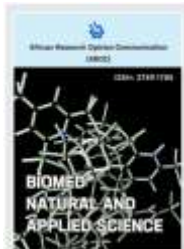




RESEARCH ARTICLE

Prevalence of Urinary Tract Infections Among Students Residence in Nicon Hostel, Federal Polytechnic Bida, Niger State, Nigeria

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<https://doi.org/10.53858/bnas02030109>

ABSTRACT

Background: Urinary tract infections (UTI) are serious health problems affecting millions of people each year. It is caused by both certain fungi, Gram-negative and Gram-positive bacteria and occurs in both acute and chronic forms. The most common causative agent for both uncomplicated and complicated UTIs is uropathogenic *Escherichia coli* (UPEC). The uropathogens include UPEC, *Klebsiella pneumoniae*, *Staphylococcus saprophyticus*, *Enterococcus faecalis*, group B *Streptococcus* (GBS), *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Candida spp.* This study is based on the determining the presence or absence of bacteria in the urine sample, isolation and identification of the most prevalent bacteria associated with UTI and to identify the drug sensitivity patterns of the isolates. **Methods:** This involves determination of sample and sample collection, urinalysis, isolation and identification of uropathogens and antibiotic sensitivity test. One hundred and ninety (190) female students residing in the hostel of the Federal Polytechnic Bida were examined for significant bacterial indicators of urinary tract infections. **Results:** Analysis of their clean voided, midstream urine revealed that 57 (30%) isolates were positive for bacteria while 133 (70%) were negative. The fifty-seven (57) bacterial isolates were tentatively characterized into six genera. The frequencies of occurrence of the bacterial species are in the order: *Escherichia coli* (35.09%), *Proteus sp.* (10.53%), *Klebsiella sp.* (19.29%), *Staphylococcus sp.* (22.81%), *Candida sp.* (21.05%) and *Pseudomonas sp.* (7.02%) whereas mixed culture (15.79%). A total of 57 (100%) were sensitive to ciprofloxacin, 51 (89.47%) to Pefloxacin, 41 (71.93%) to Sparfloxacin. Zinnacef, Gentamycin and streptomycin had a relatively fair activity on the isolates with sensitivities of 37 (64.91%), 30 (52.63%) and 24 (42.1%) respectively. However, bacterial isolates obtained from this survey generally showed a similar pattern of resistance to antibiotics. **Conclusion:** The prevalence of UTI is high among the student resident of Nicon hostel of the Federal Polytechnic Bida.

Keywords: Urinary tract infections (UTIs); Uro-pathogens; Antibiotic sensitivity.

Received: 15 May 2022, Revised: 27 June 2022, Published: 01 July 2022

Citation: Alfa, S., Theresa, A.A., and Umar, Z. (2022). Prevalence of Urinary Tract Infections Among Students Residence in Nicon Hostel, Federal Polytechnic Bida, Niger State, Nigeria. *BIOMED Natural and Applied Science*, 2(3):01-09, <https://doi.org/10.53858/bnas02030109>

1.0 Introduction.

Urinary tract infections (UTI) are serious health problems affecting millions of people each year. They are the second most common type of infection in the body, accounting for about 8.3 million visits to the hospitals each year [1]. UTIs are caused by the presence of bacteria in urine, although fungi and viruses could be involved. The majority of women have recurrent infections within one year [2]. *Escherichia coli* causes 75 – 90% of uncomplicated UTIs [3] whereas *Staphylococcus saprophyticus* causes an estimated 5 – 15% of UTIs frequently in younger women [4].

Enterococcus and other Gram-Negative rods other than *E. coli* have also been implicated in some cases [5]. Significant bacteria can be defined as the isolation of persistent bacteria Colony Forming Units (CFU) per mL of clean voided, mid-stream urine specimens plated within 6 hours of collection. In females, it is possible that slow-growing Microaerophiles such as *Lactobacillus*, *Corynebacterium* and *Streptococcus mileri* may be involved in the pathogenesis of the infections. Symptoms are usually precipitated by sexual intercourse [4]. UTIs occur in

both acute and chronic forms. In the former, patients complain of severe and low back pain that may associate with fever due to the associated bacteraemia, while in the latter, a sensation of perennial fullness is felt [6].

The common causative agent is *E. coli* but micrococcal infections may account for up to 10 – 20% of cases in sexually active women [6]. This infection reaches the bladder by the ascending route, with the main symptoms as urinary frequency and dysuria [3]. Other infections that are due to less common pathogens usually occur in the presence of gross structural abnormality of the urinary tract or neurological effects [1]. The common source of *E. coli* infections in women is the faecal flora. Introital colonization precedes the development of urinary tract infections in women and girls. In males, the organisms frequently originate from the sub-pepucial sac [7].

The higher prevalence in females as compared with males is attributable to the shortness of the female urethra and so is more liable to contamination during sexual intercourse, urethra massage and even urination with chronic flora that resides in the perineal skin. It also includes the effect of turbulence on the urinary Stream [7].

The present study evaluated the presence or absence of bacteria in the urine samples, isolated and identified the most prevalent bacteria associated with UTIs and identified the drug sensitivity patterns of the isolates from student residents of Nicon hostel of the Federal Polytechnic Bida.

2.0 Materials and Methods

2.1 Studied Population

Female students of Nicon Hostel resident of the Federal Polytechnic Bida were recruited for this study. All recruited students gave their consent for participation in the study and Ethical approval was also sought from The Federal Polytechnic Bida Medical Centre.

2.2 Ethics Approval and Consent:

Ethical clearance was obtained from the Research and Ethical Review Committee and was approved by the Department of Biological Sciences, School of Applied and Natural Sciences, Federal Polytechnic Bida. Ethical clearance was also secured from Federal Polytechnic Bida Medical Center. Official permission was also obtained from the HOD of the department and the Director of The FPB Medical centre. In addition, written informed consent was obtained from the study participants before the initiation of data collection and all participants were informed about the purpose of the study. The individual results of the investigations remained confidential. The laboratory findings of the study participants were communicated to the responsible health professional assigned to the laboratory for the purpose of managing the cases accordingly.

2.3 Determination of sample size

The sample size was determined by using the equations below

$$N = \frac{Z^2 \times P \times (1 - P)}{D^2}$$

$$N = \frac{(1.96)^2 \times 0.146 \times (1 - 0.146)}{(0.05)^2}$$

$$N = \frac{3.8 \times 0.146 \times 0.854}{0.0025}$$

$$N = \frac{0.4737992}{0.0025}$$

$$N = 189.51968$$

$$N = 190$$

Where

N = sample size (190)

Z = statistics for a level of confidence 95%

P = prevalence of UTI 14.6% (based on retrospective study results of Jombo *et al.* [8].

D = margin of error (0.05)

2.4 Sample collection

Clean-voided, mid-stream urine (MSU) specimens were collected from the female students residing in Nicon hostel the federal polytechnic Bida. Each of the students was instructed on the mode of collection of the MSU that is, during forceful urination after the first 10 – 20 ml has been voided. The subjects were educated adequately on the precautions to prevent contamination of specimens. The specimens were collected in sterilized, wide-necked, leak-proof, plastic (specimen bottles) [9].

2.5 Dipstick Urinalysis (combo10 stick)

The test strip was dipped approximately 1 second into the fresh urine. The strip was drawn across the rim of the container to remove excess urine. After 30 to 60 seconds (leukocyte test field after 60 – 120 seconds), the test strip was compared with the colour scale. The best time for comparison is after 30 seconds because colour changes that take place after more than 2 minutes are of no significant [10].

2.6 Isolation of Uropathogens

Primary isolation was done on CLED Agar and Nutrient Agar to allow the growth of all bacteria in the urine. Each specimen of urine was shaken properly to ensure homogeneity. Using a sterilised wire loop sterilized at red hot on a Bunsen flame and allowed to cool, a little of the urine sample was picked using the sterile wire loop. This was used as inoculums using the streak plate method [11]. Growth identified on plates is indicated as significant bacteria.

2.7 Identification of Uropathogens

All bacterial isolates were characterized on the basis of colonial morphology, reaction to Gram's stain, motility test, [12] and coagulase tests. The tentative identities of the isolate were obtained from Bergey's Manual of Determinative Bacteriology [13].

2.8 Sensitivity tests

Nutrient Agar was used for the antibiotics sensitivity test. The method described by Singh *et al.* [14] was employed. The bacterial isolates were subjected to in vitro susceptibility tests against some common third-generation antibiotics.

3.0 Results

3.1 Percentage frequency of occurrence of the characterized isolates

A total of one hundred and ninety urine samples were analyzed. Fifty-seven (30%) of the samples were positive for uropathogens while one hundred and thirty-three (70%) samples were negative for uropathogens. The fifty-seven (57) positive samples were either Nitrite (29) or leukocyte (28) positive. The isolates were tentatively identified to belong to six (6) genera

including *Escherichia coli*, *Klebsiella sp.*, *Staphylococcus sp.*, *Proteus sp.*, *Candida sp.* and *Pseudomonas sp.* *E. coli* shows the highest prevalence (24.56%) and *Pseudomonas sp.* (7.02%) has the least prevalence. The Cultural characterization of the isolates is presented in Table 1. Out of the fifty-seven (57) significant bacteria isolate, the frequency of occurrence of the uropathogens includes; 14 *Escherichia coli*, 4 *Pseudomonas aeruginosa*, 8 *staphylococcus aureus*, 6 *Proteus mirabilis*, 11 *Klebsiella pneumoniae*, 5 *Candida albican* with percentage frequency of occurrence as 24.56%, 7.02%, 14.04% 10.53%, 19.29% and 8.77% respectively. Nine (9) isolate of the significant bacteria isolated were mixed growth which include; 3 (5.26%) *Candida albican* and *Staphylococcus aureus*, 4 (7.02%) *Escherichia coli* and *Candida albican* and 2 (3.51%) *Escherichia coli* and *Staphylococcus aureus* (Table 2, Figure 1).

Table 1: Cultural characterization of the isolates

Isolates	CLED Agar	Nutrient Agar	Gram Stain	Motility Test	Coagulase Test	Suspected Organism
A	Opaque yellow colonies with a slightly deeper yellow center	Large, thick, grayish white, moist, smooth, opaque or translucent discs with some mucoid strain	Gram negative bacilli, exist singly or in pairs	Motile	Negative	Escherichia coli
B	Green colonies with typical matte surface and rough periphery	Greenish colouration, large, opaque, flat colonies with irregular margins and distinctively fruity odour colonies	Gram-negative, rod shaped, asporogenous, monoflagellate, has apearlescent appearance	Motile	Negative	Pseudomonas aeruginos
C	Deep yellow colonies about 0.75mm in diameter, uniform in colour on yellow medium	Round, smooth, convex, glistening with entire edge golden yellow coloured colonies	Gram-positive and appear in spherical shape. They are often in clusters resembling bunch of grape	Non-motile	Positive	Staphylococcus aureus
D	No swarming, no visible growth within 24hrs	Smooth, pale or colourless colonies with successive waves that form a thin filmy layer which colonizes the whole plate within 24hr	Gram-negative, non-capsulated, rod-shaped, hyper-flagellated and elongated with swarmer cells	Motile	Negative	Proteus mirabilis
E	Large, mucoid colonies	Dome-shaped, Mucoid, Translucent–Opaque which is Greyish white	Gram-negative encapsulated rod-shaped, appears singly and in pairs or short chain	Non-motile	Negative	Klebsiella pneumonia
F	Tiny to small whitish colonies on a blue medium	Pasty and yellow-white filamentous colonies from which feet extend out from the marging into the surrounding agar	Gram-positive, encapsulated and diploid with filamentous cells which appears singly	Motile	Negative	Candida albican

The tentative identities of the isolates were obtained from Bergey's Manual of Determinative Bacteriology Buchanan and Gibson, [13].

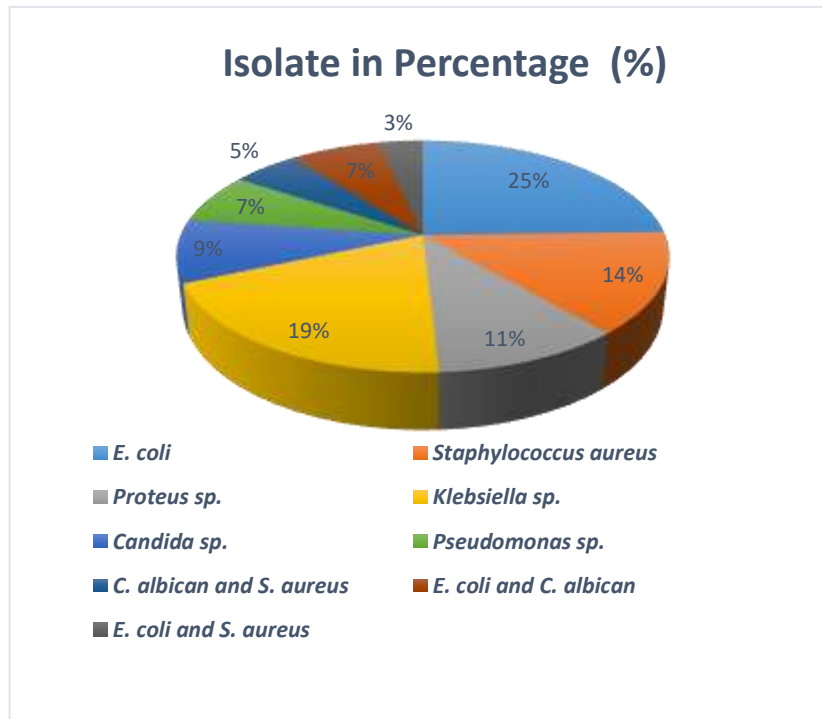


Figure 1: Chart representation on the percentage frequency of occurrence of the characterized isolates

Table 2: Percentage frequency of occurrence of the characterized isolates

Isolates	Occurrences Frequencies	Percentage occurrence (%)
<i>Escherichia coli</i>	14	24.56
<i>Pseudomonas aeruginosa</i>	4	7.02
<i>Staphylococcus aureus</i>	8	14.04
<i>Proteus sp.</i>	6	10.53
<i>Klebsiella pneumoniae</i>	11	19.29
<i>Candida albican</i>	5	8.77
<i>Candida albican and staphylococcus aureus</i> (mixed growth)	3	5.26
<i>Escherichia coli and Candida albican</i> (mixed growth)	4	7.02
<i>Escherichia coli and staphylococcus aureus</i> (mixed growth)	2	3.51

3.2 Antibiotics sensitivity patterns of the isolated pathogens

In Table 3, One hundred and ninety (190) samples were examined for significant bacterial indicators of urinary tract infections. The analysis reveals that 57 (30%) isolates were positive for bacteria while 133 (70%) were negative. The fifty-seven (57) bacterial isolates were tentatively characterized into six genera. The frequencies of occurrence of the bacterial species are in the order: *Escherichia coli* (35.09%), *Proteus sp.* (10.53%), *Klebsiella sp.* (19.29%), *Staphylococcus sp.* (22.81%), *Candida sp.* (21.05%) and *Pseudomonas sp.* (7.02%) whereas mixed culture (15.79%). 57 (100%) were sensitive to ciprofloxacin, 51 (89.47%) to Pefloxacin, 41 (71.93%) to Sparfloxacin. Zinnacef, Gentamycin and streptomycin had a relatively fair activity on the isolates with 37 (64.91%), 30 (52.63%) and 24 (42.1%) respectively. However, bacterial isolates obtained from this survey generally showed a similar pattern of resistance to antibiotics. A particularly remarkable result was obtained with Ciprofloxacin and Pefloxacin.

It was seen that out of the 57 isolates, 100% were sensitive to ciprofloxacin and 89.47% were sensitive to Pefloxacin. Earlier research also revealed that the success of ciprofloxacin could be due to its broad-spectrum activities, its bactericidal activity on organisms both in replicating and resting state and its ability to disrupt DNA functions leading to the death of the bacterium. Sparfloxacin was also similar in action to ciprofloxacin, recording 71.93% of sensitive cases. In that, it is equally highly recommended. Drugs like Zinnacef, Gentamycin and streptomycin have a relatively fair activity on isolates with 64.91%, 52.63% and 42.1% activities respectively. The recorded high level of resistance could be due to the quantity and concentration of some chemicals used in the production of these antibiotics and the fact that these antibiotics are also produced to handle other viral diseases. This may lead to the development of resistance. On the other hand, Ampiclox recorded a very poor performance with 21.05% sensitivity.

In general, antibiotics like ciprofloxacin (CPX) at 10µg and pefloxacin (PEF) at 10µg showed excellent sensitive inhibitory actions while the activity of Ampiclox (APX) at 30µg is not commendable because its inactivity in UTI cases is attributable to the fact that it was manufactured for activity against anaerobic microorganisms and not aerobes as the case is for the isolates.

Table 3: Antibiotics sensitivity test on the isolated pathogens

Antibiotics (µg)	Isolates					
	<i>Klebsiella pneumoniae</i>	<i>Proteus mirabilis</i>	<i>Candida albican</i>	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>	<i>Pseudomonas eruginosa</i>
SXT(30)	S(20)	R(7)	R(9)	R(10)	R(15)	R(10)
CN(10)	S(16)	S(16)	-	R(15)	S(17)	R(15)
E(10)	R(9)	R(10)	S(20)	-	S(20)	-
CPX(10)	S(20)	S(19)	S(20)	S(19)	S(18)	S(19)
APX(30)	R(12)	R(14)	R(13)	-	R(11)	-
AM(30)	R(5)	-	S(18)	R(12)	R(9)	R(12)
Z(10)	S(20)	S(20)	S(19)	-	S(17)	-
PEF(10)	S(17)	R(15)	S(16)	S(16)	S(17)	S(16)
S(30)	S(20)	R(11)	R(15)	R(11)	S(20)	R(11)
SP(10)	S(17)	S(20)	R(10)	S(18)	-	S(18)
R(25)	R(3)	-	S(16)	-	S(19)	-
AU(30)	S(16)	-	-	R(13)	-	R(13)
OXF(10)	R(14)	R(12)	-	S(16)	-	S(16)
CH(30)	S(17)	R(14)	S(18)	R(9)	-	R(9)

Keys: R = Resistance (0-15), S = Sensitivity (16 -20), - = (<0). SXT = Septrin, CN = Gentamycin, E = Erythromycin, CPX = Ciprofloxacin, APX = Ampiclox, AM = Amoxicillin, Z = Zinnacef, PEF = Pefloxacin, S = streptomycin, SP = sparfloxacin, R = Rocephin, AU = Augmentin, OFX = Tarivid, CH = chloramphenicol.

4.0 Discussion

The dipstick urinalysis (combo 10 stick), nitrate reduction test is based on the reduction of nitrate in the urine (from diet) to nitrite by the action of gram-negative bacteria. The test is most accurate on a first-morning urine specimen or on a sample that has been collected 4h or more after the last voiding to allow time for organisms in the bladder to metabolize the nitrate. The test is reasonably effective in identifying infection due to members of the family Enterobacteriaceae but fails to identify infection due to gram-positive organisms, *Pseudomonas spp.*, or yeast [10].

Pyuria is demonstrated in almost all acute bacterial UTI, and its absence should call the diagnosis into question. The leukocyte esterase test for pyuria will detect both lysed and intact leukocytes and is based on the presence of intracellular esterases that catalyze the hydrolysis of esters, releasing components that yield a purple colour. The leukocyte esterase test is less sensitive than microscopy in identifying pyuria but is a useful alternative when microscopy is not feasible [15].

Ascorbic acid concentrations of 25 mg/dl or greater may cause false-negative results in specimens containing only small amounts of nitrite. Other interfering substances include elevated glucose concentrations, high specific gravity, the presence of cephalixin or cephalothin, and high concentrations of oxalic acid or tetracycline [15].

One hundred and ninety (190) urine specimens were examined for presence of bacteria or otherwise. Fifty-seven (30%) were found positive for urinary tract infections. However, 133 (70%) other specimens are found negative. The study implicated six microorganisms as possible Aetiological agents of the UTI cases observed. According to Mars [16], the common causative agents of UTI are *E. coli*, *Proteus sp.*, *Klebsiella sp.*, *Staphylococcus sp.*, *Candida sp.* and *Pseudomonas sp.* which are in agreement with the organisms identified in this study. This higher prevalence of *E. coli* (24.56%) may be due to faecal contamination, the predilection of the organisms from the toilets and the shortness of the female urethra [17].

This prevalence however, is also reported in earlier works by Smith *et al.* [18], where they found out that *E. coli* accounts for 32% of UTI cases, *Proteus sp.* with 17.25% prevalence has a significant association with UTI. Its active motility and swarming ability can in comparison with other organism's transverse easily through the urethra. Other organisms implicated were *Klebsiella sp.* (13.79%), *Staphylococcus sp.* (12.07%), *Streptococcus sp.* (8.63%) and *Pseudomonas sp.* (5.17%).

Six of the positive cases were caused by a mixed culture of these organisms accounting for 10.34%. In this study, *Proteus sp.* with 10.53%, *Klebsiella pneumoniae* (19.29%), *Staphylococcus aureus* (14.04%), *Candida albican* (8.77%), and *Pseudomonas sp.* (7.02%) which are in agreement with the organisms identified with the previous work. Nine of the positive cases were caused by a mixed growth of these organisms accounting for 15.79%, which are; *Candida albican* and *staphylococcus aureus* (5.26%), *Escherichia coli* and *Candida albican* (7.02%) and *Escherichia coli* and *staphylococcus aureus* (3.51%).

There is also a possible link between the prevalence of UTI among students and the level of personal hygiene or the state of toilet facilities in the hostels. From the private oral interview conducted with some of these students, most of the students rated the hostel toilets as bad. Bad, in this context implies that there is no adequate supply of water to clean and flush the toilets regularly when dirty. Therefore, there is an accumulation of urine sediments forming a thick scum. In this case students could become infected during urination. In this study, it was observed that the susceptibility of the isolates to the fourteen antibiotics tested differs with the species due to their genetic makeup and their cellular morphology. A particularly remarkable result was obtained with Ciprofloxacin and Pefloxacin.

It was seen that out of the 57 isolates, 100% were sensitive to ciprofloxacin and 89.47% sensitive to Pefloxacin. Earlier researches also revealed that the success of ciprofloxacin could be due to its broad spectrum activities, its bactericidal activity on organisms both in replicating and resting state and its ability to disrupt DNA functions leading to the death of the bacterium. Sparfloxacin was also similar in action as ciprofloxacin, recording 71.93% sensitive cases. In that, it is equally highly recommended.

Drugs like Zinnacef, Gentamycin and streptomycin have a relatively fair activity on isolates with 64.91%, 52.63% and 42.1% activities respectively. The recorded high level of resistance could be due to the quantity and concentration of some chemicals used in the production of these antibiotics and the fact that these antibiotics are also produced to handle other viral diseases. This may lead to the development of resistance.

On the other hand, Ampiclox recorded a very poor performance with 21.05% sensitivity. In general, antibiotics like ciprofloxacin (CPX) at 10µg and pefloxacin (PEF) at 10µg showed excellent sensitive inhibitory actions while activity of Ampiclox (APX) at 30µg is not commendable because it's inactivity in UTI cases is attributable to the fact that it was

manufactured for activity against anaerobic microorganisms and not aerobes as the case is for the isolates. Those that are negative were only 133 (70%). As earlier reported by several researchers, *E. coli* was also implicated as the most common causative agent of UTI among female students of this study.

5.0 Conclusion

Prevalence of UTI is high among the students of Federal Polytechnic Bida student residing in Nicon hostel when compared to other studies. This is a matter of concern. Lack of awareness regarding these risk factors, lack of time to spend for one's health, busy schedules may be some factors which could play in this aspect.

Author Contributions: Suleiman, A.: Design the research plan, organized the study and contributed to the writing of the manuscript.: Adole, A.T.: Researched, collected the data, conducted the practical, reviewed the table and wrote the manuscript.

Funding: This study was sponsored by the Authors.

Conflict of Interest: The authors declare that they have no conflicts of interest for this work.

Data Availability Statement: Data is available upon request.

Consent for Publication: Not applicable.

Acknowledgments: The authors would like to thank The Federal Polytechnic Bida Medical Center and Department of Biological Sciences for sponsoring the research. Our special thanks and appreciation goes to the medical director and laboratory staff working in the school medical for their support in screening of symptomatic and asymptomatic study participants and organizing the preconditions of sample and data collection. Our deepest thanks also goes to the Federal Polytechnic Bida Directorate for their unreserved material and reagent supply that made this study possible. We also extend our profound gratitude to the study participants for their willingness to engage, without whom this research would not have been possible.

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