1 | 2.00 | 0.8 |
| 9 | AMX, CEF, CH, CN, COT, CPX, E, OFL. PER | 3 | 6.00 | 0.9 |
| | AMX, CEF, CH, CN, COT, CPX, E, OFL, S | 1 | 2.00 | 0.9 |
| | AMX, CEF, CH, CN, COT, CPX, E, PER, S | 1 | 2.00 | 0.9 |
| | AMX, CEF, CH, COT, CPX, E, OFL, PER, S | 2 | 4.00 | 0.9 |

**KEY**

AMX- Amoxicillin, CEF-Ceftriaxone, CH- Chloramphenicol, CN-Gentamycin, COT- Co-trimoxazole, CPX-Ciprofloxacin, E-Erythromycin, OFL- Ofloxacin, PE- Pefloxacin, and S-Streptomycin.

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