

Role of urine dipstick test in diagnosis of UTI in urolithiasis patients attending BPKIHS

Pratima Shah^{*1}, Ratna Baral² and Basudha Khanal³

¹Senior Resident, ²Additional Professor, ³Professor & Head, Microbiology & Infectious Diseases, B. P. Koirala Institute of Health Sciences (BPKIHS), Dharan, Sunsari 56700, Nepal

Abstract

Background: Urolithiasis and its association with urinary tract infection (UTI) is one of the most common diseases scenario encountered in clinical practice and account for significant morbidity and high medical costs. Though urine culture is gold standard, it is expensive and time consuming. Therefore, this study was carried out to compare dipstick urinalysis with urine microscopy and urine culture results and identify the common uropathogens and their antimicrobial susceptibility pattern.

Materials and Methods: This was a hospital based study carried out in Microbiology laboratory, BPKIHS, Dharan, Nepal. Clean catch midstream urine specimen were collected from patients with urolithiasis. Dip stick test (leukocyte esterase and nitrite) and microscopic examination were carried out. The culture isolates were identified and antimicrobial susceptibility test was performed following Clinical and Laboratory Standards Institute (CLSI) guidelines.

Result: Among 88 urine samples recruited, leukocyte esterase (LE) was detected in 35 (39.8%) and nitrite test was positive in 26 (29.5%); pyuria in 56 (63.3%) and 44 (50%) yielded growth in urine. *Escherichia coli* (46.7%) was the most common bacteria isolated from urine culture. Almost all the uropathogens isolated showed susceptibility to commonly used antibiotics. Considering urine culture as gold standard, sensitivity, specificity, PPV and NPV of LE was 86.6%, 91.75%, 70.5% and 90.9% respectively and nitrite test was 56.8% sensitive and 97.7% specific with PPV 96.15% and NPV 69.35% respectively.

Conclusion: The study demonstrates that the urine dipstick test seems to be useful to rule out the infection but positive test results have to be confirmed by culture.

Keywords: UTI; urinalysis; uropathogens.

*Correspondence Info:

Dr. Pratima Shah, MBBS, MD
Senior Resident
Microbiology & Infectious Diseases
B. P. Koirala Institute of Health Sciences
(BPKIHS), Dharan, Sunsari 56700, Nepal

*Article History:

Received: 29/05/2019
Revised: 27/06/2019
Accepted: 01/07/2019
DOI: <https://doi.org/10.7439/ijbr.v10i7.5192>

QR Code



How to cite: Shah P., Baral R. and Khanal B. Role of urine dipstick test in diagnosis of UTI in urolithiasis patients attending BPKIHS. *International Journal of Biomedical Research* 2019; 10(07): e5192. DOI: 10.7439/ijbr.v10i7.5192 Available from: <https://ssjournals.com/index.php/ijbr/article/view/5192>

Copyright (c) 2019 International Journal of Biomedical Research. This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

1. Introduction

Urinary tract infection (UTI) is one of the most common infections in humans and is a frequent cause of hospitalization. [1] UTI is very common in patients with urolithiasis, which makes the treatment of urolithiasis complicated, even dangerous. [2] Calculi may develop secondary to infection more likely by *Proteus* spp. and other urea slitting organisms.[3] Urinary tract infections (UTIs) account for a significant workload in clinical microbiology laboratories. In view of increasing antibiotic resistance in low-income countries efficient, economic and effective diagnostic and treatment strategies are required for UTI. [4]

Clinically the diagnosis of UTI can be difficult as symptoms are non-specific. The only way to reliably exclude a urinary tract infection is by the laboratory examination of a urine specimen. [5] In most instances, growth of $> 10^5$ colony forming unit per milliliter (CFU/mL) from a properly collected midstream “clean-catch” urine sample indicates infection. However, urine culture is gold standard; the analysis takes at least 24-48 hours for the result. Urinalysis is the most frequently used test for the evaluation of potential UTI. [6]

Microscopic examination of urine is the standard method used to detect pyuria. However, the dipstick test is a rapid screening test for detecting pyuria and urinary nitrite

which is formed when bacteria reduce nitrate that is normally present [3]. A dipstick nitrite test is highly sensitive and specific when properly used in first morning urine, because bladder incubation for the organism to convert nitrate to nitrite takes a minimum of four hour.[7- 9]

The combination of a positive and negative test for both nitrite and leukocyte esterase was found to be most accurate for ruling in and ruling out disease. [10] The aim of our study was to focus primarily on the interpretation of urinalysis with a manual dipstick or microscopic and subsequent urine culture in the diagnosis and treatment of UTIs. Therefore, this study was carried out to compare dipstick urinalysis with urine microscopy and urine culture results and identify the common uropathogens and their antimicrobial susceptibility pattern

2. Materials and method

This study was conducted in the department of Microbiology at B.P. Koirala Institute of Health sciences, Dharan Nepal from July 2014 to June 2015. A total of 88 urine samples of patients having urolithiasis that were routinely sent to lab were included. Ethical clearance was obtained from the Institutional Ethical Review Board. The clean caught mid stream urine specimen were collected in a sterile container, before antibiotic treatment which was routinely used for surgical stone removal.

2.1 Processing of specimens

After culturing the urine specimen for quantitative bacterial count, dip stick test (leukocyte esterase and nitrite test) and microscopic examination were carried out.

2.2 Urine dipstick test

Dipstick urinalysis was done using URS – 10T reagent strip to screen for the presence of pyuria and significant bacteriuria in patients. The test was performed according to manufacturer's instructions. The reagent strip contained tests parameters for protein, blood, leukocyte, nitrite, glucose, ketone, pH, specific gravity, bilirubin and urobilinogen. Reading time for nitrite was one minute and two minutes for leukocyte esterase. A cut-off value for a positive result was trace or more of leukocyte esterase and nitrite (+).

2.3 Microscopic examination for pus cells

The wet mount preparation of urine was examined directly under microscope for pus cells. A count more than 5 pus cells per high power field was considered as pyuria. [11]

2.4 Identification of organisms:

2.4.1 Calibrated loop direct streak method

Urine culture was performed by calibrated loop direct streak method on cysteine lactose electrolyte deficient (CLED) media. Using semiquantitative method, 10^5 colony-forming units per milliliter (CFU/ml) of urine, was considered as significant bacteriuria and further processed for identification of organisms. The bacterial pathogens were identified by standard microbiological techniques. The biochemical methods performed for identification of the isolates were as follows, catalase test, coagulase test, oxidase test, citrate utilization test, urease test, sulphide indole motility test, triple sugar iron test, bile esculin, mannitol test. The Mixed growth of three or more organisms was considered as contamination and a request were sent for repeat specimen. In case of absence of growth, specimens were reported as sterile after 24 hours. [12-14]

Antimicrobial susceptibility of the isolates was determined by Kirby Bauer Disc-Diffusion method on Muller Hinton agar (MHA) according to Clinical Laboratory Standards Institute (CLSI) guidelines. [15]

3. Result

3.1 Urine analysis

3.1.1 Urine microscopy

The microscopic examination recorded presence of pyuria in 56 (63.3%) patients.

3.1.2 Urinalysis by dipstick

The leukocyte esterase (LE) was detected in 35 (39.8%) and nitrite test was positive in 26 (29.5%). The Leukocyte esterase (LE) was positive in all the urine samples having significant WBC count i.e. >5 WBC/HPF. In the urine samples showing pyuria, nitrite was also positive indicating bacteriuria which was significant. The findings of the patients are as shown in Table no 1.

Table 1: WBC count with Dipstick test in urine

Characteristics	Categories	WBC (Percentage)			p value*	Remarks
		≤ 5	6 – 10	>10		
Leucocyte esterase	Positive	0	11	24	<0.001	Significant
	Negative	32	20	1		
Nitrate	Positive	1	9	16	<0.001	Significant
	Negative	31	22			

*Chi square test

3.2 Association of WBC count with Leukocyte esterase test in urine

The association of WBC count in urine microscopy with Leukocyte esterase test in urine was significant (p value < 0.001) which showed sensitivity of 62.5% and specificity of 100% with Positive predictive

value (PPV) 100% and Negative predictive value (NPV) 60.38%.

Out of 88 cases, bacterial growth was obtained in urine of 44 (50%) patients. The most common organism isolated was *Escherichia coli* 20 (45.5% of total isolates) as shown in table 2.

Table 2: Pattern of bacteria isolated in Urine

Bacteria	Urine
	Frequency (%)
<i>Escherichia coli</i>	20 (45.5)
<i>Klebsiella pneumoniae</i>	7 (15.9)
<i>Enterococcus faecalis</i>	4 (9.1)
<i>Proteus mirabilis</i>	4 (9.1)
<i>Staphylococcus aureus</i>	3 (6.8)
<i>Klebsiella oxytoca</i>	2 (4.5)
<i>Citrobacter koseri</i>	2 (4.5)
<i>Pseudomonas aeruginosa</i>	1 (2.3)
CONS	1 (2.3)
Total	44 (100)

3.3 Association of Leukocyte esterase test in urine and urine culture

Out of Leukocyte esterase test positive in 35 urine specimen, 31 (88.5%) yielded growth in urine culture also. Considering urine culture as gold standard, LE test in urine sample to detect pyuria was significant. Thus, considering urine culture as gold standard, sensitivity, specificity, PPV and NPV was 86.6%, 91.75%, 70.5% and 90.9% respectively.

3.3 Bacteria with Nitrite test

The nitrite test was positive in the urine which yielded growth of the Enterobacteriaceae in culture. The nitrite test was also positive in 1 case where there was no growth (Table 3.)

Table 3: Bacteria with Nitrite test

Bacteria	Growth in urine culture	Nitrite test positivity (%)
<i>Escherichia coli</i>	22	14 (70)
<i>Enterococcus faecalis</i>	4	0
<i>Klebsiella pneumoniae</i>	7	5 (71.4)
<i>Proteus mirabilis</i>	4	3 (75)
<i>Staphylococcus aureus</i>	3	0
<i>Citrobacter koseri</i>	1	1 (50)
<i>Pseudomonas aeruginosa</i>	1	0
Coagulase Negative Staphylococcus (CONS)	1	0
<i>Klebsiella oxytoca</i>	2	2 (100)
Total	44	25 (56.8)

3.4 Association of urine culture with nitrite test in urine

Association of nitrite test in urine with urine culture which is gold standard was significant (p value <

0.001) which showed sensitivity of 56.8% and specificity of 97.7% with PPV 96.15% and NPV 69.35 (Table 4)

Table 4: Association of urine culture with nitrite test in urine

Test	Test status	Urine culture		P value	Remarks
		Positive	Negative		
Nitrite test	Positive	25	1	<0.001	Significant
	Negative	19	43		
Total		44	44		

3.5 Antimicrobial susceptibility pattern (AST) of urinary pathogen:

3.5.1 Antimicrobial susceptibility pattern of Gram negative bacteria

Among the bacteria isolated all Gram negative bacteria were sensitive to imipenem (100%) followed by amikacin (91%), nitrofurantoin (88%), as shown in figure 1. Out of twenty *E. coli*, seven (35%) were ESBL producers.

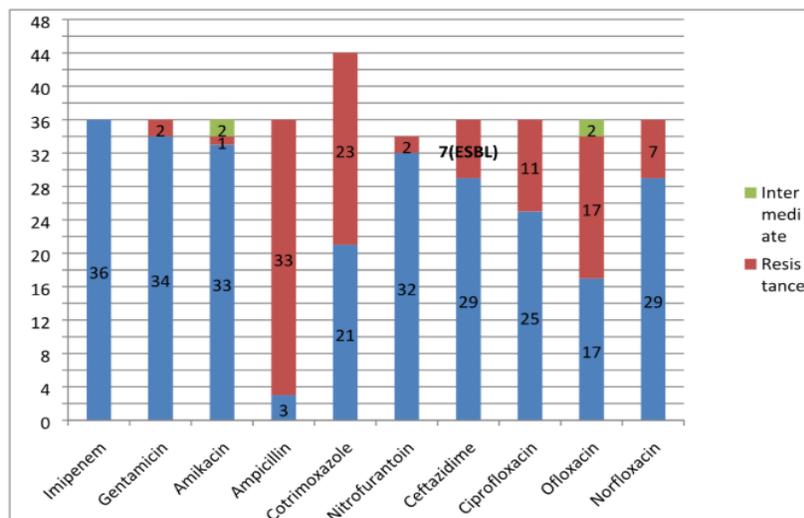


Figure 1: Antimicrobial susceptibility pattern of Gram negative bacteria

3.5.2 Antimicrobial susceptibility pattern of Gram positive bacteria:

Among the *Staphylococcus aureus*, *E. fecalis* and CONS isolated, all Gram positive bacteria were sensitive to vancomycin (100%), linezolid (100%), Gentamicin (100%), nitrofurantoin (100%) followed by amikacin (87.5%), norfloxacin (87.5%) ciprofoxain (75%), cotrimoxazole (62.5%), ampicilin (62.5%), ofloxacin (50%). Out of 3 isolates of *S. aureus*, 2 were MRSA.

4. Discussion

Urinary tract infection (UTI) is a common complaint which is diagnosed through bacterial culture with significant colony count of $> 10^5$ CFU/ml when pathogenic microorganisms are present in urine. However, several rapid screening tests are used commonly to make a presumptive diagnosis of UTI, including dipstick biochemical analysis of urine. Many studies have evaluated the accuracy of dipstick tests as rapid detectors of urinary tract infections (UTI). [3]

In our study, urine microscopy showed pyuria in 56 (63.3%) patients. The Leucocyte esterase (LE) was detected in 35 (39.8%) and nitrite test was positive in 26 (29.5%). Out of microscopic pyuria in 56 (63.3%) patient, LE detected pyuria in 35 urine samples making the association of WBC count in urine microscopy with leucocyte esterase test in urine significant (p value < 0.001). Thus the sensitivity, specificity, PPV and NPV of LE test in urine for pyuria was found to be 62.5%, 100%, 100% and 60.38% respectively.

Considering urine culture as gold standard, LE test in urine sample to detect pyuria was significant. Thus, sensitivity, specificity, PPV and NPV was 86.6%, 91.75%, 70.5% and 90.9% respectively. When leukocytes considered alone as a parameter for diagnosing UTI is not highly sensitive. However, the LE test had the advantage to identify ASB even when the pus cells were disintegrated in the specimen. This finding was different from other studies where the sensitivity of leukocyte esterase varied between 61.7% and 77% [16-18] and similar to study done by Jido *et al.* [19]

Nitrite test was positive in the urine which yielded growth of the *Enterobacteriaceae* in culture. Nitrite test was also positive in one case where there was no growth. There was significant association of nitrite test with urine culture (p value < 0.001) with sensitivity of 56.8%, specificity of 97.7%, PPV of 96.15% and NPV of 69.35% which concordance to the findings reported by Mustafa *et al* who found the sensitivity and specificity for nitrite 61.7% and 96.9% respectively and the positive predictive value was 95.4% [20]. The sensitivity of nitrite was higher in different studies which varied between 66.7% - 81%. [16-18].

The nitrite test gave lesser sensitivity as positive cases were missed as false negative that include infections

caused by Gram-positive cocci and the first voided urine specimen has been proved to be accurate, but collection was not practical in all our patient population

Performance of nitrite test in our study was similar to that of meta analysis done by Walter *et al*, 2004 who stated that overall, the sensitivity of the urine dipstick test for nitrite was low (45 – 60%) with higher levels of specificity (85 – 98%). The sensitivity of the urine dipstick test for leukocyte-esterase was slightly higher than that of the dipstick test for nitrites. [21]

Though urine culture is the gold standard for the diagnosis of UTI, it is expensive and time consuming, requiring at least 48 hours producing results [22]. Substituting a urine dipstick test or urine microscopy for a hospital laboratory urinalysis may be less time consuming and less expensive, but also some doubts are present about that the urinalysis may not be accurate [23]. When only leukocyte esterase is taken into consideration, sensitivity and specificity was 65% and 64%, respectively, whereas sensitivity and specificity in microscopic examination, when only leukocyte esterase taken into consideration, was 87% and 71%, respectively. When leukocyte esterase, or nitrite were considered, sensitivity increased to 80% from 65%, however specificity decreased to 60% from 64% due to increased false positives [23].

Escherichia coli is the most frequent infecting organism, the relative frequency of infection caused by *Proteus*, *Pseudomonas*, *Klebsiella*, and *Enterobacter* spp. and by Enterococci and Staphylococci increases greatly. [3] Microorganisms like *Proteus mirabilis* and *Escherichia coli* are associated with infection-induced stones. [24]. However, our study population had predominantly *Escherichia coli* 20 (45.5%) followed by *Klebsiella pneumoniae* 7 (15.9%), *P. mirabilis* 4 (9.1%), *Enterococcus fecalis* 4 (9.1%) and *Staphylococcus aureus* 3 (6.8%) similar to other studies [25,26].

The use of an antibiotic has been correlated with the subsequent development of resistance to it [27]. The antimicrobial susceptibility patterns showed that imipenam (100%), amikacin (91%) and nitrofurantoin (88%) were found to be the most effective antimicrobial agents among the gram negative bacteria similar to the pattern shown in [28, 29] with seven ESBL producing *Escherichia coli*.

All Gram-positive bacteria were sensitive to vancomycin (100%), linezolid (100%), nitrofurantoin (100%), amikacin (87.5%) followed by commonly used antibiotics with two isolates MRSA. Nitrofurantoin is a urinary antibiotic, hence not used for infections outside the urinary tract. Carbapenem, vancomycin and linezolid are the final therapeutic option for any infection, and hence not given for empirical therapy. This may be the reason that resistance to this agent has not occurred much.

5. Limitation of the Study

This study limits to its sample size as it included urine samples from urothiasis patients only and also the gram stain could be done to aid in the diagnosis.

6. Conclusion

Although LE detected pyuria in all samples having significant WBC count (>5WBC/HPF) but is more sensitive when is >10 WBC/HPF. LE and nitrite test was culture positive in 31(88.5%) and 25 (56.8%) cases. Overall this study reveals that the urine dipstick test seems to be useful for diagnosis of UTI if the combination of both LE and nitrite are taken into consideration. Hence dipstick analysis appears to be rapid and first level screening test in patients with urolithiasis where UTI is very common.

Reference

- [1]. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. *Dis Mon.* 2003; 49:53-70.
- [2]. Bichler KH, Eipper E, Naber K, Braun V, Zimmermann R, Lahme S. Urinary infection stones. *Int J Antimicrob Agents.* 2002;19: 488–98.
- [3]. Jack D. Sobel, Donald Kaye, Urinary tract infections. Gerald. Mandell John E. Bennett Raphael Dolin Mandell, Douglas and Bennett's Principle and Practice of Infectious diseases 7th edition. Churchill livingstone Elsevier; 2010.p.957-980.
- [4]. Chalmers L, Cross J, Chu CS *et al.* The role of point-of-care tests in antibiotic stewardship for urinary tract infections in a resource-limited setting on the Thailand-Myanmar border. *Trop Med Int Health* 2015; 20: 1281–9.
- [5]. Anigilaje EA, Adedoyin OT. Correlation between dipstick urinalysis and urine sediment microscopy in detecting haematuria among children with sickle cell anaemia in steady state in Ilorin, Nigeria. *Pan Afr Med J* 2013; 15:135.
- [6]. Simerville JA, Maxted WC, Pahira JJ. Urinalysis: a comprehensive review. *Am Fam Physician.* 2005; 71: 1153-1162.
- [7]. Subramanian R, Annamalai T, Subramaniam K, kirupanandhan S, Thangakumar V. Comparison of urine culture and urine dipstick nitrite test in diagnosis of Urinary Tract Infection. *Rwanda Medical Journal.* 2015; 72(1): 5-7.
- [8]. Marahatta R, Dhungel BA, Pradhan P, Rai SK and Choudhury DR. Asymptomatic bacteriuria among pregnant women visiting Nepal Medical College Teaching Hospital, Kathmandu, Nepal. *J Nepal Med Coll* 2011; 13(2): 107-110.
- [9]. Carias BMJ, Orillaza AM, and Llanera LF. Utility of Nitrate and Leukocyte Esterase Tests for Laboratory Detection of Urinary Tract Infection in a General Population at the Philippine Heart Center: A Prospective Study Philippine from October 2005 to September 6. *Phil Heart center J* 2008; 14(1): 56-60.
- [10]. Whiting P, Westwood M, Bojke L, Palmer S, Richardson G, Cooper J, Watt I, Glanville J, Sculpher M, Kleijnen J. Clinical effectiveness and cost-effectiveness of tests for the diagnosis and investigation of urinary tract infection in children: a systematic review and economic model. In NIHR Health Technology Assessment programme: Executive Summaries 2006. NIHR Journals Library
- [11]. Ramazan Memişoğulları, Hatice Yüksel, Hayriye Ak Yıldırım, Ozlem Yavuz. Performance Characteristics of Dipstick and Microscopic Urinalysis for Diagnosis of Urinary Tract Infection. *Eur J Gen Med* 2010; 7(2): 174-178.
- [12]. Patricia M Bailey and Scott Diagnostic Microbiology. Infections of the Urinary Tract.13th edition. Mosby, Inc, Elsevier Inc; 2014.p.919-929.
- [13]. Mackie & McCartney. Practical Medical Microbiology, 14th edition, 2011; 84-88.
- [14]. Winn W, Allen S, Janda W, Koneman E *et al.* Koneman's color atlas and textbook of diagnostic microbiology. 6th edition 2006.
- [15]. Clinical and Laboratory Standard Institute. Performance standard for antimicrobial disk susceptibility tests, Document no M100-S23. 23rd ed. Wayne: Clinical and Laboratory Standard Institute; 2013.
- [16]. Jayalakshmi J, Jayaram VS. Evaluation of various screening tests to detect asymptomatic bacteriuria in pregnant women. *Indian J Pathol Microbiol.* 2008; 51: 379–81.
- [17]. Rehmani R. Accuracy of urine dipstick to predict urinary tract infections in an emergency department. *J Ayub Med Coll Abbottabad.* 2004; 16: 4–7.
- [18]. Laosu-angkoon S. The sensitivity and specificity of a urine leukocyte esterase dipstick test for the diagnosis of urinary tract infection in the outpatient clinic of Rajavithi Hospital. *J Med Assoc Thai.* 2013; 96: 849–53.
- [19]. Jido TA. Urinary tract infections in pregnancy: evaluation of diagnostic framework. Saudi journal of kidney diseases and transplantation: an official publication of the Saudi Center for Organ Transplantation. *Saudi Arabia* 2014; 25: 85-90.
- [20]. Mustafa Y, Idris S, Ucukbayrali A, Sukru O, Selda A, Yavuz TM. The Validity of the Rapidly Diagnostic Tests for Early Detection of Urinary Tract Infection. *Duzce Tıp Fakultesi Dergisi* 2008; 3: 39-42.
- [21]. Walter LJM Deville, Joris C Yzermans, Nico P van Duijn, P Dick Bezemer, Danielle AWM van der Windt and Lex M Bouter. The urine dipstick test useful to rule out infections. A meta-analysis of the accuracy. *BMC Urol.* 2004; 4: 4.

- [22]. Mambatta AK, Jayalakshmi Jayarajan VL, Harini S, Menon S, Kuppusamy J. Reliability of dipstick assay in predicting urinary tract infection. *Journal of Family Medicine and Primary Care*. 2015 Apr; 4(2): 265.
- [23]. Ramazan Memisogullar, Hatice Yuksel, Hayriye AK Yildirim, Ozlem Yavuz. Performance Characteristics of Dipstick and Microscopic Urinalysis for Diagnosis of Urinary Tract Infection. *Eur J Gen Med* 2010; 7(2): 174-178.
- [24]. Du Toit PJ, van Aswegen CH, Steyn PL, et al: Effects of bacteria involved with the pathogenesis of infection-induced urolithiasis on the urokinase and sialidase (neuraminidase) activity. *Urol Res* 1992; 20: 393-397.
- [25]. Sharma A, Shrestha S, Upadhyaya and Rijal P. Clinical and Bacteriological profile of urinary tract infection in children at Nepal Medical College Teaching Hospital Department of Pediatrics Nepal Medical College Kathmandu, Nepal. *Nepal Med Coll J* 2011; 13(1): 24-26.
- [26]. Taneja N, Chatterjee SS, Singh M, Sivapriya S, Sharma M, Sharma SK. Validity of quantitative unspun urine microscopy, dipstick test leucocyte esterase and nitrite tests in rapidly diagnosing urinary tract infections. *J Assoc Physicians India*. 2010; 58: 485-7.
- [27]. Kunin CM, Johansen KS, Worning AM, Daschner FD. Report of a symposium on use and abuse of antibiotics worldwide. *Rev Infect Dis* 1990;12:12-9
- [28]. Pai V, Nair B. Etiology and sensitivity of uropathogens in outpatients and inpatients with urinary tract infection: Implications on empiric therapy. *Ann Trop Med Public Health* 2012; 5:1.
- [29]. Mazed MA, Hussain A, Akter N, Sultan T, Dewanje AK, Pattern of Bacteria Causing Urinary Tract Infections and Their Antibiotic Susceptibility Profile at Chittagong Medical College Hospital Bangladesh. *J Med Microbiol* 2008; 02 (02):17-21. 81-184