

RESEARCH ARTICLE

Staphylococcus aureus Dominates Urinary Tract Infections with Significant Antibiotic Resistance: A Cross-Sectional Study Among Hospitalized Patients

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Abstract: Urinary tract infection (UTI) remains one of the most common infections, often complicated by antimicrobial resistance. In recent years, Staphylococcus aureus has been increasingly identified as a causative organism, particularly among patients with comorbidities or prolonged catheterization. This study aimed to examine the prevalence and resistance profile of S. aureus in UTI and to assess its clinical associations. A cross-sectional analytical study was conducted using retrospective data from 59 medical records of hospitalized patients diagnosed with UTI at Dr. Pirngadi General Hospital Medan, between Januari 2020 and December 2022. were obtained from medical records. Statistical analysis used the Chi-square test. Staphylococcus aureus was identified as the most frequent pathogen (59.3%). Infections were more common in females and in patients aged over 60 years. S. aureus infection showed a significant association with comorbidities and catheter use ($p < 0.05$). The organism exhibited high resistance to ceftriaxone but remained sensitive to oxacillin, linezolid, and cefazolin. S. aureus is the predominant pathogen causing UTI among hospitalized patients, with significant associations to catheter use and comorbidities, as well as notable antibiotic resistance.

Keywords: Antibiotic resistance; Catheter use; Staphylococcus aureus; Urinary tract infection

INTRODUCTION

Urinary tract infection (UTI) is caused by the growth of microorganisms within the urinary tract, including the kidneys, ureters, bladder, and urethra. According to the National Kidney and Urological Diseases Information Clearinghouse (NKUDIC), UTI is the second most common infectious disease after respiratory tract infections, with

approximately 8.3 million cases reported annually, affecting individuals of all ages from infancy to the elderly.¹ Globally, UTI remains a major public health concern, with an estimated 8.1 million cases each year. The incidence among females is twice as high as in males, at 1.2% versus 0.6%.²

The most frequent causative bacteria include Escherichia coli, Klebsiella

pneumoniae, *Proteus mirabilis*, *Staphylococcus aureus*, and *Enterococcus faecalis*.³ The pathogenesis of UTI begins with bacterial colonization of the periurethral mucosa, followed by ascending infection toward the bladder. The global incidence of UTI increased by 60.4% in 2019 compared to 1999, with an age-standardized mortality rate (ASMR) of 3.13 per 100,000 population, particularly in South Asia and tropical Latin America.⁴

In Indonesia, the incidence of UTI is estimated at 90–100 cases per 100,000 population annually, with approximately 180,000 new cases each year.⁶ In North Sumatra Province, the 2018 prevalence reached 107.06 per 100,000 population, with the highest rates observed in Medan City (2,717 per 100,000), followed by Deli Serdang Regency (2,109 per 100,000) and Simalungun (209 per 100,000).⁵ Medical records from Dr. Pirngadi General Hospital, Medan, reported 32 UTI cases in 2020, 13 in 2021, and 30 in 2022.

Cases of Methicillin-Resistant *Staphylococcus aureus* (MRSA) have increased globally since their first identification in 1961. The Antimicrobial Resistance in Indonesia (AMRIN) study found that among 2,494 community isolates, 43% of *E. coli* strains were resistant to common antibiotics such as ampicillin, cotrimoxazole, and chloramphenicol, while resistance among 781 hospitalized patients reached 81%, particularly to ampicillin (73%), cotrimoxazole (56%), chloramphenicol (43%), ciprofloxacin

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(22%), and gentamicin (18%).⁷ These findings underscore the growing threat of antibiotic resistance among uropathogens, including *S. aureus*.

As an important nosocomial pathogen, *S. aureus* has increasingly been identified as a cause of UTI, particularly in patients with comorbidities and prolonged catheterization. Rising resistance to commonly used antibiotics, including third-generation cephalosporins such as ceftriaxone, has further complicated management and infection control efforts in hospitals.

This study aims to analyze the profile of *Staphylococcus aureus* as a causative agent of UTI, its antibiotic resistance patterns, and its associations with clinical factors such as age, sex, comorbidities, and catheter use.

METHOD

This analytical observational cross-sectional study was conducted on hospitalized patients diagnosed with urinary tract infection (UTI) at Dr. Pirngadi General Hospital Medan, Indonesia, from January 2020 to December 2022. Data were obtained retrospectively from medical records of patients who met the inclusion criteria.

A total of 59 samples were included in the analysis. Inclusion criteria consisted of patients diagnosed with UTI who had positive urine culture results and complete antibiotic sensitivity data. Exclusion criteria included incomplete medical records or urine cultures showing more than one microorganism (polymicrobial infection).

Data were collected from patients' medical records, including demographic characteristics (age, sex), clinical factors (comorbidities, catheterization), and microbiological findings derived from urine culture and antibiotic sensitivity results.

Data were analyzed using SPSS version 25.0. Descriptive analysis was used to present the distribution of variables, while associations between categorical variables were tested using the Chi-square test.

RESULTS

A total of 59 hospitalized patients diagnosed with urinary tract infection (UTI) were included in this study. Most patients were aged over 60 years (45.8%), and female patients predominated (61.0%). Comorbid conditions were present in 86.4% of the subjects, with hypertension and diabetes mellitus being the most common (Table 1).

Table 1, Demographic and Comorbidity Characteristics of the Study Population

Karakteristik Demografi	n	%
Age group		
< 20 years	3	5%
20 - 40 years	11	18,7%
40 - 60 years	18	30,5%
> 60 years	27	45,8%
Sex		
Male	23	39%
Female	36	61%
Comorbidities		
Present	51	86,4%
Absent	8	13,6%
Total	59	100%

Table 2. Distribution of Microorganisms Causing Urinary Tract Infection

Microorganisms	n	%
<i>Staphylococcus aureus</i>	35	59%
<i>Non-Staphylococcus aureus</i>	24	41%
Total	59	100%

Based on urine culture results, *Staphylococcus aureus* was identified as the most frequent pathogen causing UTI (35 cases, 59.3%).(Table 2).

Table 3. Antibiotic Sensitivity Profile

Antibiotic / Microorganisms n(%)	<i>Staphylococcus aureus</i>		<i>Non - Staphylococcus aureus</i>	
	S	R	S	R
Ceftriaxon	18 (30,5%)	19 (32,3%)	9 (15,2%)	13 (22%)
Ampicilin	22 (37,3%)	13 (22%)	16 (27,2%)	8 (13,5%)
Amikacin	29 (49,1%)	6 (10,1%)	23 (39,1%)	1 (1,7%)
Cefotaxime	26 (44,1%)	8 (13,5%)	23 (39,1%)	2 (3,3%)
Chloromfenicol	29 (49,1%)	6 (10,1%)	23 (39,1%)	1 (1,7%)
Gentamicyn	26 (44,1%)	6 (10,1%)	25 (42,5%)	2 (3,3%)
Meropenem	29 (49,1%)	6 (10,1%)	21 (35,7%)	3 (5,1%)
Oxacillin	35 (59,2%)	0	23 (39,1%)	1 (1,7%)
Erythromycin	34 (57,6%)	1 (1,7%)	24 (40,6%)	0
Linezolid	35 (59,2%)	0	24 (40,6%)	0
Cefazolin	35 (59,2%)	0	23 (39,1%)	1 (1,7%)
Trimethoprim	34 (57,6%)	1 (1,7%)	23 (39,1%)	1 (1,7%)
Levofloxacin	34 (57,6%)	1 (1,7%)	24 (40,6%)	0

The antibiotic sensitivity profile of *S. aureus* showed the highest resistance to ceftriaxone

(32.3%), followed by ampicillin (22.0%) and cefotaxime (13.5%). Moderate resistance was observed to chloramphenicol, gentamicin, and meropenem (10.1%), while low resistance (1.7%) occurred with erythromycin, trimethoprim, and levofloxacin. The organism remained most sensitive to oxacillin, linezolid, and cefazolin (59.2%) (Table 3).

Table 4. Association Between *S. aureus* Infection and Comorbidities

Comorbidities	Microorganisms				p-value
	<i>S. aureus</i>		<i>Non-S. aureus</i>		
	n	%	n	%	
Present	35	59,32	16	27,12	0,000
Absent	0	0,00	8	13,56	
Total	35	59,32	24	40,68	

Table 5. Association Between *S. aureus* Infection and Catheterization

Catheterization	Microorganisms				p-value
	<i>S. aureus</i>		<i>Non-S. aureus</i>		
	n	%	n	%	
Used	35	59,32	18	30,51	0,002
Not used	0	0,00	6	10,17	
Total	35	59,32	24	40,68	

The Chi-square test revealed a significant association between *S. aureus* infection and comorbidities ($p = 0.000$) as well as catheter use ($p = 0.002$). No significant associations were observed with age or sex ($p > 0.05$) (Tables 4 and 5).

DISCUSSION

Most patients with urinary tract infection (UTI) in this study were aged over 60 years. Advanced age is associated with reduced bladder and urethral defense mechanisms,⁹ and declining immune function, both of which increase susceptibility to infection.⁹ A study in Surabaya (2019) also found that UTI was most frequent among patients aged ≥ 59 years.¹⁰ consistent with Reginawati et al. (2023), who reported that most patients were aged 46–65 years.¹¹ Similarly, Chen et al. (2024) observed that older adults had a 2.3-fold higher risk of recurrent UTI due to decreased innate and adaptive immunity.¹⁸

Females accounted for the majority of cases (61%), consistent with the anatomical and physiological predisposition related to the shorter female urethra and its proximity to the anus.^{8,9} This finding aligns with studies by Reginawati et al. (2023), Pratistha et al. (2017), Desouky et al. (2020), He et al. (2018), and Lee et al. (2025) all reporting a higher incidence of UTI in women, particularly those of reproductive or postmenopausal age.^{11,12,13,14,19}

In this study, *Staphylococcus aureus* was the predominant pathogen (59.3%), followed by *Escherichia coli* and *Klebsiella pneumoniae*. Although *E. coli* is classically recognized as the leading uropathogen, several recent studies have reported a rise in *S. aureus* infections, especially in catheterized and hospitalized patients. A multicenter study by Morales et al. (2023) reported increased isolation rates of *S. aureus* in long-term catheter users and a

growing trend of resistance to first-line antibiotics.²⁰

The antibiotic sensitivity profile in this study showed *S. aureus* resistance to ceftriaxone (32.3%), ampicillin (22%), and cefotaxime (13.5%), with moderate resistance to chloramphenicol, gentamicin, and meropenem (10.1%). The highest sensitivity was observed for oxacillin, linezolid, and cefazolin (59.2%). These findings suggest that β -lactam and oxazolidinone antibiotics remain effective therapeutic options, although emerging resistance should be monitored closely. Uncontrolled or prolonged antibiotic use contributes significantly to resistance development³, while novel agents such as plazomicin show promise against multidrug-resistant pathogens.¹⁵

A significant association was observed between *S. aureus* infection and comorbid conditions ($p=0.000$), with diabetes mellitus being the most frequent underlying disease. Diabetes reduces immune response and impairs bladder emptying due to autonomic neuropathy.¹⁶ Additionally, catheter use was significantly associated with *S. aureus* infection ($p = 0.002$). Catheterization may disrupt the bladder mucosal barrier and facilitate bacterial colonization through biofilm formation.¹⁷

Overall, these findings highlight the shifting epidemiology of UTI in hospitalized patients, emphasizing the clinical relevance of *S. aureus* and the importance of prudent antibiotic use and infection control strategies.

CONCLUSION

This study shows that *Staphylococcus aureus* remains a major and clinically important cause of hospital-acquired urinary tract infections, particularly among patients with comorbidities and catheterization. The organism demonstrated marked resistance to ceftriaxone but maintained good sensitivity to oxacillin, linezolid, and cefazolin. These findings underline the need for continuous local monitoring of antibiotic resistance and the rational use of antibiotics in clinical practice.

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