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Research Article

Prevalence and Antibiotic susceptibility pattern of Pseudomonas in Urinary TractInfections: A Retrospective Observational study:Insights from a tertiary care hospital, North Karnataka

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ABSTRACT

Background: Urinary tract infections (UTI) are the most common infections encountered by clinicians and one of the leading causes of morbidity in human population. Pseudomonas is an important uropathogen, that has shown varied antibiotic susceptibility patterns.

Aims and Objective: This study focuses on reviewing and analysing the prevalence of Pseudomonas spp in Urinary tract infection & to assess the Antibiotic susceptible pattern of the Pseudomonas at Ballari Medical college and research centre BMCRC, Ballari, Karnataka.

Materials and Methods: A Retrospective study was conducted by collecting urinary infection samples from 1/7/2022 to 30/6/2023. Urine samplesunderwent initial procedures like Urine Microscopy analysis i.e Wet Mount and were inoculated on various culture plates. Antimicrobial Susceptibility testing was performed using the Kirby – Bauer disk diffusion methodand results interpreted as per CLSI guidelines.All the culture and sensitivity reports of urine with positive Pseudomonas spp showing $\geq 10^5$CFU /ml were considered as significant bacteriuria

Results: A total of 6,084 urine samples were analyzed during the one-year study period. Among these, 1,903 showed significant bacteriuria, and Pseudomonas spp. were isolated from 354 culture-positive samples. Pseudomonas spp. was the third most common urinary pathogen after Escherichia coli and Klebsiella spp. Multidrug resistance was identified in 122 isolates. Among the antibiotics tested, meropenem, piperacillin-tazobactam, and imipenem showed the highest in vitro susceptibility against the Pseudomonas isolates.Meropenem (93.22%), piperacillin-tazobactam (92.94%), and imipenem (90.40%) showed the highest antimicrobial susceptibility among the Pseudomonas isolates.

Conclusion: The study highlights the increasing occurrence of multidrug-resistant *Pseudomonas* spp. in urinary tract infections and is a major clinical concern. Regular monitoring of antimicrobial susceptibility patterns and the implementation of effective antibiotic stewardship programs are essential to guide appropriate therapy and prevent the further development of antimicrobial resistance. In this study the antimicrobial susceptibility pattern observed suggests effective options for treatment, emphasizing the need for ongoing surveillance to adapt to resistance patterns.

Keywords: Urinary Tract Infection, Pseudomonas, Antimicrobial Susceptibility.

INTRODUCTION

Urinary tract infection (UTI) is the most common of infections in the clinical practice[1]. Epidemiological data indicate that 50% to 60% of women will experience at least one UTI during their lifetime[2].Over the last decade there has been an alarming increase in antimicrobial resistance (AMR) among the common bacterial agents of UTI in developing and developed countries.[1] .Aerobic non-fermenting gram-negative bacilli are now emerging asimportant uropathogens. Among these non-fermenters,P. aeruginosa is the predominant and most well-knownubiquitous, gram-negative bacillusthat can survive in myriads of environments such as aquatic and terrestrial. It is a versatile opportunisticpathogen, associated with nosocomial infections alongwith other serious implications with high rate ofmorbidity and mortality. According to the report ofnosocomial infection surveillance system of centre fordisease control and prevention, P.aeruginosa is thethird most common organism causing nosocomialurinary tract infections[3]

Currently UTI is mostly managed empirically without urine culture or susceptibility testing this may lead to the frequent misuse of antibiotics. In P.aeruginosa, increasingresistance towards the available antimicrobials.MDR mechanism in P. aeruginosa are due to lower outer membrane permeability, acquisition of enzymes like β-lactamases especially extended spectrum enzymes, carbapenemases or aminoglycoside modifying enzymes. Resistance is conferred by the transfer of plasmids which carry genes to produce antimicrobial enzymes[3,5]

The most common pathogensare multidrug-resistant (MDR) bacteria, especially Gram-negative rods[6] . Multiple factors have been associated with decreased survival in patients with bacteremia caused by UTI due to *P. aeruginosa*: age, low functional status, need for mechanical ventilation, central venous catheter, inadequate antibiotic treatment, resistance to carbapenems, respiratory origin bacteremia, severe sepsis, shock, respiratory failure, death[7] .Because of increasing multidrug resistant (MDR) P. aeruginosa isolates in health care settings, infections are difficult to treat, causing life threatening conditions which can lead to fatal sepsis in older patients or immunocompromised individuals with deteriorating general conditions, such as those with diabetes or undergoing steroid or anticancer chemotherapy treatments[6,7].

MATERIALS & METHODS

One year Retrospective, record-based study was conducted on all culture and sensitivity (C/S) reports of urine samples obtained in Central Diagnostic lab, Microbiology atBallari Medical college and research centre BMCRC, Ballari during 1st July 2022 – 30th June 2023.

Clean catch mid-stream urine samples were collected in sterile containers and were processed by standard bacteriological methods. The samples were cultured on medium with a standard loop and were incubated at 37°C overnight. After biochemical tests, antimicrobial susceptibility were performed by Kirby-Bauer disc diffusion method on Muller Hinton agar media and results interpreted as per CLSI guidelines. All the culture and sensitivity reports of urine with positive Pseudomonas spp showing ≥ 105CFU /ml were considered as significant bacteriuria.

Antibiotics against which susceptibility tested were given in table 1. The antibiotics tested were broad-spectrum penicillin, third generation cephalosporin, quinolones, aminoglycosides, carbapenems and nitrofurantoin. An isolate was considered as MDR if found resistant to three or more antimicrobials belonging to different classes/groups of antimicrobials

Inclusion Criteria

All Urine C/S reports with positive Pseudomonas spp showing ≥105 CFU/mlwere included in the study.

Exclusion Criteria

Reports of Isolates from repeat culture of previously recruited patients and isolates identified as commensals or contaminants.Patients with negative urine culture reports and Patients who had missing clinical or microbiological data were excluded from the study.

Upon receipt, samples underwent a series of standardized procedures:

1. Urine Microscopy / wet mount to demonstration of pus cells ,followed by ,
2. Culture Media Inoculation: Following staining, specimens were inoculated onto Blood Agar and MacConkey Agar plates to promote the growth of aerobic bacteria.
3. Identification and Antimicrobial Susceptibility Testing: The colonies that developed on the agar plates were further analyzed through Gram staining and biochemical reactions for organism identification. Antimicrobial susceptibility testing was then performed using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar plates. This test determined the susceptibility patterns of the bacterial isolates to various antimicrobial agents, guiding effective treatment strategies.

Through this comprehensive methodology, the study aimed to accurately identify the Pseudomonas causing UTI and assess their antimicrobial Susceptibility profiles, thereby contributing valuable information for clinical management and treatment protocols.

Antibiotics against which susceptibility tested were given in table 1. The antibiotics tested were broad-spectrum penicillin, third generation cephalosporin, quinolones, aminoglycosides, carbapenems ,fluroquinolones . An isolate was considered as

MDR if found resistant to three or more antimicrobials belonging to different classes/groups of antimicrobials.

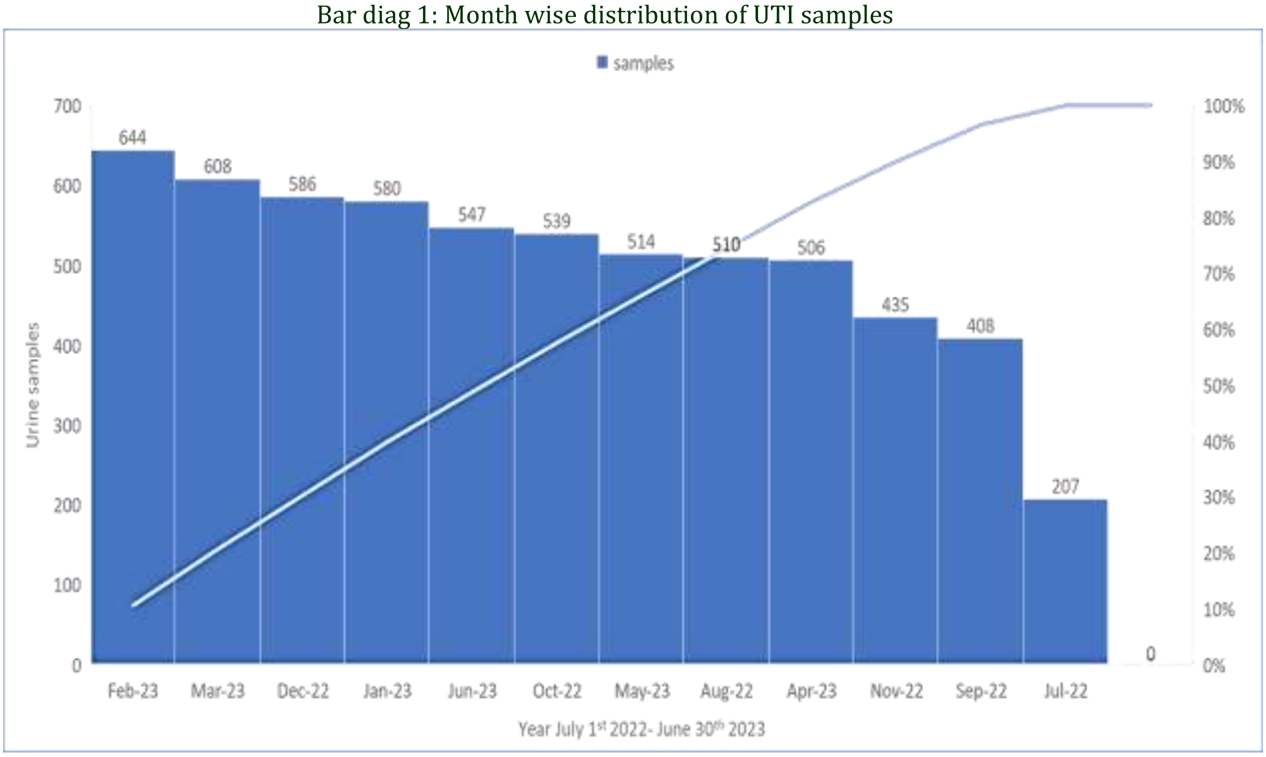
Table 1. List of Antimicrobials used in this study

1st line of drugs	2nd line of drugs
Amikacin AK 10 µg	Imipenem IMP10 µg
Norfloxacin NX 10 µg	Meropenem MRP 10 µg
Gentamycin GEN 10 µg	Piperacillin tazobactam PTZ 200µg
Ciprofloxacin CIP 5µg	Azithromycin AZM 15 µg
Cotrimoxazole COT 25 µg	Tobramycin TOB 10 µg
Ceftriaxone CTR 30 µg	Levofloxacin LE 5 µg
Cefotaxime CTX 30 µg	Linezolid LZ 30 µg
Ceftazidime CAZ 30 µg	
Amoxiclav AMC 10 µg	

RESULTS

During the study period of one year, 6084 urine samples received to our lab. Among these 1903 (31.28%) were culture positive cases with significant bacteriuria and no growths observed in 4181(68.72%) samples. Among the culture positive samples, prevalence of Pseudomonas spp were identified to be 354(18.60%) cases. Of which 232 samples (65.5%) were males and 122(34.46%) were from females. High prevalence was observed in males as compared to females. The highest prevalence was obtained among age groups 60-69yrs (n=93, 26.27%) followed by 40-49yrs(n=87,24.57%). Pseudomonas spp was the third most common urinary isolate after E. coli and Klebsiella spp during the entire study period. Multi drug resistance Pseudomonas spp isolates were 122(34.46%). The most effective antimicrobial agents in our study were, ceftazidime, Cotrimoxazole , Gentamicin , Meropenem

Bar diag 1: Month wise distribution of UTI samples



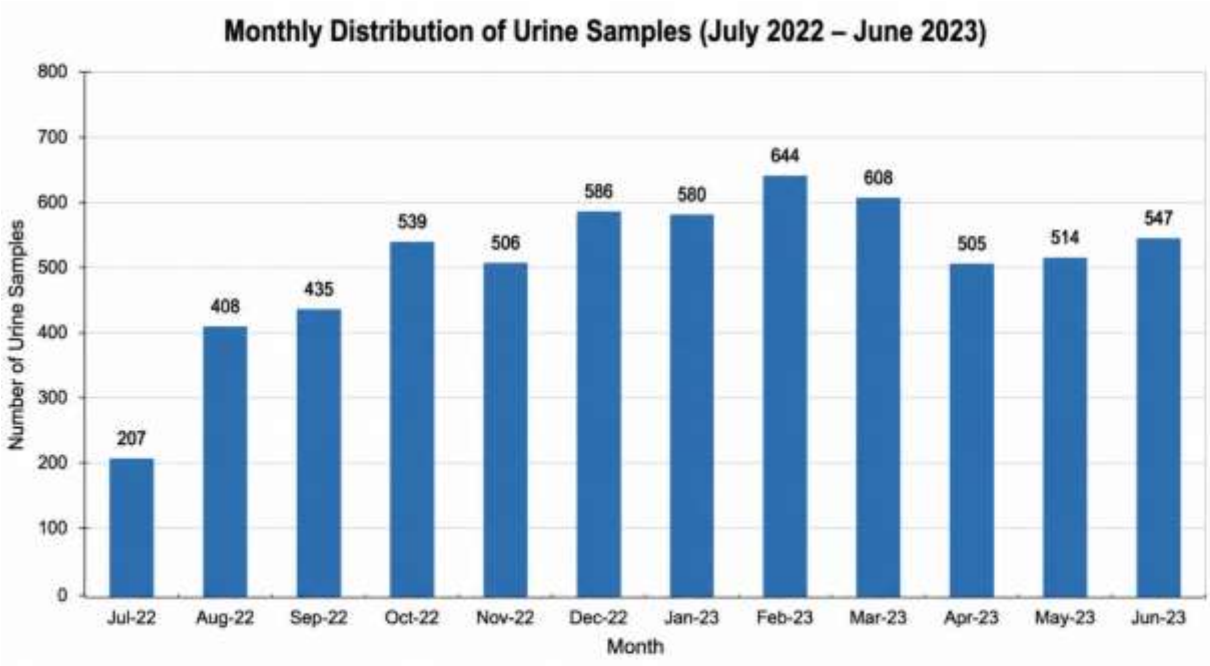
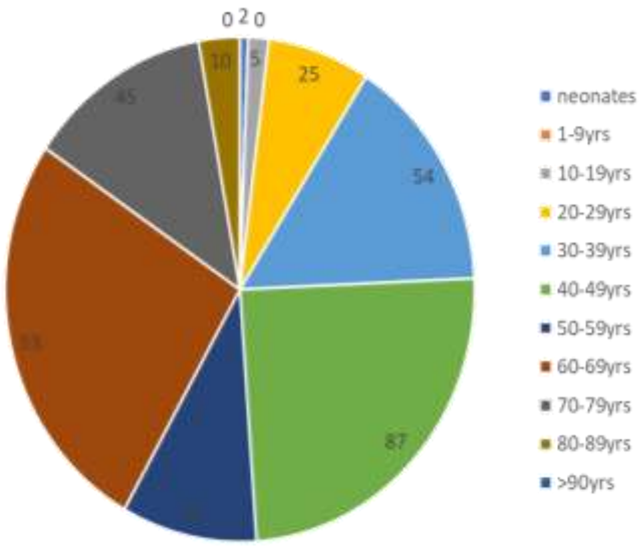
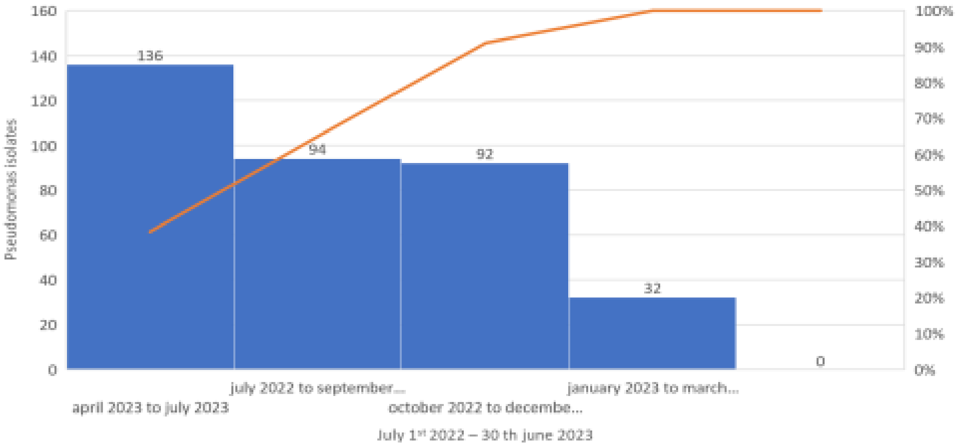


Table 2: Age wise distribution of Pseudomonas isolates

AGE GROUP	Pseudomonas isolate
Neonates	2(0.6%)
1- 9 yrs	nil
10-19 yrs	5(1.41%)
20-29yrs	25(7.06%)
30-39yrs	54(15.3%)
40-49yrs	87(24.57%)
50-59yrs	33(9.32%)
60-69yrs	93(26.27%)
70-79yrs	45(12.71%)
80-89yrs	10 (2.82%)
>90yrs	nil



Bar diag 2: Total .no of Pseudomonas isolates



Bar diag 3 Multi Drug Resistance Pseudomonas isolates

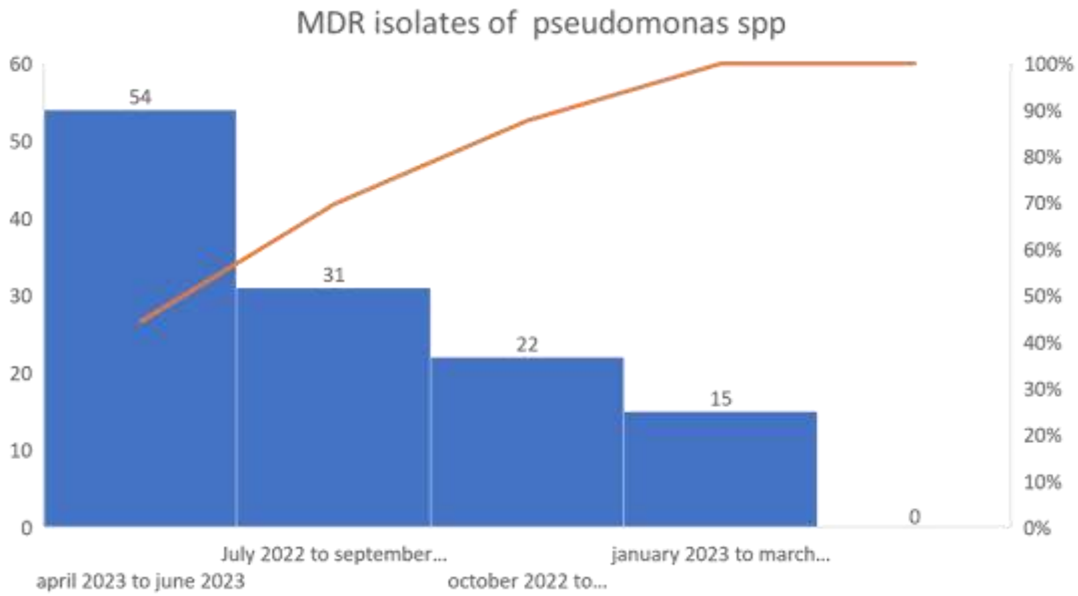


Table 3: Distribution of antibiotic susceptibility pattern among Pseudomonas isolates – First-line drugs

Antibiotics	**First line of drugs**									
		NX	**CIP**	**AK**	**GEN**	**COT**	**CTR**	**CTX**	**CAZ**	**AMC**
Total Pseudomonas isolates susceptible for antibiotics out of n=354		111	119	86	139	145	69	50	174	28
Percentage		31.36	33.61	24.30	39.27	40.96	19.49	14.12	49.15	7.9

Table 4: Distribution of antibiotic susceptibility pattern among Pseudomonas isolates – Second-line drugs

Antibiotics	**Second line of drugs**							
	IMP	**MRP**	**AZM**	**LE**	**LZ**	**TOB**	**PTZ**	
Total Pseudomonas isolates susceptible for antibiotics out of n=354	320	330	312	315	305	305	329	
Percentage	90.40	93.22	88.14	88.98	86.16	86.16	92.94	

AK: Amikacin; CIP: Ciprofloxacin; CTR: Ceftriaxone; CTX: Cefotaxime;GEN: Gentamicin ;TE: Tetracycline; DOX: Doxycycline

DISCUSSION

Review of Prevalence of Pseudomonas from urine samples in various recent studies

In the present study, *Pseudomonas* spp. accounted for 18.6% of all culture-positive urinary isolates, making it the third most common uropathogen after *Escherichia coli* and *Klebsiella* spp. The isolation rate was higher than those reported by Pritam et al. (8.56%), Jain et al. (9%), Sangeetha et al. (9.85%), and Sharma et al. (14%), but was comparable to the findings of Khalil I et al. (20.5%). A much higher isolation rate (73.9%) was reported by Porwal et al., which may be due to differences in study design, patient population, healthcare setting, and regional epidemiology.

A higher prevalence of *Pseudomonas* spp. was observed among male patients, with the greatest number of isolates occurring in the 60–69-year age group. This may be associated with increased hospitalization, catheterization, underlying comorbidities, and recurrent urinary tract infections in elderly patients.

Multidrug resistance was observed in a considerable proportion of *Pseudomonas* isolates, highlighting the growing challenge of antimicrobial resistance. Among the antibiotics tested, meropenem, piperacillin-tazobactam, and imipenem showed the highest in vitro susceptibility against the Pseudomonas isolates. Continuous surveillance of antimicrobial susceptibility patterns and periodic updating of institutional antibiograms are essential to guide empirical therapy. Strengthening antibiotic stewardship practices is necessary to reduce the emergence and spread of multidrug-resistant *Pseudomonas* spp. in urinary tract infections.

Various studies	Isolation rate of pseudomonas (%)
Pritam et al; 2018; Maharashtra	8.56
Jain et al;2014; Patiala	9
Sangeetha et al;2017, Maharashtra	9.85
Sharma et al;2016; Punjab	14
Our study (2022)	**18.6**
Khalil I et al; 2026, southern Bangladesh	20.5
Porwal S et al;2025, Madhya Pradesh	73.9%

World Health Organization has named antimicrobial resistance (AMR) as a serious global threat and an estimated 10 million people die each year due to AMR by 2050 which could rise by 2050[14]. Robust AMS programs should enforce stringent antibiotic regulations, enhance public awareness, and promote evidence-based prescribing. Infection control must prioritize high-risk settings through improved hygiene, disinfection, and reduced invasive procedures. Pathogen-specific treatment protocols tailored to resistance patterns, continuous surveillance using advanced molecular tools, and investments in healthcare infrastructure are imperative. Expanding public education on antibiotic use and fostering interdisciplinary research through a One Health approach will further strengthen efforts to combat MDR-UTIs globally.MDR HAI appears to be strongly associated with increases in direct cost, prolonged length of stay and increased mortality[12].

CONCLUSION

Pseudomonas isolates in urine culture is increasing in hospitalized patients. This organism is becoming resistant to aminoglycoside, Fluoroquinolone, Carbapenem and beta lactam group of antibiotics which is frightening. So, each institution should have an antibiotic policy based on the local antibiogram which is to be renewed regularly. Instead of opting for higher antibiotics each time, strict implementation of restrictive and rotational antibiotic policies and adherence to the concept of 'Reserve drugs" should be followed. This is the only modality to inhibit the emergence of resistance strains of all uropathogens especially opportunistic pathogens like Pseudomonas.A comprehensive approach is essential to mitigate the spread and impact of MDR pathogens. The findings advocate for the necessity of ongoing surveillance, region-specific preventive measures, and empirically guided therapeutic strategies to enhance patient care and quality of life in affected populations.

Ethical Clearance

Clearance was obtained and approved and all studies were carried out by approved guidelines. (ethical approval letter dated 07/01/2023)

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Author's Contribution

Krishna S-Definition of intellectual content, Literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article; **Vishalakshi A**-Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **Agalya A**-Design of study, statistical analysis, Interpretation, Review Manuscript, Literature survey, preparation of tables, Coordination and Manuscript revision

Conflict of Interest: No! Conflict of interest is found elsewhere considering this work.

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