Original Research Report

BACTERIAL AND ANTIBIOGRAM PROFILE OF URINARY TRACT INFECTION PATIENTS IN A TERTIARY HOSPITAL, SURABAYA

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ABSTRACT

Urinary tract infection (UTI) is one of the most common bacterial infections. Inappropriate antibiotic use for UTI treatment may lead to antibiotic resistance. This study aimed to provide an updated bacterial and antibiogram profile from urine specimens of patients diagnosed with UTI. This study was a retrospective study using urine culture and antibiotic susceptibility test results obtained from Clinical Microbiology Laboratory in a tertiary general hospital in Surabaya, Indonesia for a two-month period between June to July 2019. There were 215 patients with significant urine culture results of 54.4% from Escherichia coli female patients. Most aged more than and/or equal to 59 years, in both sexes. Gram-negative bacteria, particularly , was being the most common bacteria that caused UTI, followed by K. pneumoniae. Some antibiotics with the highest susceptibility to gram-negative bacteria were carbapenem antibiotics and amikacin, while teicoplanin and vancomycin were some antibiotics susceptible to gram-positive bacteria. This study result indicated that there was an urge to conduct local antibiogram profile investigation due to the low susceptibilities shown in recent empirical therapy recommendations, such as trimethoprim-sulfamethoxazole, fluoroquinolone, nitrofurantoin, and fosfomycin.

Keywords: *Antibiotic resistance; Escherichia coli; microbial susceptibility test; public health; urinary tract infection*

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Highlights:

1. Most urinary tract infections are caused by Gram-negative bacteria with E. coli being the most common bacteria.
2. Antibiotics with the highest susceptibility for Gram-negative bacteria were ertapenem, meropenem, amikacin, and imipenem.
3. Antibiotics with the highest susceptibility for Gram-positive bacteria mainly were susceptible to colstreptomycin, vancomycin, rifampin, tigecycline, teicoplanin, and ampicillin.

INTRODUCTION

Urinary tract infection (UTI) is one of the leading causes of both community-acquired and hospital-acquired infections (Najar et al. 2009). Both Gram-negative and Gram-positive bacteria can cause UTI. The most common etiology of UTI is *E. coli* (Flores-Mireles et al 2015). It is estimated that there were 150 million UTI cases occur annually worldwide. As one of the most common bacterial infections (Flores-Mireles et al. 2015), UTI could greatly contribute to inappropriate use of antibiotics which leads to resistance occurrence.

A local antibiogram or bacterial resistance profile is one consideration in choosing appropriate empiric antibiotic therapy. Initial therapy for infection is needed immediately, especially for patients with severe infection, as the microbiological result is not usually available in the first 24 to 72 hours (Leekha et al. 2011). UTI can contribute to urosepsis. In adults, urosepsis counted in about 25% of all sepsis cases. In this setting, providing adequate initial antibiotic therapy is a critical step in improving patient outcomes (Wagenlehner et al. 2013). Therefore, updating the bacterial resistance profile is an important way to increase the success rate of therapy.

Moreover, antibiotic resistance is a critical public health issue, specifically in developing countries with poor hygiene practices, poverty, and drug abuse (Seifu & Gebissa 2018). Until now, Indonesia does not have a formal estimation of the antibiotic resistance burden. However, the rate is considered high and is still rising (Parathon et al. 2017). Studies concerning antibiotic resistance rate and its susceptibility are needed to provide local data for clinical use of antibiotics, to lower the risk of inappropriate antibiotic use. In

addition, Indonesia is one of the developing countries where the empirical use of antibiotics is frequently still used due to the expensiveness of antibiotic susceptibility tests and much time is needed to conduct the procedure (Rosana et al. 2020). This study aimed to provide an updated bacterial and antibiogram profile from urine specimens retrieved from UTI patients in Clinical Microbiology Laboratory at tertiary general hospital in Surabaya, Indonesia for two-month period between June to July 2019. From this setting, the associated laboratory had a large sample volume so that two-month period of data had reached quite a lot of samples.

MATERIALS AND METHODS

The study was a descriptive retrospective study of 215 bacterial UTI patients from both in- and out-patients. The patients' age was limited above 18 years. Results indicating fungal and parasitic infections were excluded from this study. Data were obtained consecutively from a urine culture, bacterial identification, and antibiotic susceptibility test data conducted in the Clinical Microbiology Laboratory, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia for a two-month period between June to July 2019. Additional data regarding the patients' profiles were taken from medical records. All data were descriptively analyzed using IBM SPSS Statistics for Windows, Version 21.0 (Armonk, NY: IBM Corp.).

Urine specimens were previously collected from the patients by either clean-catch midstream or indwelling catheter urine, according to indication and the patients' condition. The uncentrifuged, homogenized urine specimen was streaked on an agar plate with Mayo's technique and then incubated for 24 hours at 35±2ºC in aerobic conditions. UTI was diagnosed when the bacterial count was greater than or equal to 10^5 CFU/m. Any urine samples with three or more different bacterial colonies were not considered for further investigation. Bacterial identification was done using VITEK 2 system based on fluorescence technology. Antibiotic susceptibility testing was carried out automatically by broth microdilution system of VITEK 2 according to Clinical Laboratory Standards Institute (CLSI) guidelines.

The study was approved by the Health Research Ethics Committee, Dr. Soetomo General Academic Hospital with reference number: 0222/LOE/301.4.2/XI/2020. Data were collected and analyzed retrospectively, therefore patient's consent was not obtained.

RESULTS

Patients' characteristics

Out of 215 patients in total, 117 (54.4%) patients were females. Most patients aged more than equal to 59 years, in both genders. The summary of the patients' age and sex distribution is available in Table 1.

Most of the patients had at least one associated underlying disease (N; %: 212; 98.6%), with the most common comorbidities were malignancy (N; %: 57; 26.5%), chronic kidney disease (N; %: 44; 20.5%), and diabetes mellitus (N; %: 41; 19.1%).

Table 1. Patients' characteristics

Age (years)	Sex				Total (n)	
	Male		Female			
	n	%	n	%	n	%
19-28	7	3.26%	12	5.58%	19	8.84%
29-30	6	2.79%	10	4.65%	16	7.44%
39-48	5	2.33%	17	7.91%	22	10.23%
49-58	31	14.42%	38	17.67%	69	32.09%
≥59	49	22.79%	40	18.60%	89	41.40%
Total (n; %)	98	45.58%	117	54.42%	215	100%

Bacteriological investigations

Most UTI-causing bacteria were Gram-negative bacteria (N; %: 181; 84.19%). *E. coli* was the most common bacteria in the current study (N; %: 91; 42.33%), with 67 out of 91 *E. coli* isolates were ESBL-producing strains.

Table 2. Distribution of UTI-causing bacteria

Bacteria	Gram	Total (n)	%
Escherichia coli	Negative	91	42.33
Klebsiella pneumoniae	Negative	25	11.63
Enterococcus faecalis	Positive	20	9.30
Pseudomonas aeruginosa	Negative	19	8.84
Acinetobacter baumanii	Negative	9	4.19
Enterobacter cloacae	Negative	7	3.26
Proteus mirabilis	Negative	5	2.33
Citrobacter freundii	Negative	5	2.33
Burkholderia cepacia	Negative	4	1.86
Morganella morganii	Negative	3	1.40
Streptococcus agalactiae	Positive	3	1.40
Kluyvera ascorbata	Negative	2	0.93
Enterococcus faecium	Positive	2	0.93
Staphylococcus aereus	Positive	2	0.93
Corynebacterium urealyticum	Positive	2	0.93
Escherichia fergusonii	Negative	1	0.47
Klebsiella ozaenae	Negative	1	0.47
Klebsiella oxytoca	Negative	1	0.47
Pseudomonas spp. (species not classified)	Negative	1	0.47
Moraxella spp. (species not classified)	Negative	1	0.47
Citrobacter werkmanii	Negative	1	0.47
Citrobacter koseri	Negative	1	0.47
Stenotrophomonas maltophilia	Negative	1	0.47
Enterobacter aerogenes	Negative	1	0.47
Salmonella enterica	Negative	1	0.47
Providencia rettgeri	Negative	1	0.47
Streptococcus gallolyticus	Positive	1	0.47
Pediococcus pentosaceus	Positive	1	0.47
Corynebacterium amylocatum	Positive	1	0.47
Corynebacterium matruchotii	Positive	1	0.47
Bacillus pumilus	Positive	1	0.47
Total		215	100

K. pneumoniae, *P. aeruginosa*, *A. baumanii*, and *E. cloacae* were other Gram-negative bacteria that followed *E. coli* in number to cause UTI. Similar to *E. coli*, there were ESBL and non-ESBL-producing *K. pneumoniae* strains, with 12 out of 25 total isolates were ESBL-producing strains. Meanwhile, *E. faecalis* was the most common Gram-positive bacteria causing UTI (N; %: 20; 9.30%). The order of UTI-causing Gram-positive bacteria prevalence following *E. faecalis* were *S. agalactiae*, *E. faecium*, *S. aereus*, and *C. urealyticum*. The bacterial distribution is summarized in Table 2.

Antibiotics susceptibility

Gram-negative bacteria tended to have high resistance level to amoxicillin (100%), cefotetan (100%), cefoxitin (100%), trimethoprim (100%), ampicillin (96.05%), cefazolin (95.33%), and colistin (92.31%), while gram-positive bacteria were mostly resistant to fusidic acid (100%), trimethoprim (100%), streptomycin (100%), tobramycin (95.45%), cefoxitin (94.12%), trimethoprim-sulfamethoxazole (90%), gentamicin (85.29%), quinupristin-dalfopristin (85.71%), amikacin (87.5%), ceftriaxone (82.61%), and clindamycin (81.82%).

Antibiotics with the highest susceptibility for Gram-negative bacteria were ertapenem (100%), meropenem (92.18%), amikacin (90%), and imipenem (85.63%). Meanwhile, chloramphenicol (100%), rifampin (100%), tigecycline (100%), streptomycin (100%), vancomycin (90.63%), teicoplanin (90.00%), and ampicillin (82.61%) were some antibiotics with susceptibility for Gram-positive bacteria. Despite linezolid only having a 51.52% in sensitivity level, 42.42% of the Gram-positive isolates showed intermediate results. It is implicated in the resistance level of linezolid for Gram-positive bacteria which was only 6.06%. Full data are available in Tables 3 and 4.

Specifically, each bacteria had different susceptibilities to diverse antibiotics. The result of antibiotic susceptibility tests from specific bacteria isolates has already been summarized in Table 5 and 6.

DISCUSSION

Patient's characteristics

Women have a greater risk of developing UTIs as their urethra is shorter compared to men, therefore allowing more vulnerability of women's urinary tract to be exposed. The current result showed that UTIs were more common in women (54.4%) and this result was supported by another research that have been conducted previously. Pratista *et al* stated that 52% of their patient who experienced UTIs were women, while a study mentioned that 87.4% of the population were women (Pratistha et al. 2018, Ren et al. 2016).

Table 3. Gram-negative UTI-causing bacteria susceptibilities to antibiotics

Antibiotics	Gram-negative bacteria		
	R (%)	I (%)	S (%)
Amikacin	7.78	2.22	90.00
Amoxicillin	100.00	0.00	0.00
Amoxicillin-clavulanate	78.21	5.59	16.20
Ampicillin	96.05	0.56	3.39
Ampicillin-sulbactam	69.32	7.95	22.73
Aztreonam	64.25	0.56	35.20
Cefazolin	95.33	0.00	4.67
Cefepime	61.63	1.16	37.21
Colistin	92.31	0.00	7.69
Cefotaxime	68.33	1.11	30.56
Cefotetan	100.00	0.00	0.00
Gentamycin	38.67	1.66	59.67
Cefoxitin	100.00	0.00	0.00
Ceftazidime	55.80	2.21	41.99
Ceftriaxone	67.84	4.09	28.07
Chloramphenicol	78.95	0.00	21.05
Ciprofloxacin	64.00	2.86	33.14
Ertapenem	0.00	0.00	100.00
Fosfomycin	37.21	0.00	62.79
Imipenem	9.38	5.00	85.63
Levofloxacin	59.78	3.91	36.31
Meropenem	7.26	0.56	92.18
Moxifloxacin	63.31	2.88	33.81
Nitrofurantoin	45.98	6.90	47.13
Piperacillin	74.85	4.29	20.86
Piperacillin-tazobactam	18.18	11.36	70.45
Tetracycline	71.08	2.41	26.51
Tigecycline	19.43	9.71	70.86
Trimethoprim	100.00	0.00	0.00
Trimethoprim-sulfamethoxazole	62.50	0.00	37.50
Cefoperazone-sulbactam	8.47	24.29	67.23

I: intermediate; R: resistant; S: sensitive

Table 4. Gram-positive UTI-causing bacteria susceptibilities to antibiotics

Antibiotics	Gram-positive bacteria		
	R (%)	I (%)	S (%)
Amikacin	87.5	0.00	12.5
Amoxicillin-clavulanate	50.00	0.00	50.00
Ampicillin	17.39	0.00	82.61
Cefotaxime	78.57	7.14	14.29
Gentamycin	85.29	0.00	14.71
Cefoxitin	94.12	0.00	5.88
Ceftriaxone	82.61	4.35	13.04
Chloramphenicol	0.00	0.00	100.00
Ciprofloxacin	50.00	10.00	40.00
Clindamycin	81.82	3.03	15.15
Erythromycin	62.96	11.11	25.93
Fosfomycin	25.00	0.00	75.00
Fusidic Acid	100.00	0.00	0.00
Levofloxacin	62.07	13.79	24.14
Linezolid	6.06	42.42	51.52
Meropenem	100	0.00	0.00
Moxifloxacin	50.00	0.00	50.00
Nitrofurantoin	35.48	0.00	64.52
Oxacillin	75.00	0.00	25.00
Penicillin	74.19	0.00	25.81
Rifampin	0.00	0.00	100.00
Quinupristin-dalfopristin	85.71	0.00	14.29
Teicoplanin	10.00	0.00	90.00
Tetracycline	62.50	0.00	37.50
Tigecycline	0.00	0.00	100.00
Tobramycin	95.45	0.00	4.55
Trimethoprim	100.00	0.00	0.00
Trimethoprim-sulfamethoxazole	90.00	0.00	10.00
Streptomycin	100.00	0.00	0.00
Vancomycin	9.38	0.00	90.63

I: intermediate; R: resistant; S: sensitive

Table 5. Specific Gram-negative bacteria susceptibility to antibiotics

Antibiotics	*E. coli* (n=91)		*K. pneumoniae* (n=25)		*P. aeruginosa* (n=19) (%)	*A. baumanii* (n=9) (%)
	Non ESBL (%)	ESBL producing strain (%)	Non ESBL (%)	ESBL producing strain (%)		
Amikacin	100	98.48	100	83.33	94.74	33.33
Amoxicillin	NA	0	0	NA	R	R
Amoxicillin-clavulanate	52.17	0	61.54	9.09	R	R
Ampicillin	16.67	0	R	R	R	R
Ampicillin-sulbactam	50	2.99	69.23	10	R	44.44
Aztreonam	95.83	0	84.62	8.33	52.63	R
Cefazoline	20	0	33.33	0	0	0
Cefepime	95.83	0	75	8.33	72.22	0
Colistin	NA	NA	NA	100	NA	NA
Cefotaxime	95.83	0	84.62	0	0	0
Cefotetan	NA	NA	NA	NA	0	NA
Gentamycin	87.50	56.72	69.23	41.67	73.68	0
Cefoxitin	NA	NA	NA	NA	NA	NA
Ceftazidime	100	1.49	84.62	8.33	68.42	0
Ceftriaxone	85.71	0	84.62	8.33	R	0
Chloramphenicol	100	50	NA	NA	R	R
Ciprofloxacin	66.67	10.61	41.67	16.67	61.11	0
Ertapenem	NA	100	100	NA	R	R
Fosfomycin	50	88.89	100	50	33.33	R
Imipenem	100	95.16	90.91	100	82.35	44.44
Levofloxacin	70.83	11.94	53.85	33.33	57.89	0
Meropenem	95.83	98.51	92.31	100	89.47	44.44
Moxifloxacin	66.67	9.68	45.45	25	NA	NA
Nitrofurantoin	75	72.31	23.08	8.33	0	0
Piperacillin	26.09	0	50	0	76.47	0
Piperacillin-tazobactam	95.65	73.13	100	66.67	72.22	0
Tetracycline	29.17	33.87	36.36	16.67	R	0
Tigecycline	91.30	90.77	81.82	58.33	R	44.44
Trimethoprim-sulfamethoxazole	47.83	33.33	50	16.67	R	55.56
Cefoperazone sulbactam	78.26	64.62	92.31	50	57.89	50

NA: not available, specific test was not conducted; R: intrinsically resistant.

Table 6. Specific Gram-positive bacteria susceptibility to antibiotics

Antibiotics	*E. faecalis* (n=20) (%)
Ampicillin	100
Ciprofloxacin	33.33
Erythromycin	12.50
Fosfomycin	100
Levofloxacin	15.79
Linezolid	15.79
Meropenem	0
Moxifloxacin	0
Nitrofurantoin	80
Oxacillin	0
Penicillin	17.65
Quinupristin-dalfopristin	5.26
Teicoplanin	88.89
Tetracycline	27.78
Vancomycin	84.21

Urinary tract infection comprises several clinical syndromes including asymptomatic bacteriuria, acute pyelonephritis, acute cystitis,and severe urosepsis. Urinary tract infection prevalence is determined by sex and age. In this study, patients over 59 years old were the most population experiencing UTI about 41.40% of all the population. Several factors are associated with the vulnerability of elder patients to

experience UTI. The factors are, for example, high rates of catheter use in this population, urinary retention, and the prevalence of comorbid diseases in elderly patient, such as stroke and dementia. UTIs are also commonly diagnosed in sexually active young women (Rowe & Juthani-Mehta 2013). However, in this study there was no peak of UTI incidence in the sexually active women age. Recent study was done in a tertiary hospital in which the patients tended to have many complications. On the other hand, UTI which is experienced by a sexually active young woman is usually the uncomplicated one, so it might already have been well treated by a previous primary health care provider (Lema & Lema 2018). This result was consistent with a study that no UTI incidence peaks in sexually active women age (Gidamudi et al. 2015).

Microbiological investigation

Most of the uropathogens identified in this study were gram-negative. *E. coli* was the most common bacteria. This result was supported by other previous studies in Indonesia and other countries as well (Ren et al. 2016, Pratistha et al. 2018, Setyorini et al. 2019). Fimbriae, flagella, toxins, pili, curli, and iron acquisition systems are some virulence factors that help *E. coli* cause infection (Terlizzi et al. 2017).

Nearly 74% of *the E. coli* strain in this study was an ESBL-producing strain. Another study in the same area that used data in the year 2018 mentioned that only 34.78% of the *E. coli* strain produces ESBL in hospitalized patients (Setyorini et al. 2019). The data indicated that there was a rapid spreading of the ESBL gene in the clinical environment as Indonesia is a country where there is the emersion and transmission of ESBL genes harbored inside the bacterial strains (Severin et al. 2010).

Antibiotics susceptibility

Gram-negative and positive bacteria were resistant to several penicillin class antibiotics, cephalosporins, and trimethoprim. Particularly for gram-negative bacteria, the resistance of beta-lactam antibiotics (penicillin and cephalosporin) can evolve along with the emergence of the ESBL strain of uropathogen. In this study, *E. coli* and *K. pneumoniae* that produce ESBL had higher resistance to related antibiotics compared to the ones which not produce ESBL. It could happen because ESBL is an enzyme that will hydrolyze beta-lactam rings, causing loss of beta-lactam antibiotic activities (Trevor et al. 2015). However, the higher resistance rate of ESBL-producing strain presented in this study was not limited to beta-lactam antibiotics. These data were supported by another study which found that ESBL-producing strain of *E. coli* was more resistant to antibiotics tested except amikacin, imipenem, meropenem, and nitrofurantoin which had a similar result in this study (Gharavi et al. 2021). The high susceptibility of amikacin, meropenem, and imipenem toward *E.coli* that produced ESBL was also mentioned in other studies (Rajabnia et al. 2019, Yadav & Prakash 2017).

In this study, *K. pneumoniae* that produced ESBL had a higher resistance rate to ceftazidime, cefotaxime, ceftriaxone, and trimethoprim-sulfamethoxazole. The result was consistent with Gharavi et al. study (2021). Some antibiotics with a high level of sensitivity for ESBL-producing *K. pneumoniae* shown in this study were carbapenem antibiotics (imipenem and meropenem), amikacin, and colistin. In many isolates, the sensitivity of imipenem and meropenem toward ESBL-producing *K. pneumoniae* was high (Mansury et al. 2016). Another study by Singh et al. (2015) discussed that 76% of ESBL-producing *K. pneumoniae* was still sensitive to amikacin.

Most gram-negative bacteria were susceptible especially to carbapenems (ertapenem, meropenem, imipenem) and aminoglycosides (amikacin). Carbapenems are antibiotics that have low susceptibility to beta-lactamase. They are commonly used intravenously for bacteria that are resistant to other antibiotics. This antibiotic has a broad spectrum of activity for gram-negative rods, gram-positive cocci, and anaerobic bacteria. Meanwhile, amikacin is one of the aminoglycoside antibiotics with the lowest resistance profile (Trevor et al. 2015). However, it should be noted that aminoglycosides are one of the well-known nephrotoxic agents (Morales-Alvarez 2020).

In complicated UTI patients, especially with underlying kidney disease, prescribing nephrotoxic antibiotics should be done carefully and under closed monitoring. Moreover, chronic kidney disease was one of the most common comorbidities found in patients in this study.

The majority of gram-positive-related UTIs were caused by *E. faecalis* in this study. Unfortunately, this bacterium was resistant to many antibiotics including meropenem, moxifloxacin, and oxacillin. *E. faecalis* had a high intermediate level for linezolid in this study. Linezolid and vancomycin were two antibiotics with very good susceptibility for *Enterococcus* bacteria (Gajdács et al. 2020). This indicated that the use of linezolid for *E. faecalis* needs to be given in a higher dose to achieve an effective effect (Gajdács et al. 2020).

Chloramphenicol, rifampin, tigecycline, streptomycin, vancomycin, teicoplanin, ampicillin, and fosfomycin were some antibiotics that gram-positive bacteria were

mostly susceptible to. For specific bacteria, linezolid was also one of the most susceptible antibiotics for Gram-positive bacteria (seen as low resistance percentage for Gram-positive bacteria).

Linezolid is an oxazolidinone antibiotic which active in overcoming resistant Gram-positive bacterial infections, such as MRSA (Methicillin-Resistant *Staphylococcus aereus*), PRSP (Penicillin Resistant *Streptococcus pneumoniae*), and VRE (Vancomycin-Resistant Enterococcus) (Trevor et al. 2015). In another study, Gram-positive bacteria had good susceptibility to vancomycin as well. Mechal et al. (2021) mentioned that 88.9% of Gram-positive bacteria were sensitive to vancomycin (Mechal et al. 2021).

Recent clinical antibiotic preference for UTI

Antibiotic prescriptions might be different around the world. Yet, it should be noted that according to Infectious Disease Society of America guidelines, trimethoprim-sulfamethoxazole is a therapy of choice in treating women experiencing uncomplicated UTI. Inside the guidelines, it is stated that trimethoprim-sulfamethoxazole can only be used for uncomplicated UTI if local uropathogens resistance does not exceed 20% (Gupta et al. 2011). In this study, uropathogens (both Gram-negative and -positive) had a high resistance rate exceeding 20%. This should be taken into consideration in prescribing trimethoprim-sulfamethoxazole as empirical therapy for UTI patients. However, as the most common Gram-positive bacteria, Enterococci could greatly contribute to the high resistance rate of Gram-positive bacteria to trimethoprim-sulfamethoxazole due to its characteristic that intrinsically resistant to trimethoprim-sulfamethoxazole.

In Indonesia, the current empirical first drug choice in overcoming both lower and upper UTIs is a fluoroquinolone (especially levofloxacin) as it is affordable and broadly available in Indonesia (Sugianli et al. 2017). However, from this study, the susceptibility result of both Gram-negative and Gram-positive bacteria to levofloxacin was not satisfying enough, with a sensitivity rate of only 36.31% and 24.14%, respectively. Other fluoroquinolones tested in this study were ciprofloxacin and moxifloxacin. Both of them also had low sensitivity levels, in percentage 33.14% and 33.81% for gram-negative, and 40% and 50% for gram-positive bacteria, respectively.

In primary care background, nitrofurantoin is one choice in managing uncomplicated UTI due to its affordable price, acceptable previous resistance prevalence, and mild toxicity (Huttner et al. 2015, Sugianli et al. 2017). Fosfomycin is another choice for managing lower uncomplicated UTIs (Sugianli et al. 2017).

The result of the current study showed that the sensitivity for fosfomycin and nitrofurantoin were 62.79% and 47.13% for gram negative-bacteria, 75% and 64.52% for gram-positive bacteria, respectively. However, Regulation of the Ministry of Health, Republic of Indonesia number 8 the year 2015 stated that antibiotic has good susceptibility if the sensitivity is exceeding 80%. This showed that even though fosfomycin and nitrofurantoin were acceptable in managing UTI, it was not considered a good antibiotic in this study setting based on the mentioned regulation. This highlights, even more, the importance to update the local antibiotic-resistant profile.

Continuous study regarding this topic should be done to monitor the rise of resistance levels to provide proper empirical therapy for UTI patients. The limitation of this study was that the secondary data used as a data source made the authors unable to control the intervention carried out directly on the research.

Strength and limitation

This work provides the latest findings on the bacterial and antibiogram profiles of urine specimens from UTI patients. Clinicians may be informed regarding the most appropriate administration of antibiotics to treat an illness according to the profile. Ongoing research on this topic are needed to monitor the increasing resistance levels and offer appropriate empirical therapy for UTI. The limitation of this study was that the authors were unable to carry out the intervention directly due to the use of secondary data as a data source.

CONCLUSION

Most UTIs were caused by gram-negative bacteria, with *E. coli* as the most common etiology. This result was consistent with other studies that showed The predominant microorganism found in UTI was Escherichia coli. The possible reason Escherichia coli was a causative agent of UTI is that this bacterium can occupy and reproduce within uroepithelial cells that supply a survival advantage to escape recognition and apoptosis by both innate and adaptive immune defense mechanisms. Gram-negative bacteria were susceptible to ertapenem, meropenem, amikacin, and imipenem, while teicoplanin and vancomycin were some antibiotics with high sensitivity levels for gram-positive bacteria. A high level of drug resistance for recent antibiotic preferences was seen in this study. It urges the need of updating empirical therapy recommendations based on local antibiograms for ensuring the success of the patient's therapy. Furthermore, definitive therapy of UTI should be based on antibiotic susceptibilities test.

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Conflict of interest

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Author contribution

MDTU, WM and RJS conceived the idea of the study. MRW prepared the draft of the manuscript. MDTU was in charge of the manuscript arrangement. All authors were involved in the revision of the manuscript and have agreed to the final content.

REFERENCES

Aswani SM, Chandrashekar U, Shivashankara K, Pruthvi B (2014). Clinical profile of urinary tract infections in diabetics and non-diabetics. Australas Med J. 29–34.

Bonadio M, Costarelli S, Morelli G, Tartaglia T (2006). The influence of diabetes mellitus on the spectrum of uropathogens and the antimicrobial resistance in elderly adult patients with urinary tract infection. BMC Infect Dis. 6:54.

El-Mahdy R, Mostafa A, El-Kannishy G (2018). High-level aminoglycoside-resistant enterococci in hospital-acquired urinary tract infections in Mansoura, Egypt. Germs 8, 186-190.

Flores-Mireles AL, Walker JN, Caparon M, et al (2015). Urinary tract infections: Epidemiology, mechanisms of infection and treatment options. Nat. Rev. Microbiol. 13, 269-284.

Gajdács M, Ábrók M, Lázár A, et al (2020). The increasing relevance of Gram-positive cocci in urinary tract infections: a 10-year analysis of their prevalence and resistance trends. Sci. Rep. 10, 1-11.

Gharavi MJ, Zarei J, Roshani-Asl P, et al (2021). A comprehensive study of antimicrobial susceptibility pattern and extended spectrum beta-lactamase (ESBL) prevalence in bacteria isolated from urine samples. Sci. Reports 2021 111 11, 1–11.

Gidamudi SS, Jadhav SA, Khanwelkar CC, et al (2015). View of antimicrobial utilization pattern of urinary tract infection in tertiary care hospital. Asian J. Pharm. Clin. Res. 8, 161–164

Gupta K, Hooton TM, Naber KG, et al (2011). International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: A 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. Clin. Infect. Dis. 52, 103–120

Huttner A, Verhaegh EM, Harbarth S, et al (2015). Nitrofurantoin revisited: A systematic review and meta-analysis of controlled trials. J. Antimicrob. Chemother. 70, 2456–2464

Kristianto Sugianli A, Ginting F, Lia Kusumawati R, et al (2017). Antimicrobial resistance in uropathogens and appropriateness of empirical treatment: A population-based surveillance study in Indonesia. J Antimicrob Chemother 72, 1469–1477

Leekha S, Terrell CL, Edson RS (2011). General principles of antimicrobial therapy. Mayo Clin. Proc. 86, 156-167.

Mansury D, Motamedifar M, Sarvari J, et al (2016). Antibiotic susceptibility pattern and identification of extended spectrum β-lactamases (ESBLs) in clinical isolates of Klebsiella pneumoniae from Shiraz, Iran. Iran. J. Microbiol. 8, 55–61.

Mechal T, Hussen S, Desta M (2021). Bacterial profile, antibiotic susceptibility pattern and associated factors among patients attending adult OPD at Hawassa University Comprehensive Specialized Hospital, Hawassa, Ethiopia. Infect. Drug Resist. 14, 99–110.

Morales-Alvarez MC (2020). Nephrotoxicity of antimicrobials and antibiotics. Adv. Chronic Kidney Dis. 27, 31–37.

Mulvey MA (2002). Adhesion and entry of uropathogenic Escherichia coli . Cell Microbiol.4:257–71.

Najar MS, Saldanha CL, Banday KA (2009). Approach to urinary tract infections. Indian J. Nephrol. 19, 129-139.

Norafika, Arbianti N, Prihatiningsih S, Indriani DW, Indriati DW (2020). A retrospective cross-sectional study of urinary tract infections and prevalence of antibiotic resistant pathogens in patients with diabetes mellitus from a public hospital in Surabaya, Indonesia. Germs.1;10(4):157-166.

Parathon H, Kuntaman, Widiastoety TH et al (2017). Antimicrobial Resistance in South East Asia: Progress towards antimicrobial resistance containment and control in Indonesia. BMJ 358, 31–35.

Pratistha FSM, Sudhana IW, Adnyana, IWL (2018). Diagnosis cepat infeksi saluran kemih dengan menghitung jumlah leukosituria pada urinalisis metode flowcytometry sysmex Ux-2000 dengan baku emas kultur urin di RSUP Sanglah Denpasar. J. Penyakit Dalam Udayana 1, 52–56.

Rajabnia M, Forghani MS, Hasani S, et al (2019). Prevalence and antibiotic resistance pattern of extended spectrum beta-lactamase producing Escherichia coli isolated from urinary tract infection. J. Ren. Inj. Prev. 8, 78–81.

Ren W, Fang Y, Chen W, et al (2016). Patterns of etiology and antibiotic resistance of bacteria causing urinary tract infections in the Anhui Provincial Hospital, Int J Clin Exp Med. 9, 4515–4520.

Rosana Y, Ocviyanti D, Akbar W (2020). Bacterial susceptibility patterns to cotrimoxazole in urinary tract infections of outpatients and inpatients in Jakarta, Indonesia. Med. J. Indones. 29, 316–21.

Rowe TA, Juthani-Mehta, M (2013). Urinary tract infection in older adults. Aging health 9, 519–528.

Seifu WD, Gebissa AD (2018). Prevalence and antibiotic susceptibility of Uropathogens from cases of urinary tract infections (UTI) in Shashemene referral hospital, Ethiopia. BMC Infect. Dis. 2018 181 18, 1–9.

Setyorini H, Mardiana N, Tjempakasari A (2019). Risk Factors for urinary tract infection in hospitalized patients. Biomol. Heal. Sci. J. 2, 4-8

Severin JA, Mertaniasih NM, Kuntaman K, et al (2010). Molecular characterization of extended-spectrum β-lactamases in clinical Escherichia coli and Klebsiella pneumoniae isolates from Surabaya, Indonesia. J. Antimicrob. Chemother. 65, 465–469

Singh A, Jain S, Kumar D, et al (2015). Antimicrobial susceptibility pattern of extended-spectrum beta-lactamase producing Klebsiella pneumoniae clinical isolates in an Indian tertiary hospital. J. Res. Pharm. Pract. 4, 153-159.

Terlizzi ME, Gribaudo G, Maffei ME (2017). UroPathogenic Escherichia coli (UPEC) infections: Virulence factors, bladder responses, antibiotic, and non-antibiotic antimicrobial strategies. Front. Microbiol. 8, 1566, 1-23.

Trevor AJ, Katzung BG, Kruidering-Hall M(Eds.) (2015). Katzung & Trevor's pharmacology: Examination & Board Review, 11e. McGrawHill, New York.

Lema VM, Lema APV (2018). Sexual activity and the risk of acute uncomplicated urinary tract infection in premenopausal women: Implicationsfor reproductive health programming. Obstet. Gynecol. Int. J. 9, 49-55.

Wagenlehner FM, Lichtenstern C, Rolfes C, et al (2013). Diagnosis and management for urosepsis. Int. J. Urol. 20, 963–970.

Yadav K, Prakash S (2017). Screening of ESBL Producing multidrug resistant E. coli from urinary tract infection suspected cases in Southern Terai of Nepal. J Infect Dis Diagn 2, 1-8.